

# MATARY'S TEXTBOOK OF **SPECIAL SURGERY**

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# CHAPTER 1 P T E R

## Orthopedic surgery

- General traumatology
- Upper limb fractures
- Lower limb fractures
- Bone inflammation
- Bone tumors
- Bone & joint deformities
- Congenital disorders of bones & joints
- Painful conditions

\* Emergency :-



# General Traumatology

## Definitions

- **Fracture:** *discontinuity of bone.*
- **Dislocation:** *disruption of the continuity of a joint. "joint surface are no longer in continuity"*
- **Subluxation:** *partial disruption of the continuity of a joint. "Joint surface are still opposed."*  
*weak Lig. → it make dislocation be chronic*
- **Fracture dislocation:** *dislocation together with a fracture of one or more of the bones forming the joint.*

## Types of Fractures

### According to Etiology

#### 1. Traumatic fracture (major trauma):

##### a) Tubular bone:

- **Direct:** fracture occurs at the point of trauma. e.g. crush fracture.
- **Indirect:**
  - **Avulsion:** Muscular violence due to uncoordinated muscular contraction. e.g. patella (due to separation of long process with its attached muscles as a result of sudden undue movement).
  - **Angulation.**
  - **Rotation.**

##### b) Cancellous bone:

- **Compression** "Burst fracture" e.g. vertebra.
- **Traction:** e.g. medial malleolus & patella (d.t. attachment of tendons)

#### 2. Pathological fracture:

- A minor trauma to already weakened bone by **pre-existing disease**, by a degree of stress or trauma.
- The disease may be local e.g. **metastasis** or generalized e.g. **osteoporosis**.

#### 3. Stress fracture (Fatigue fractures):

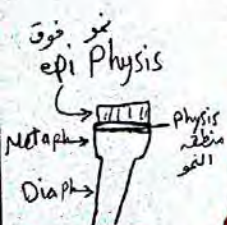
- Fractures that occur 2ry to **repeated loads applied to the skeleton** e.g. march fracture in 2<sup>nd</sup> & 3<sup>rd</sup> metatarsal bones due to **prolonged walking**.

### According to relation to surrounding structures

1. **Closed (simple) fracture:** does not communicate with the exterior environment
2. **Open (compound) fracture:** communicates with the exterior environment or body cavity e.g. skull fracture communicating with air sinus.
3. **Complicated fracture:** there is associated damage to nerve, blood vessels or internal structure.

### According to Shape of Fracture Line

1. **Transverse** (angle  $< 30^\circ$ ).
2. **Oblique** (angle  $> 30^\circ$ ).
3. **Spiral.**
4. **Comminuted** =  $> 2$  fragments.
5. **Double level fracture or segmental fracture.**
6. **Epiphyseal separation:** in children always occurs on the metaphyseal side of the epiphyseal cartilage so that the separated epiphysis always includes the epiphyseal cartilage with a triangular fragment from the metaphysis.



Transverse



Oblique



Greenstick



Fissured



Comminuted

According  
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2. Inco

According  
1. N  
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## According to extent

1. **Complete fracture.**
2. **Incomplete fracture:**
  - **Fissure fracture:** incomplete fracture in **adult** bone.
  - **Greenstick fracture:** incomplete fracture in **child** (soft bones & thick periosteum.).
  - **Compression fracture.**

## According to Impaction

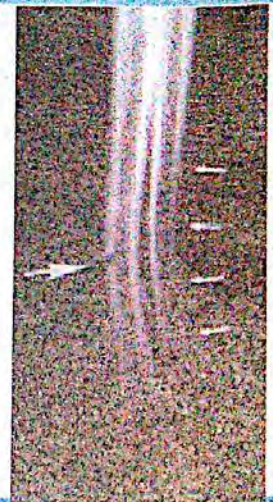
1. **Non-impacted.**
2. **Impacted:** Missed fracture
  - A fragment is driven into the other fragment.
  - Mainly occurs in epiphyseal areas e.g. with Colles' fracture.

## According to stability

1. **Stable fracture:** unlikely to displace **further**.
2. **Unstable fracture:** will continue to displace **further**, if action isn't taken to keep the fracture secure.

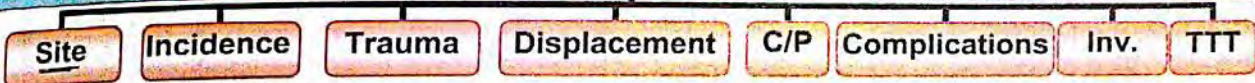
### -Factors controlling stability are:

- Line of the fracture, e.g., oblique, spiral and comminuted fractures are unstable.
- Muscle pull .
- Integrity of the supporting ligaments.



Greenstick fracture of the Tibia

## Scheme for Any Fracture



### Site

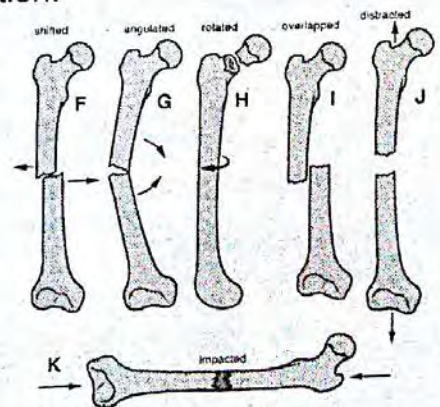
### Incidence

### Trauma

### Displacement

→ الكسور على (Lower Ext.)

- Position of **distal fragment** in relation to **proximal** one.
- **Causes:**
  - the effect of trauma.
  - the force of gravity.
  - the power of the surrounding muscles and
  - the movement of the patient during transport
- **Possible types:**
  - **Lateral displacement:** deviates to one side with loss of opposition.
  - **Angulation:** loss of the normal longitudinal axis of the shaft. It may occur in one of four directions, anterior, posterior, medial and lateral.
  - **Over-riding:** the distal fragment overlaps the proximal fragment with shortening of the limb.
  - **Rotation:** the distal fragment is rotated along its long axis.
  - **Distraction:** the fragments are separated either by over traction during treatment (more common) or by excessive muscle pull at the time of injury (rare).
  - **Depression:** e.g. a skull fracture.
  - **Impaction:** the distal fragment is forcibly driven into the proximal fragment.





## Clinical Picture

### Symptoms

- History of trauma (+ type & onset of trauma +/- history of loss of consciousness)
- Pain.
- Swelling.
- Inability to use the affected limb (disturbance of function).

### Signs

#### ⇒ General:

- Hemorrhage.
- Shock.
- Associated injury (brain, spinal cord, viscera).

#### ⇒ Local:

##### ▪ Exposure:

- At least one joint above & one below.
- Exposure of the other side for comparison.

##### ▪ Inspection:

- Skin → ecchymosis, bruises.
- Soft tissue → swelling
- Bone → deformity (due to displacement of the fragments).  
± length discrepancy.

##### ▪ Palpation:

- Tenderness.
- Crepitus & abnormal movement (better to be avoided to avoid neurogenic shock & neurovascular injury)
- Temperature (compare with the other side)
  - Warm ≠ inflammation
  - Cold = vascular or nerve injury.

- **Movements:** both active & passive movements are lost or limited by pain  
+/- limping in L.L. fractures.

للألم لازم لازم **Neurovascular evaluation** → the check for neurovascular damage in a traumatized limb is more important than diagnosis of the fracture or the dislocation. *Nerve, art, vein*

➤ **Absent pulses:** 1. Shock. 2. Vascular injury.

## Complications

- General.
- Local.

## Investigations

### ➤ X-ray:

- 2 views (A-P view, Lateral view) → for displacement
- 2 occasions → before & after reduction
- 2 joints → proximal & distal

### ▪ Points to be assessed:

1. Site of the fracture: intra-articular, epiphyseal, metaphyseal or diaphyseal.
2. Extent of the fracture: • Complete fractures. • Incomplete fractures.
3. Fracture line.
4. Displacement.

## Treatment

1. First Aid: A B C D
2. Resuscitation, monitoring & neurovascular evaluation.
3. Definitive treatment:
  - Reduction (if displaced)
  - Fixation
  - Rehabilitation (passive & active)
  - Treatment of complications.



# Fracture healing

## Phases

### 1- Repair by granulation tissue. " few weeks "

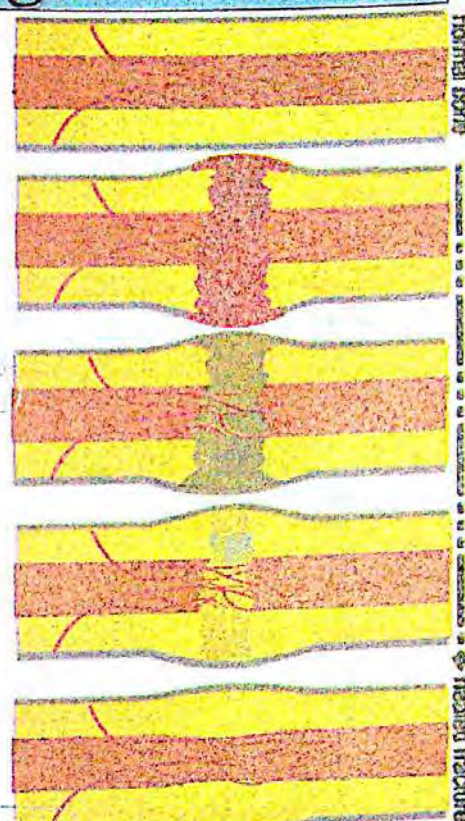
- A hematoma forms between the bone ends under the raised periosteum.
- Vascular granulation tissue invades the haematoma and bridges the fracture gap.

### 2- Union of primary callus. " 2-3 months "

- Trabeculae of cartilage invade and replace the granulation tissue.
- Bone cells and matrix gradually appear leading to the formation of primary callus ( an irregular mass of vascular bone and calcified cartilage at the site of the fracture).
- This callus first appears on the outer aspect of the fragments (external callus), then along the medullary canal (internal callus) and finally between the cortex of the bone ends (intermediate).

### 3- Formation of mature bone. " 4-6 months "

- The intermediate callus is gradually replaced by lamellar trabeculae laid down along the lines of stress and strain.
- The external and internal calluses are absorbed with restoration of the medullary cavity.



## Factors affecting healing process

1. **Age:** - Fractures of children heal in a much shorter time than adults.  
- Elderly people have senile osteoporosis which retards the union of fractures.
2. **Type of fracture:** Long oblique and spiral fractures heal more rapidly than transverse fractures.
3. **Position of segments:** If the fragments are impacted, union occurs rapidly. Distraction of the segments markedly delays healing.
4. **Vascularity of the fragments:** Impaired blood supply can lead to delayed healing. Fractures of the lower thirds of the tibia and ulna are also liable to delayed healing.
- ✓ 5. **Immobilization of the fragments.** This is vital for proper healing
6. **Infection:** disastrous to the healing process, as the granulation tissue is destroyed by infection and the bone ends are decalcified leading to non union.
- ✓ 7- improper reduction



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## Complications of Fractures

### العمامة A- General:

- 1- Shock.
- 2- Fat embolism.
- 3- Infections.
- 4- Crush \$.
- 5- Complications of prolonged recumbency.

### اليد B- Local:

#### 1- Skin:

- a. Injury.
- b. Infection.
- c. Sores.

#### 2- Muscles & tendons:

- a. Injury.
- b. Myositis ossificans.

#### 3- Blood vessels:

- a. Acute ischemia.
- b. Compartmental \$.
- c. Volkmann's Ischemic contracture.

#### 4- Visceral injury.

#### 5- Nerve injury

#### 6- Bones:

- a. Non-union.
- b. Delayed union.
- c. Malunion.
- d. Ischemic necrosis.
- e. Growth arrest & stimulation.
- f. Shortening in LL fractures.
- g. Epiphyseal Injuries.

#### 7- Joints:

- a. Sudeck's atrophy.
- b. Traumatic Ossification.
- c. Ligamentous injuries & sprain.
- d. Hemarthrosis.
- e. Intra-articular fracture.
- f. Osteoarthrosis.
- g. Dislocation & subluxation.
- h. Septic arthritis.
- i. Effusion.
- j. Post traumatic joint stiffness.

### Causes of gangrene after fracture in a limb:

- Direct crushing of tissues.
- Injury to the main vessels.
- Tight plasters.
- Clostridial infection.



# Details of Complications of Fractures

## A- General

### Shock

- A- **Hypovolemic** → fluid replacement + blood transfusion.
- B- **Neurogenic** → analgesic up to morphine.
- C- **Septic** → antibiotics + debridement.
- D- **Cardiogenic** (associated chest trauma) → +ve inotropics + careful pericardiocentesis & surgery.

### Fat Embolism

#### Clinical Picture:

- **Type of patient:** young patient
- **Trauma:** fracture long bone especially femur when immobilization & reduction are delayed
- **Time:** 2nd day.
- **Two forms exist:**
  - a. **Cerebral:** the patient is drowsy, restless and subsequently may be Comatosed.
  - b. **Pulmonary:** there is cyanosis, frothy sputum or heart failure.

#### Investigations:

1. ABG → ↓ PO<sub>2</sub>.
2. CXR.
3. Examination of the sputum and urine for fat droplets.

#### Treatment:

- **Prophylaxis:**
  - High dose of O<sub>2</sub>.
  - Stabilization of fracture.
- **Curative:**
  - O<sub>2</sub>.
  - Corticosteroids.
  - Treatment of pulmonary embolism (heparin).
  - Low molecular weight dextrans.

### Infections

- Tetanus, gas gangrene, acute & chronic osteomyelitis especially with open fractures.

### Crush Syndrome

#### Diagnostic criteria:

1. **Crushing (injury)** to a large mass of skeletal muscle (damaged limb → Mus + bone, flesh inj)
2. Sensory and motor disturbances in the compressed limbs, which subsequently become tense and swollen (**compartment syndrome**) → Necrosis
3. Peak creatine kinase (CK) > 1000 U/L.
4. Myoglobinuria and/or hematuria. } **Rhabdomyolysis**

#### Pathogenesis:

Continuous pressure or stretch on muscles → sarcolemma becomes leaky:

- ① To inside the muscle → accumulation of the ECF inside the muscle → compartment syndrome & hypovolemic shock.
- ② To outside → release of toxic substances into the circulation
  - K<sup>+</sup> → hyperkalemia → H.F.
  - Myoglobin → myoglobinuria & ARF.
  - Urates, phosphates ...etc

50% of patients develop acute RF due to hypo-volemic shock metabolic acidosis, nephrotoxic substances as myoglobin, urate, phosphate ...etc.



## SPECIAL SURGERY

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### Treatment:

- **Emergency Treatment:**  
o At site of accident or 1ry care room: ABCD.

### - At Hospital:

- o For crush injury → R&M + 1ry survey.
- o For Rhabdomyolysis →  $\rightarrow$  fluid + mannitol +  $\text{NaHCO}_3$ 
  - > Forced mannitol-alkaline diuresis up to 8 L/d.
  - > Alkalinization increases the urine solubility of acid hematin and aids in its excretion. This may protect against renal failure and should be continued until myoglobin is no longer detectable in the urine.
- o For compartment syndrome →
  - > fasciotomy & Immobilization of the limb,
  - > Amputation if gangrene develops. to prevent crush.

## 5- Complications of Prolonged Recumbency in lower limb fracture or pelvic

1. DVT & pulmonary embolism. pneumonia
2. Bed sores.
3. Osteoporosis.
4. Renal stones.
5. Constipation.

### NB:

1. In elderly patients respiratory complications includes aspiration pneumonitis.
2. Renal stones are calcium phosphate, avoided by High fluid intake and early mobilization.

## B- Early Local

### Skin

#### A-Injury:

- Direct violence to skin → crushing of skin blood vessels → appear after 2-3 wks (it may be unnoticed if the fracture is enclosed in plaster of Paris)

**B- Infection:** it leads to delayed healing, non-union and osteomyelitis.

#### C-Sores:

1. Pressure → mobilization – cleanness – air mattress.
2. Cast → avoid tight cast.

## Muscles & Tendons

### ➡ Injury.

### Blood Vessels

#### A. Hemorrhage

#### B. Acute Ischemia (Arterial Injury):

##### ▪ Pathological Types:

##### a- without tear

1. Spasm.
2. Contusion.
3. Compression from outside by cast or hematoma

##### b- with tear

1. Partial tear.

↑ Pressure  
swelling →

Ava



## 2. Complete tear.

- It is essential to check the circulation in the distal part of the limb and if there is suspicion of vascular injury, an angiography can be performed.
- If an arterial injury is diagnosed, ORIF are performed prior to the vascular repair. Venous injuries are also repaired.

■ **Fracture fixation should be done before arterial repair.**

## C. Compartment Syndrome:

■ **Definition:** Impairment of the circulation to a space due to ↑ pressure within it.

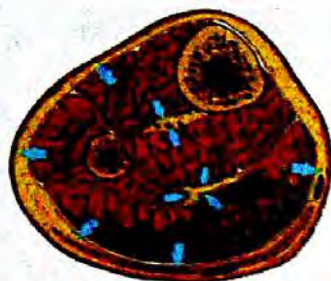
■ **Pathophysiology:**

1. **Causes of ↑ pressure within a space (>30 mmHg):**

- ↓ **Size of the compartment: tight cast.**
- ↑ **contents of the compartment which is bound by an inelastic fascia:**
  - Bleeding within the space
  - Traumatic muscle swelling.

2. **Sequelae**

↑ Pressure within the space → impaired venous drainage → ↑ capillary permeability → more swelling → vicious circle → ↓ perfusion → ischemia

**General**

- Crush syndrome

**Local**

- Gangrene
- Volkmann's ischemic contracture

3. **Common sites:** (compartments bound by an inelastic fascia)

- The 4 compartments of the leg: (anterior, lateral, superficial & deep posterior).
- The volar and dorsal compartments of the forearm.
- The intrinsic compartment of the hand.

The most common site is the leg or forearm (anterior Compartment)

■ **Clinical Picture:**

- Severe pain on passive extension of digits. (finger or toes)
- Paralysis and absent pulse (late).

■ **Complications:**

- Volkmann's ischemic contracture (see below).

■ **Treatment:**

- Prevention → avoid tight casts or even delay cast if marked edema is suspected to occur.
- Curative → decompression
  - Fasciotomy & debridement of necrotic tissues.

**Avascular necrosis of bone**■ **Vulnerable sites:**

1. **Femoral head:** after hip dislocation or fracture neck femur.
2. **Carpal scaphoid** (its proximal segment).
3. **Carpal lunate.**
4. **Talus:** after dislocation or fracture dislocation.



- On X-ray:
  - Early cases → appear normal.
  - After 3 months → the avascular fragment becomes denser.
- Treatment
  - In avascular necrosis of the head of femur → Austin-moore head (hemiarthroplasty).
  - scaphoid ischemic necrosis → vascularized bone graft from the fibula.

### Visceral injury

- A fracture of the Pelvis may be complicated by injury to the bladder or urethra

### Nerve Injury

- Pathological Types:
  - Neuropraxia, axonotmesis or neurotmesis.
- Etiology:
  1. Trauma by the fracture.
  2. Nerve compression e.g. compression of lateral popliteal n. against the outer bar of Thomas splint.
  3. Stretch of the nerve e.g.: delayed ulnar neuritis in cubitus valgus.
  4. Entrapment of the nerve: as in carpal tunnel syndrome due to entrapment of the median nerve.
- Treatment:
  - a- Closed → expectant treatment for 6 weeks + massage + electric stimulation (neuropraxia or axonotmesis)
    - If failed → explore & repair the nerve.
  - b- Open → mark the nerve at 1<sup>st</sup> by black silk then delayed suturing (no 1<sup>ry</sup> repair).

### Joints

#### a) Ligament injuries: (sprain → complete tear)

- Examination under anaesthesia may be needed to assess the stability of the joint.

- Treatment:
  - Sprain → joint is firmly strapped until pain subsides.
  - Complete tear → • Plaster of Paris 6-8 weeks
    - Young individuals: surgical repair

#### b) Traumatic effusion:

- Treatment: bandage, if tense → aspiration

#### c) Hemoarthrosis:

- Treatment: aspiration & bandage of joint.

#### d) Internal derangement of a joint:

- Refers to injuries which impair movements and stability of the joint.
- It particularly affects the knee joint where it is secondary to:
  1. Injury of the medial, lateral or cruciate ligaments.
  2. Injury of the menisci.
  3. Loose bodies.
  4. Recurrent dislocation of the patella.

### C- Delayed

#### 1- Non-un

#### Definit

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#### Types

##### A) HYP

##### B) AT

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## C- Delayed Local

### 1- Non-union:

#### Definition:

- Complete failure of fracture to unite.

#### Types:

##### A) HYPERTROPHIC:

- Excessive callus formation which become calcified.
- Causes:** presence of a gap (2 inches or more) due to:
  - Distraction by traction.
  - Soft tissue inter-position.
  - Bone loss.

##### B) ATROPHIC:

- Failure of union due to loss of blood supply.

#### Clinical picture:

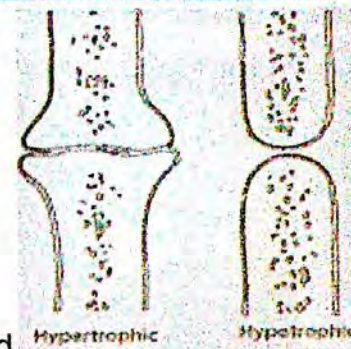
- Persistent tenderness & abnormal range of mobility.

#### X-ray:

- Sclerosed ends.
- Medullary canal is closed by a dense bone.

#### Treatment:

- Hypertrophic:** right fixation
- Atrophic:** autogenous bone graft from iliac crest + rigid fixation.



### 2- Delayed union:

#### Definition:

- Fracture healing which takes longer than normal time.

#### Causes:

##### a) Local:

- Infection.
- Inadequate blood supply.
- Soft tissue interposition.
- Foreign body.
- Intra-articular fracture.
- Type of bone.

##### b) General:

- Age
- Nutrition.
- Systemic illness e.g. D.M.
- Drugs e.g. corticosteroids.

##### c) Orthopedic intervention factors:

- Improper reduction.
- Imperfect immobilization.
- Improper traction.
- Early mobilization.

#### Clinical picture:

- Persistent tenderness & abnormal range of mobility.

#### X-ray:

- Decalcified bone ends.
- Widened gap.

#### Treatment:

- Possible with proper prolonged uninterrupted immobilization.



	DELAYED UNION	NON-UNION
<b>Pathology</b>	■ Bone ends are <b>decalcified</b> and the fracture line is widened into a gap full of fibrous tissue	■ The bone ends are <b>sclerosed</b> and the medullary canal is closed by dense bone
<b>Clinically</b>	■ Abnormal movement and tenderness at the site of fracture.	
<b>Spontaneous healing</b>	■ Possible with prolonged uninterrupted immobilization.	■ Impossible

### 3- Mal-union:

#### **Definition:**

- Fracture which unites, but in a non-anatomical position.

#### **Types:**

1. Angular.
2. Rotational.
3. With shortening.

#### **Causes:**

1. Improper fixation.
2. Premature removal of the cast.

#### **Clinical picture:**

1. Deformity: cosmetic disfigurement.
2. Affection of limb function: limping.

#### **Complications:**

- Osteoarthritis of nearby joint.

#### **Treatment:**

- Prophylaxis: ORIF avoid this complication.
- Curative: corrective osteotomy.

### 4- Sudeck's atrophy:

#### **- Definition:**

- It is a syndrome of marked osteoporosis, associated with swelling of soft tissues, vascular stasis, pain & joint stiffness which may complicate

#### **- Etiology:**

- Unknown But may be due to:

- Disuse atrophy.
- Sympathetic overactivity → vasomotor imbalance in the form of arteriolar spasm.

#### **- Incidence:**

- Colle's, Pott's fracture or scaphoid bone fracture (wrist or ankle injuries).

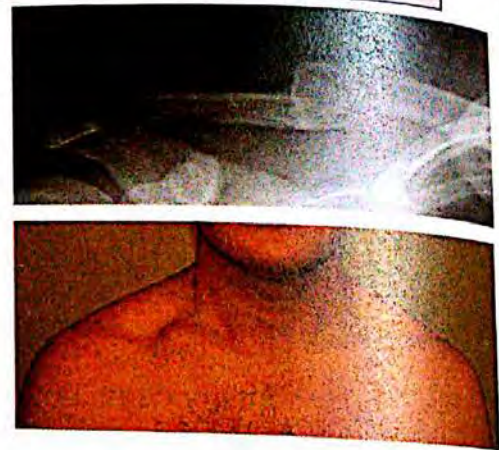
#### **- Prevention**

- The joints which are not immobilized are exercised from the 1<sup>st</sup> day.

#### **- Treatment:**

1. Physiotherapy, hot wax.
2. Sympathetic block.

3. Sympathectomy.
4. Analgesics.





**5- Myositis ossificans:****- Definition:**

- ▣ Deposition of Ca in soft tissues. i.e. heterotopic bone formation.
- ▣ It is frequent after injuries of elbow or hip causing restriction of joint movement.

**- Mechanism:**

- ▣ Muscle laceration → hematoma → becomes organized & calcified and may become transformed into bone when the osteoblast invade the hematoma
- ▣ Massage & passive stretching of joints ↑ the tendency for traumatic ossification.

**- Prevention:**

- ▣ Early reduction of fractures.
- ▣ Avoid massage & passive exercise.

**- Treatment:**

- ▣ During active stage → immobilization of this joint.
- ▣ After (6-9) months → if still restrict the movement → resection (with tendency to recurrence especially if resected before 6 months).

**6- Volkmann's Ischemic Contracture:****- Definition:**

- Flexion contractures caused by fibrosis of muscles of flexor compartment due to missed partial acute ischemia e.g. compartment syndrome.

**- Pathology**

- 1- Cause → acute ischemia of forearm muscles → infarction after 6-12 hours → muscle fibrosis → shortening within few months
- 2- Flexors of the forearm are affected more than extensors and deep flexors are affected more the superficial flexors.
- 3- Flexor digitorum profundus is the most common muscle to be involved.

**- Clinical Picture:**

- **Early** → Inability to fully extend the fingers
- **Late** → Extension of the fingers is limited but improves as the wrist is flexed (fixed length phenomenon).
  - extension of metacarpophalangeal joints
  - fibrosis of flexors → complete claw hand
  - Hand grip is weak as the muscles still have some function (important diagnostic feature)

- ▣ **D.D of complete claw hand** (some of the muscles will be completely paralyzed)

**- Treatment:****- Prophylactic:**

- Rapid reduction of the fracture.
- Assessment of vascular condition of limb.
- Avoid tight cast.



- **Curative:**

Freely you have received; freely give.

- **Early cases (within 8 hrs):**
  - Reduce the fracture if it is the cause.
  - Vasodilators.
  - If failed explore the artery & repair.
  - Fasciotomy if compartment syndrome.
  - Remove the cast if it is the cause.
- **Late cases (fibrosis):**
  - Mild → physiotherapy.
  - Severe → excision of dead ms & tendon transfer.

**7- Joint stiffness and osteoarthritis:**

- May occur after prolonged immobilization and after intra-articular fractures, certain joints as the elbow, shoulder and hip are prone to this problem.

**8- Growth disturbance:**

- May occur if the fracture affects the epiphyseal growth plate in children.

**9- Osteoporosis:**

- Due to prolonged immobilization.



Slipped Lt. femoral epiphys

## Treatment of Fractures

### First Aid

#### I- General → If poly-traumatized patient

##### A. Primary Survey

This includes a pre-hospital phase and a hospital phase

### ABCDE

#### A- Airway

- **Assessment:** if the patient is able to speak freely, his airway is patent.
- **Action:**
  1. Clear airway.
  2. Protect airway: oropharyngeal airway, tracheal intubation or cricothyroidotomy.
  3. Cervical spine control.

#### B- Breathing

- **Assessment:** inspection, palpation, percussion and auscultation (look - feel - listen).
- **Action:** e.g. Needle decompression for tension pneumothorax.

#### C- Circulation

- **Assessment:** general examination for hemorrhagic, cardiogenic or neurogenic shock.
- **Action:**
  1. Control bleeding.
  2. Restore the lost blood.

#### Blood loss from specific fracture areas (1 unit = 500 ml)

- Hip: 2-6 units.
- Rib: 2-4 units.
- Femur: 2-4 units.
- Knees & legs: 2-4 units.
- Upper limb: 1-4 units.



### D- Disability

- **Assessment:** AVPU evaluation (alert, vocal, painful stimulation, unresponsive), followed by Glasgow coma scale in the secondary survey.
- **Pain:** should be immediately relieved by:
  - a. Local splitting (at accident site).
  - b. Analgesics

### E- Exposure

- Insert Foley's catheter and nasogastric tube
- Radiological assessment
- AMPLE history (may be done in the secondary survey).

### B. Secondary Survey

- After establishment of the general condition of patient, 2<sup>nd</sup> survey has to be done.

## II- Definitive Treatment at Hospital (local treatment)

### 1. Reduction

#### A. Aims:

- Allows end to end alignments.
- Allows shortest time for union.
- Allows full function of limb.

#### B. Types:

- **Closed:** (checked by x-ray)
  - Done under sedation/anesthesia (procedure becomes painless, adequate muscular relaxation for perfect reduction).
  - **Methods:**
    - Gravity.
    - Closed manipulation.
    - Traction. This is particularly for fractures of long bones of the L.L. skin or skeletal traction is used to keep reduction of the fracture.
- **Open:**
  - **Indications:**
    - Failed closed reduction (unstable).
    - Open fractures.
    - Other indications for internal fixation (injury of vessels, nerves & viscera).
    - Intra-articular fracture: for a

**N.B:**

### 2. Fixation

“Should include proximal and distal joints”

#### A. External fixation:

##### i. Plaster of Paris



## Disadvantages:

1. Joint stiffness.
2. Muscle atrophy.
3. Inability to maintain perfect reduction during the period of immobilization.
4. Liability to cause compartment syndrome or Volkmann's ischemic contracture.

ii. **Traction:** skin or skeletal (suitable only for children).

iii. **External skeletal fixators (e.g. Taylor Spatial Frame Fixator & Ilizarov Fixator)**

### Indications:

- Compound fracture
- Fractures associated with severe soft tissue damage.
- Nerve or vessel damage.
- Severe comminuted & unstable fractures.
- Fractures of pelvis.
- Infected fractures (internal fixation is contraindicated).

### Complications:

- Pin-tract infection.
- Delayed union.

## B. Internal fixation:

- Allows immediate loading but doesn't stimulate callus formation.

### Indications:

- Difficult fractures:
  - Those prone to non-union as femoral neck.
  - Those prone to mal-union as ankle fractures.
  - Those prone to be pulled apart by muscle action as transverse fractures of patella and olecranon.
- Unstable fractures.
- Poor union
- Pathological fractures.
- Multiple fracture (With two major fractures in one limb).
- Associated vascular injuries.
- Nursing difficulties:
  - Elderly patients.
  - Patients with traumatic paraplegia.

### Types:

- Screws.
- Wires.
- Plates & screws.
- Intramedullary nail (especially for comminuted fractures)
- Interlocking nails & screws.
- Dynamic compression screw & plate.

### Advantages:

- i. Accurate reduction.
- ii. Early rehabilitation.
- iii. Protection of vascular anastomosis.



Fixation by traction



Ilizarov Fixator



Taylor Spatial Frame Fixator



Thomas splint



Intertrochanteric fracture treated by plate & screw



➤ **Complications:**

- Infection.
- Non-union (due to inhibition of callus formation, damage to soft tissue & blood supply)
- Implant failure.
- Re-fracture.
- Mal-union.

### 3. Rehabilitation

*Physiotherapy & active movement*

▪ **Aims:**

1-To prevent 5

- **To prevent** stiffening of joints.
- **To prevent** wasting of bones & muscles.
- **To prevent** osteoporosis.
- **To prevent** secondary syndromes.
- **To prevent** edema.

2- **Early:** to maintain the function of the uninjured parts.

- 3- **Later:** - restoring function of the injured parts, once fracture healing occurs.
- residual joint stiffness is treated by intensive but graduated exercises.

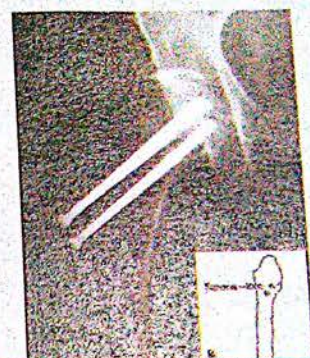
▪ **Methods:**

- Active exercise.
- Assisted movements.
- Functional activity.

### 4. Treatment of Complications

▪ **When ORIF is chosen the following should be considered:**

- Maintenance of maximum soft tissue coverage with interposition between the device and the skin surface.
- Maximum maintenance of periosteal and vascular tissues.
- Anatomic reduction and fixation stability.
- The use of high strength biocompatible implants.



Impacted femoral neck fracture treated by 3 parallel leg screws



Interlocking nail



# Open Fractures (Compound)

## Definition

- Fracture hematoma communicates with the exterior.

## Types

- **1ry:** i.e. trauma from **outside** cut skin then fracture the bone (open from the start, compound from without).
- **2ry:** i.e. trauma from **inside** (bone fragment causes skin injury, compound from within) 2ry to mobilization.

If injury from inside, it becomes less potentially infected.

## Complications

- Infection.
- Delayed union & non-union.

## Treatment

It is an Emergency

### First aid (See General)

- Airway → patent.
- Breathing → maintained.
- Circulation → stop bleeding by wound dressing (no tourniquet).
- D → Don't move limb → Immobilization.  
→ Drugs (e.g. morphia for pain).

### Definitive Treatment at Hospital

- Primary survey and second survey.
- I.V. antibiotics should be administered as soon as possible.
- General anesthesia.
- Systemic wound debridement & irrigation:** (in an operating theatre).
  - Skin: excise 1-2 mm from the edges.
  - Fascia: open tense fascia.
  - Muscles: excise dead muscles which is recognized by:
    - Color: bluish discoloration.
    - Consistency: mushy.
    - Contraction: not contract when pinched by forceps.
    - Circulation: not bleed when cut.
  - Bone: decontamination of bone by:
    - Curettage.
    - Pressure irrigation system (better).
  - Nerve → marks it for delayed repair.
  - Blood vessels → ligate, repair or graft (according to state of injured vessel).
  - Skin:
    - Clean (within 8 hrs) → closure without tension.
    - Infected (after 8 hrs) → leave it open + sterile dressing then delayed dressing or grafting.

- Immediate wound closure is rarely indicated and should be performed once the wound contamination is low.

- Immobilization:
  - External skeletal fixation.



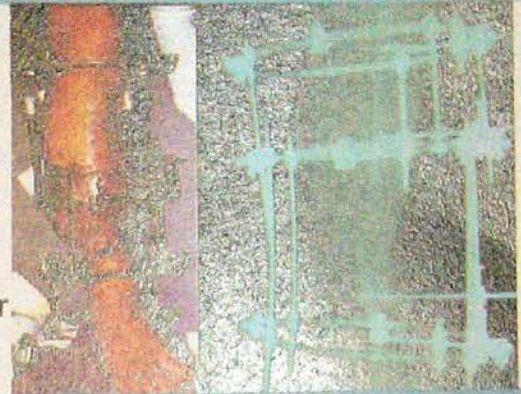


## Chapter 1: Orthopedic Surgery

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### f. After care:

- Observe distal circulation.
- Antibiotics (broad spectrum)
- Antitetanic.
- Anti gas gangrene.
- Later:
  - o Skin: 2ry suture or graft (if loss).
  - o Non-union → bone graft.
  - o Nerves & tendons → delayed repair



Open wound treated by external fixation and skin graft.

### Gustilo et. al classification of open fractures

Gustilo grade		Infection rate
I	Low energy, wound <1 cm in length	< 2%
II	Wound > 1 cm in length.	10 %
III	High energy wound with extensive tissue damage	> 10%
	IIIA Adequate soft tissue loss.	
	IIIB Extensive soft-tissue loss and bone damage	
	IIIC Associated with arterial injury	

#### N.B.:

If there is vascular injury → fracture fixation should be done before arterial repair.



## Points to remember (General)

### Scheme of any fracture:

- ▶ **Displacement:** Position of distal fragment in relation to proximal one.
- ▶ **C/P:** trauma (H/O, pain, swelling), deformity, length discrepancy, tenderness, crepitus, abnormal movement, Neurovascular evaluation.
- ▶ **Complications:** general, local
- ▶ **Investigations:** X-ray
- ▶ **TTT:** First Aid (ABCD), Reduction (if displaced), Fixation, Rehabilitation (passive & active), Treatment of complications.

### Fracture healing:

- ▶ **Phases:** 1- Repair by granulation tissue. " few weeks ",  
2- Union of primary callus. "2-3months"  
3- Formation of mature bone. " 4-6 months".
- ▶ **Factors affecting:** age, type of fracture, position of segments, vascularity, immobilization, infection.

### Complications:

- 1- **Fat embolism:**  
young patient, 2nd day, drowsy, cyanosis, frothy sputum, TTT by (O2, steroids, heparin).
- 2- **Crush syndrome:** Crushing injury, neurovascular effect (compartment \$), high CK + myoglobinuria (rhabdomyolysis), TTT by (Forced mannitol-alkaline diuresis, fasciotomy & Immobilization).
- 3- **Prolonged recumbency:** DVT & pulmonary embolism, Bed sores, Osteoporosis, Renal stones, Constipation.
- 4- **Arterial injury:** with or without tear, fracture fixation before repair.
- 5- **Compartmental \$:** high pressure in compartment, neurovascular affection, more in ant. Compartment of leg, TTT by (avoid tight cast, Fasciotomy).
- 6- **Avascular necrosis:** Femoral head, scaphoid, lunate, Talus, TTT by ( bone graft or prosthesis).
- 7- **Nerve injury:** types (Neuropraxia, axonotmesis or neurotmesis), caused by (Trauma, compression, Stretch, Entrapment), TTT by (Closed → expectant treatment for 6 weeks, Open→marked by black silk for delayed repair).
- 8- **Non-union:** - Hypertrophic: (excess callus, TTT by right fixation).  
- Atrophic: (loss of blood supply, TTT by bone graft).
- 9- **Delayed union:** healing takes longer time, X-ray →decalcified ends, TTT by (proper prolonged uninterrupted immobilization).
- 10- **Mal union:** healing in non anatomical position, types (Angular, Rotational, With shortening), TTT by (corrective osteotomy).
- 11- **Sudeck's atrophy:** reflex sympathetic osteodystrophy, Colle's, Pott's or scaphoid fracture, TTT by (Physiotherapy, hot wax, Sympathectomy, analgesics).
- 12- **Myositis ossificans:** Ca in soft tissues, muscle laceration with fracture, Osteoblasts invade the hematoma, TTT by (immobilization, resection (with tendency to recurrence)).
- 13- **Volkmann's Ischemic Contracture:** Flexion contractures due to fibrosis, partial ischemia, Flexor digitorum profundus (commonest), fixed length phenomenon, complete claw hand, TTT by – early (proper reduction, artery repair, Fasciotomy) – late ( physiotherapy, tendon transfer).

### Open fracture: (communicate with the outside)

- ▶ **Complications:** infection.
- ▶ **Treatment:**  
ABCD, widen the wound, excise dead muscles, decontamination of bone by Pressure irrigation system, mark injured nerve for delayed repair, arterial injury (ligate, repair or graft), skin ( clean→closed, infected→open + dressing for delayed repair), External skeletal fixation.



# Upper Limb

## Fracture Clavicle

Fracture between the middle and lateral 1/3  
(shaft, 80%)

- This is the **commonest** fracture in the whole body. This is due to:
  - Change of curve.
  - Foramen for nutrient artery.
  - Groove for subclavius muscle.
  - Thinnest part of the bone.

### Trauma

- **Indirect:** fall on outstretched hand.
- **Direct:** blow to the clavicle or fall on the point of shoulder (less common).

### Displacement

- **Medial fragment:** pulled up by sternomastoid.
- **Lateral fragment:** is displaced downward and inward by the weight of the limb.
- In children the fracture maybe of the greenstick variety.

### Clinical Picture

#### Symptoms

- History of trauma.
- Pain at site of fracture.
- Swelling at site of fracture.
- Inability to move the related upper limb.

#### Signs

##### 1. Inspection:

- Swelling, ecchymosis, bruises
- Deformity
  - Shoulder drop.
  - Step ladder deformity = over riding.
  - Characteristic posture (position of lactating mother).

→ The patient usually supports the elbow with the other hand & bends his head towards fracture site (to relax sternomastoid).

##### 2. Palpation:

- Broken displaced clavicle.
- Tenderness at site of fracture.
- Crepitus & abnormal movements (better to be avoided) to avoid injury of patient structures.

##### 3. Movements: both active & passive movements are lost or limited by pain.

##### 4. Neurovascular evaluation:

- Major vessels e.g. subclavian vessels → 6Ps
- Brachial plexus (C<sub>8</sub> & T<sub>1</sub>).
- Deformity → claw hand
- Sensory loss →
  - ⇒ Medial side of forearm.
  - ⇒ Medial 3 ½ fingers.

##### 5. Associated injuries: e.g. head, neck, acromioclavicular, ribs.





## Complications

- **Malunion**  
(most common but not of functional significance).
  - Costoclavicular syndrome
- **Non-union** (especially in fracture of the lateral end) uncommon due to rich blood supply).
- Shoulder stiffness. (Especially in elderly).
- **Stiffness of the shoulder in the elderly.**
- **Injury of:**
  - o Brachial plexus especially the lower trunk.
    - Motor → wasting of small muscles of the hand.
  - o Subclavian vessels (rare).
  - o Pleura and lung.

Nerve inj → Nerve plexus  
ax. 6w  
Nerve plexus  
Nerve plexus

## Investigations

### X-ray:

- Antero-posterior :-  
Fracture between medial 2/3 & lat 1/3 with overlap of fragments.

## Treatment

- If a part of polytraumatized patient → **ABCD** then **R & M.**
- A broad arm sling for 3 weeks and analgesics.
- Internal fixation is rarely needed when there is associated vascular or nerve injury.

Handwritten diagram showing a shoulder joint with a sling.

Mal union in young → I-Fix if old → no



### ⇒ Other rare types:-

#### 1. Fracture of outer 1/3 (15%):

- Usually no displacement occurs.
- But displacement may occur (if coraco-clavicular ligament is ruptured). The outer segment is displaced forwards and inwards.
- Non union is common.

#### - Treatment:

- o If not displaced → no treatment.
- o If displaced → internal fixation.

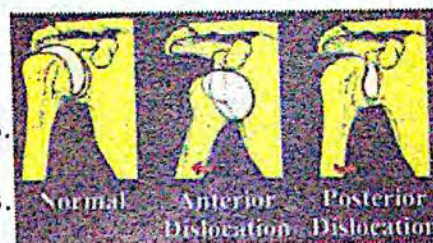
#### 2. Fracture of inner 1/3 (5%).



# Shoulder Dislocation

## Incidence

- It is the most commonly major dislocated joint of the body (45%).
- It is a **common** injury in **adolescents & young adults**.
- It is common because:
  - Shallow glenoid cavity & large head of humerus.
  - Wide range of shoulder movements.
  - Lax capsule & weak ligament.



## Types

- It may be anterior or posterior.

## I. Anterior Dislocation

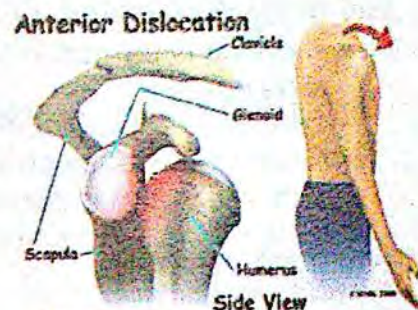
(The commonest 97-98%)

## Trauma

- Forced extension and external rotation of the abducted arm.

## Displacement

- The head of the humerus lies in front of the glenoid cavity, it may be:
  - Subcoracoid (**the commonest**).
  - Subclavicular.
  - Luxatio erecta is an anterior dislocation in which the arm is abducted above the head.
- Joint capsule:** torn (rupture of its anterior aspect).
- Glenoid labrum:** avulsed.
- Once the head is in its new subcoracoid position, the humerus is locked in this position by muscle spasm.
- ➡ This predispose to recurrent dislocation



## Clinical Picture

### Symptoms

- History of trauma. (see above)
- Pain.
- Swelling.
- Inability to move the affected limb (all shoulder movements are limited and painful).

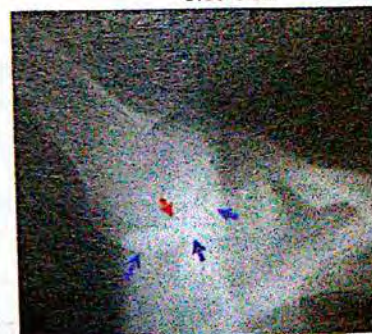
### Signs

#### 1. Inspection:

- Swelling.
- The arm appears to take origin from a point just under junction of middle and outer thirds of the clavicle.

#### ⊗ Deformity:

- The patient holds the injured limb at the elbow by the other hand in position of slight abduction.
- Loss of shoulder contour (flattening).
- Loss of axillary concavity.





## SPECIAL SURGERY

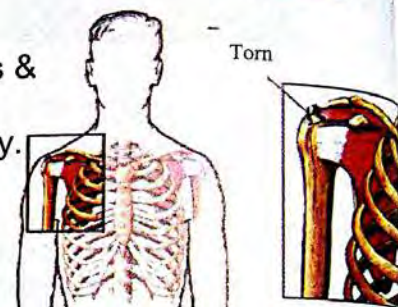
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2. **Palpation:** *limb apparent short*
  - Head is palpable anteriorly (In the subcoracoid or subclavicular region)
  - ⊙ Empty space under the acromion (empty glenoid cavity).
3. **Movement:** complete limitation of shoulder movements.
- ④ **Neurovascular evaluation:**
  - Axillary nerve → Deltoid muscle wasting & sensory loss over its lateral aspect of arm
  - Axillary artery → 6Ps. - axi. vein
5. **Associated injuries.** (See Complications)

### Complications

#### A- Early

- **Axillary nerve injury:** (mostly neuropraxia) 50%
- **Axillary artery injury** → 6Ps.
- **Associated Fractures** 1- **greater tuberosity**  
(usually results from excessive forces during shoulder reduction).
- 2- **humeral neck**.
- **Rotator cuff tear:**
  - Includes: supraspinatus, infraspinatus, subscapularis & teres minor muscles).
  - It complicates anterior dislocation especially in elderly.
  - **C/P:**
    - Avulsion of supraspinatus → inability to initiate abduction.
  - Diagnosed by U/S or arthrogram.



#### B- Late: Recurrent Dislocation (The commonest)

- It is due to detachment of the labrum glenoidal and the anterior capsule from the anterior margin of glenoid.
- A pouch is formed in front of the bare neck of the scapula into which the humeral head slips easily.
- Clinically redislocation occurs easily following minor daily actions as combing of hair.
- Reduction is easy and usually the patient can reduce the dislocation by himself.
- When the arm is abducted, externally rotated and gently moved backwards, the patient feels that the dislocation is imminent.

### Investigations

#### ▪ X-ray:

1. **Antero-posterior view:** (are diagnostic)
  - Confirm the diagnosis → humeral head outside the glenoid cavity.
  - Associated fractures.
2. **Lateral view:** confirms that it is **Anterior** dislocation.



### Treatment

#### Reduction under sedation or sometimes GA

##### ▪ Kocher's method:

- Downward traction.
- External rotation for few minutes to overcome spasm of the subscapularis muscle.
- Internal rotation and adduction.

To relax the muscles





Reduction is confirmed by putting the shoulder through full range of movement under sedation or anaesthesia.

### Immobilization

- In adduction & internal rotation for 3wks a broad arm sling or adhesive strap.
- Prolonged immobilization, as previously recommended, to allow healing of the torn capsule and to minimize the tendency for recurrence.

### Rehabilitation

- At the end of 3 weeks, the sling is removed and for three more weeks progressive mobilization of the shoulder is done avoiding only external rotation in abduction (the position in which the shoulder dislocates).

### Treatment of Complications

#### 1. Axillary artery:

⇒ Reduction:

- If pulse returns → follow up.
- If no pulse (within 20 minutes) → explore artery & repair it according to the type of injury.

#### 2. Axillary nerve:

⇒ Closed → expectant treatment for 6 weeks + massage + electric stimulation (neuropraxia or axonotmesis)

- If failed → explore & repair the nerve.

⇒ Open → mark the nerve at 1st by black silk

- Then delayed suturing (no 1ry repair).

#### 3. Fracture greater tuberosity:

⇒ First: reduction by putting the arm in abduction.

⇒ If failed: ORIF.

#### 4. Rotator cuff tear:

⇒ Needs repair in young patient.

#### 5. Recurrent anterior dislocation:

⇒ **Operation is indicated when the disability is great.**

- **Putti-Platt operation:** The idea is to limit external rotation of the shoulder by capsulorrhaphy and shortening of the subscapularis muscle by overlapping.
- **Bankart operation:** Has better results. The original lesion of the capsule or labrum is repaired by reattaching the labrum by suturing it to the bony rim of the glenoid.



## 2. Posterior Dislocation

(Less common)

### Trauma

- 1) Forcible internal rotation of abducted arm.
- 3) Direct blow on front of the shoulder.

- 2) Electric shock.
- 4) Epileptic fit.

### Displacement

- It may be subacromial or subspinosus (in infraspinous fossa of scapula).
- The head of the humerus lies behind the glenoid cavity.

### Treatment

- **Reduction:** traction to the abducted arm & then gentle external rotation.

### Fracture surgical neck of the humerus

- Usually in elderly patients associated with osteoporosis
- May be impacted or unimpacted
- Most important complication is axillary nerve injury → paralysis of deltoid & loss of sensation in skin overlying it "badge area"

## Fracture Humerus

Fracture  
proximal  
humerus

Fracture  
shaft  
humerus

Fracture  
distal Humerus  
(supracondylar  
fracture)

### I- Fracture proximal humerus

#### Types

1. Around anatomical neck.
2. Around surgical neck.
3. Greater tuberosity.
4. Lesser tuberosity

#### Incidence

- a. More common in Elderly (osteoporosis).
- b. Younger adults (strong force and fracture dislocations may occur).
- c. Children (before skeletal maturity).

#### Trauma

- a. Surgical neck of humerus → fall on out-stretched hand → causing forced abduction, extension, and external rotation and driving the humerus upwards against the acromion and glenoid.
- b. Anatomical neck of humerus → fall on point in the shoulder pushing humerus against glenoid.
- c. Greater tuberosity → fall on shoulder.



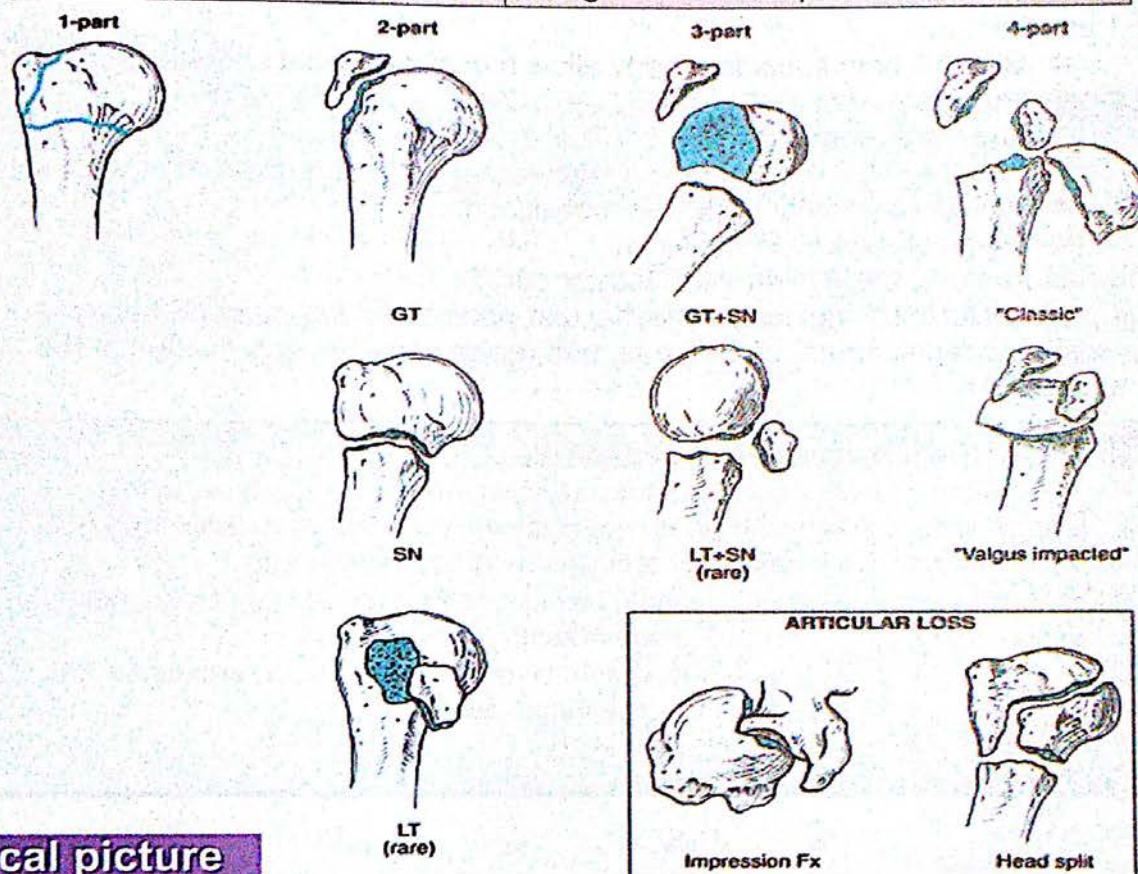


## Displacement

- Prognosis depends on degree of displacement & number of fracture segments.

## Neer's 4 classification

One part fracture	No displacement (even though a fracture line may exist between any number of segments) [80%]
2 part fracture	One segment is displaced
3part fracture	2 segments are displaced
4 part fracture	3 segments are displaced



## Clinical picture

### Symptoms

1. History of trauma.
2. Pain in the shoulder.
3. Inability to move the joint.
4. Flat shoulder (axillary nerve affection).

### Signs

#### > General:

- Shock
- Associated injuries.

#### > Local:

- Inspection:** ecchymosis, bruises, swelling
- Palpation:** tenderness, crepitus.
- Movement:** in minor fractures → limited movement may be possible.
- Neuromuscular evaluation:** axillary nerve affection → flat shoulder (inability of abduction)

**N.B:** The diagnosis is made radiologically.



### Complications

1. Shoulder stiffness (avoided by early passive followed by active mobilization).
2. Axillary nerve injury.
3. Circumflex nerve injury causes a patch of hyposthesia over the lower half of the deltoid.
4. Malunion (but, excellent function).
5. Avascular necrosis.
6. Non-union (not common).
7. Dislocation of shoulder (should be treated first).

### Treatment

- A. 1 part fracture:
  - ⇒ Sling till pain subsides, early allow mobility to avoid shoulder stiffness.
- B. 2 part fracture:
  - ⇒ Greater tuberosity:
    - ORIF by screw or wire + sling + no abduction for 3 weeks.
  - ⇒ Lesser tuberosity → just immobilization.
  - ⇒ Surgical neck → collar & cuff.
- C. 3 part fracture: ORIF + repair of rotator cuff.
- D. 4 part fracture: (↑ incidence of avascular necrosis of the humeral head) → prosthetic replacement of the head, cuff repair and wire loop fixation of the tuberosities.

#### **N.B:** Fracture of proximal humeral epiphysis

- In Children → even a complete fracture separation of the epiphysis with gross displacement can be managed non-operatively → (**collar & cuff for 3 weeks**), Because extensive remodelling occurs correcting any deformity.
- In Adolescent → 1- fracture should be reduced (attempt of closed reduction), as potential for remodelling is limited.  
 2- If reduction cannot be maintained with the arm at the side, percutaneous pinning is indicated.



## 2-Fracture Shaft Humerus

### Incidence

- Common in elderly.

### Trauma

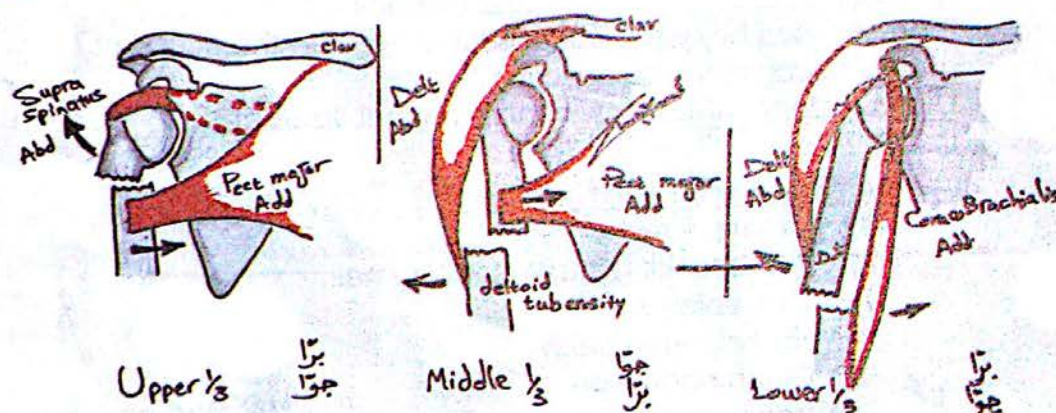
#### 1) Indirect →

- Fall on outstretched hand.
- Twisting injury to the arm producing a spiral fracture with or without a butterfly fragment.

#### 2) Direct → blow to the arm.

### Displacement

	Upper 1/3 (just below surgical neck)	Middle 1/3 (above deltoid tuberosity)	Lower 1/3 (below deltoid tuberosity)
Upper fragment	Abducted by supraspinatus	Adducted by pectoralis major	Abducted by deltoid
Lower fragment	Adducted by pectoralis major	Abducted by deltoid	Adducted and pulled upwards by coracobrachialis.



### Clinical Picture

#### Symptoms

- History of trauma.
- Pain in the arm.
- Swelling in the arm.
- Inability to move the limb

#### Signs

##### ➤ General: (if poly-traumatized patient)

- Shock.
- Associated injuries.

##### ➤ Local:

##### 1. Inspection →

- Ecchymosis, bruises, swelling.
- The patient supports the arm by the other hand.

##### 2. Palpation → Tenderness, crepitus.

##### 3. Movement → limitation of active & passive movement due to pain.



#### 4. Neurovascular evaluation → radial nerve (mostly neuropraxia):

- a. Motor: wrist drop & finger drop.
- b. Sensory: loss of sensation on the dorsum of the hand at the base of thumb (clinically it's localized to snuff box).

#### Complications

- Radial nerve injury.
- Non-union, mal-union and delayed union, joint stiffness.

#### Investigation

- X-ray.

#### Treatment

(If a part of poly-traumatized patient → **ABCD** then **R&M**)

#### 1. Undisplaced simple fracture →

##### a- Reduction with fixation by:

→ U-shaped plaster slap (for 8 weeks).

- Reduction is obtained by gravity acting on the arm, exerting steady traction which correct any angulation or overriding that may occur.
- The U-shaped plaster slab runs from the top of the acromion, down the lateral side of the arm and under the elbow, then, bandaged to the chest wall for more stability.

##### b- Alternatively:

- A hanging cast (a complete cast extending from the axilla to the wrist) can be used. Because it is heavier, the action of gravity becomes more effective.
- Disadvantage: the elbow cannot be mobilized during treatment.



#### 2. Open reduction & internal fixation:

- **By** → Plate & screw.  
→ Interlocking intramedullary nail.
- **If** → Unstable.  
→ Radial nerve palsy.  
→ Clean open wound.  
→ transverse fracture and near the middle of the shaft (intramedullary nail)

#### 3. Treatment of complications:

##### - Radial nerve injury

- ⇒ Closed → expectant treatment for 6 weeks + massage + electric stimulation (neuropraxia or axonotmesis).  
- If failed → explore & repair the nerve.
- ⇒ Open → mark the nerve at 1st by black silk.  
- Then delayed suturing (no 1ry repair).



## Supracondylar Fracture of Humerus

### Site

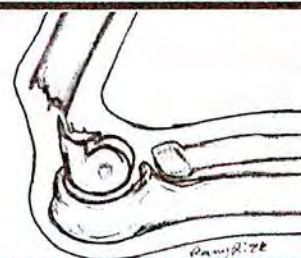
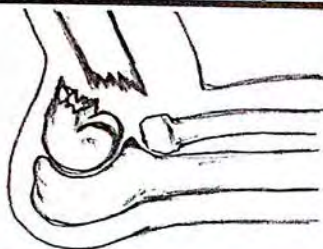
- Distal Metaphysis area just above the 2 condyles of humerus.

### Incidence

- Commonest** elbow injury in children.
- 50% complete, 50% Greenstick *incomp.*

### Trauma & Displacement

Extension type	Flexion type
99% (the commonest ✓).	1%
Fall on outstretched hands.	Fall on tip of flexed elbow.
<ul style="list-style-type: none"> <li>Distal fragment is displaced posteriorly by triceps.</li> <li>Pronation of the distal fragment because the hand is usually pronated at time of trauma.</li> <li>Internal rotation of the distal fragment.</li> <li>Medial or lateral shift may occur.</li> </ul>	<ul style="list-style-type: none"> <li>Distal fragment is displaced anteriorly by biceps &amp; brachialis.</li> </ul>



**N.B:** - The fracture line runs transversely through the distal metaphysis of the humerus.  
 - The fracture is Greenstick in 50% and complete in 50% of cases.

### Clinical Picture

#### Symptoms

- History of trauma. (see before)
- Pain (severe) around elbow.
- Swelling around elbow.
- Partial or complete limitation of movement around elbow joint.
- +/- Neurovascular injuries: painful passive extension of fingers (Early Volkmann's ischemia)

#### Signs

##### 1. Inspection:

- Swelling.
- Deformity of elbow → extension or flexion.
- Ecchymosis and bruises.

##### 2. Palpation

- Tenderness around elbow.
- Crepitus (to be avoided).
- Specific signs:
  - Relation between medial & lateral epicondyles & tip of elbow are not disturbed forming an equidistant  $\Delta$  on flexed elbow (DD of elbow dislocation).
  - Supracondylar ridge → interrupted.

##### 3. Movement

- Both active & passive → limited by pain.
- ± crepitus.



4. **Neurovascular evaluation:**

- a) **Brachial a.** may be affected at the time of trauma by the anterior aspect of the distal end of the proximal fragment, causing acute ischemia (6Ps).  
 - Pain, paralysis, parathesia, pallor, pulseless & progressive coldness.

b) **Manifestations of nerve injury:**

	Deformity	Sensory loss	Tests for motor
Median n.	Ape hand.	- Lat 2/3 of palm. - Palmar aspect of lat 3 ½ finger with dorsal of their terminal phalanges.	- Counting finger. - Pencil test.
Ulnar n.	Partial claw hand.	- Med 1/3 of palm + palmar & dorsal aspect of med 1 ½ fingers.	- Card test. - Froment's test.
Radial n.	Wrist & finger drop.	- Lat 2/3 of dorsum (Actually snuff box only is affected).	- Ask patient to extend thumb!!

DD

	Extension Type	Post. Dislocation of Elbow
Age.	Pediatric fracture.	Usually in adults.
Mobility.	Painful limitation of active movement.	Absolute loss of active & passive movement.
3 bony points at elbow.	Normal relationship.	Disturbed relationship.
Supracondylar ridge.	Interrupted.	Normal.
Measurement: a- From the tip of acromion to lateral epicondyle.	Interrupted.	Normal.
b- From the lat. epicondyle to styloid of radius:	Normal.	Interrupted.
X-ray:	Fracture Line.	Dislocation.

- Normally, the 3 bony landmarks (medial & lateral epicondyles & the olecranon) forms equidistant triangle with the elbow flexed & on straight line with elbow extended

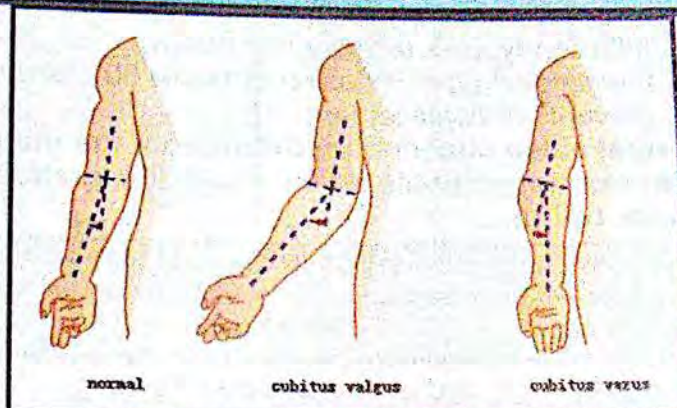
**Complications****A. The most important complications include**

- Acute ischemia** → 6Ps.
  - If not treated (within 6-8 hours) will lead to:
    - o Chronic ischemia.
    - o Volkmann's ischemic contracture manifested by:
      - Clawing of fingers & on trial to extend it passively → ↑ flexion of wrist (**Volkmann's sign**).
      - Wasting of forearm muscles.
      - Trophic changes of overlying skin.
- Myositis ossificans**: muscle hematoma with overlying ossification.



3. **Malunion:** In the form of: cubitus **varus**, **valgus**, Internal rotation and extension. The latter two are corrected by remodeling while varus is not corrected.

- Cubitus varus is more common.
- Cubitus valgus leads to delayed ulnar neuritis.



4. **Nerve injuries:** Anterior interosseus nerve (branch of median) > ulnar nerve > radial nerve.

### B. Other complications

1. Skin → tear, blisters & necrosis.
2. Muscles & tendons → tear in brachialis m. or tendons.
3. Elbow stiffness & arthritis (on long standing cases).

### Investigations

- **X-ray:**
  - AP & lateral Views.
  - Fracture line & the displacement.

### Treatment

→ If a part of poly-traumatized patient → ABCD then R&M.

### Reduction & Fixation

- a. **Undisplaced fractures and Greenstick fractures with angulation less than 20°**

require no manipulations.

- Fixation is achieved by using a posterior plaster slap and a collar and cuff with the elbow flexed for 3 weeks.

- b. **Greenstick fractures with angulation more than 20°**

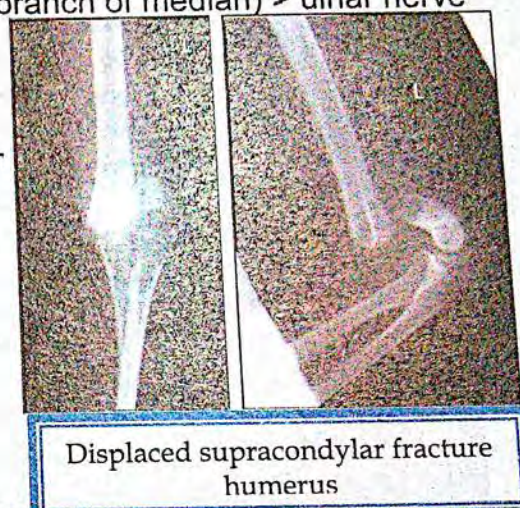
require reduction by flexion only then fixation as above.

- c. **Displaced:**

⇒ **Closed reduction & Fixation by a posterior slap for 3 – 4 weeks.**

#### ➤ Indications:

- In all children fracture and small percent of adult fractures



Displaced supracondylar fracture humerus

Fixation in Extension



Fixation in Flexion





> **Steps:**

- Under GA
- Distal fragment is pulled downward & pushed forward in extension type or backward in flexion type, then lateral or medial displacement is corrected.
- Carrying angle is checked
- Fixation by **above elbow back splint**.
  - If flexion type → extension of elbow.
  - If extension type → flexion of elbow 80° "stretched triceps muscle prevents redisplacement"
- Radial pulse **observation** throughout the maneuver if it become weak or not palpable elbow should be gradually extended until the pulse returns.

However some surgeons prefer to fix these fractures in extension whatever the type for better correction of carrying angle and to decrease arterial impairment.

- ⇒ **Closed reduction and percutaneous pinning.**
- ⇒ **Open reduction and internal fixation (Using Wires).**

> **Indications:**

- In adult fracture
  - Open fracture.
  - Vascular injury not improved after closed reduction.
  - Failed closed (unstable).
- ⇒ **External skeletal fixation (if open) (Dunlop traction).**

**Rehabilitation**

- Active elbow movement.

- Physiotherapy.

- Hospitalization for 48 h. for observation of circulation:
  - If impaired at any time → slap is removed & elbow is extended.
  - then, If there is no improvement → the brachial artery should be explored.
- Never apply a complete plaster above elbow for injuries around elbow joint due to the ↑ risk of edema which if occurred while a complete plaster is applied → may lead to compartment syndrome.

**Treatment of complications**1. **Brachial a. injury:**

- a- **Acute ischemia** (should be managed within 6-8 hour):

⇒ Reduction of the fracture:

- If pulse returns → follow up
- If no pulse (within 20 minutes) → explore artery & repair it according to the type of injury.

- b- **Volkman's** → tendon transfer.

2. **Myositis ossificans:** (avoid massage)

- Prolonged immobilization.
- If residual lesion → excision after 9 months.

3. **Mal-union** → corrective osteotomy + plating.4. **Nerve injury:**

- a- Closed → expectant treatment for 6 weeks + massage + electric stimulation (neuropraxia or axonotmesis)
  - If failed → explore & repair the nerve.
- b- Open → Mark the nerve at 1st by black silk.
  - Then delayed suturing (no 1<sup>ry</sup> repair).

5. **Open fracture** → AB + external skeletal fixation.



### 1- Fracture Medial Condyle

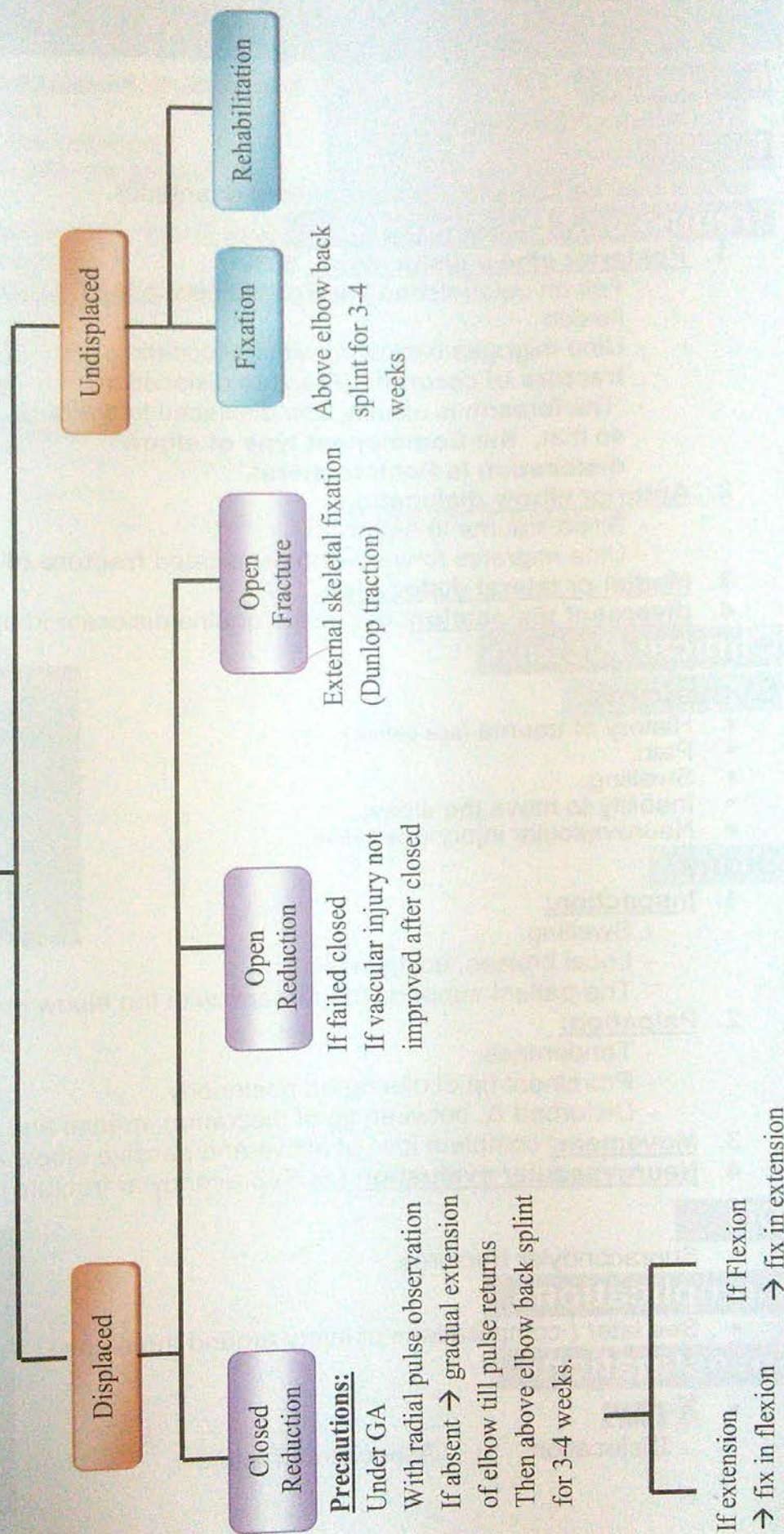
- Fall on the outstretched hand

### 2- Fracture Lateral Condyle

- Fall on the outstretched hand
- **Treatment**: reduction and internal fixation.
- **Complication**: progressive cubitus valgus and delayed ulnar neuritis (Treatment: ulnar nerve anterior transposition.)

- **Complication**: ulnar nerve paralysis

## Treatment of supracondylar fracture humerus





# Elbow Dislocation

## Incidence

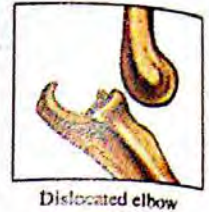
- Adults > children.

## Types

- It may be posterior (more common) or anterior.

## Trauma and Displacement

1. **Posterior elbow dislocation:** 80%
  - Fall on outstretched hand with elbow in mild flexion
  - Ulna migrates backward with associated **fracture of coronoid** (Fracture dislocation).
  - The forearm is usually also displaced laterally so that, **the Commonest type of elbow dislocation is Posterolateral.**
2. **Anterior elbow dislocation:**
  - Direct trauma to elbow.
  - Ulna migrates forward with associated **fracture of olecranon** (fracture dislocation).
3. **Medial or lateral dislocation.**
4. **divergent dislocation:** the radius or ulna dislocate in opposite directions.



## Clinical Picture

### Symptoms

- History of trauma (see before)
- Pain.
- Swelling.
- Inability to move the elbow.
- Neurovascular injury (see before)

### Signs

1. **Inspection:**
  - Swelling.
  - Local bruises, ecchymosis.
  - The patient supports the forearm with the elbow in light flexion.
2. **Palpation:**
  - Tenderness.
  - Prominent tip of olecranon posteriorly.
  - Disturbed Δ. between tip of olecranon, medial and lateral epicondyles
3. **Movement:** complete loss of active and passive elbow movements.
4. **Neurovascular evaluation** (as Supracondylar fracture)



## DD

- Supracondylar fractures.

## Complications

- See later ( complications of injury around the elbow)

## investigations

### X-ray:

- Dislocation.
- Associated fracture.





**Treatment****Posterior Dislocation****1. Reduction:**

- Under GA + muscle relaxant → downward then forward traction.
- X-ray → confirms the reduction.
- Check movements after treatment.

**2. Fixation:**

- Above elbow posterior slab → for 3 weeks (to allow for healing of the capsule and ligaments).

**3. After that the joint should be gradually mobilized.****Anterior Dislocation**

- ORIF using long screw.

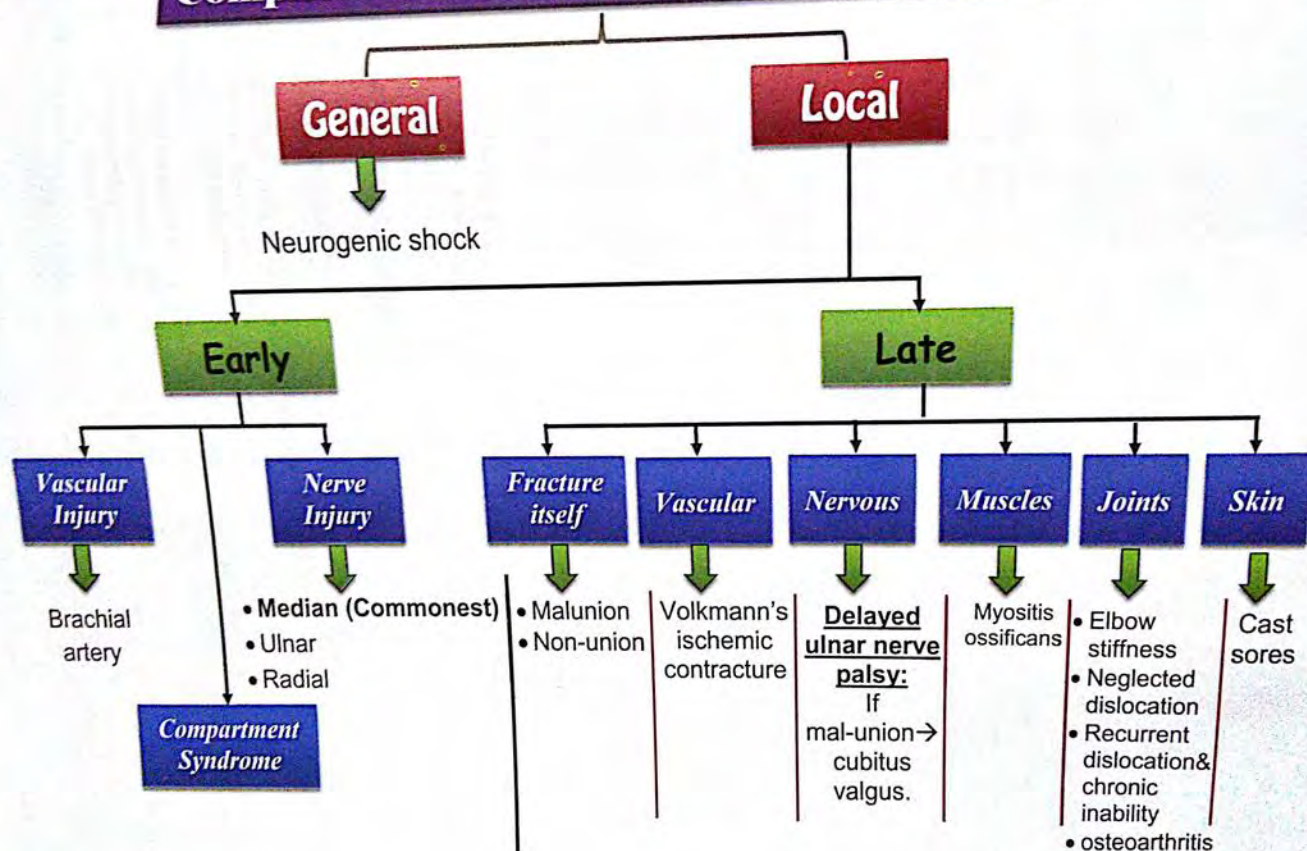
**Treatment of Complications**

- **Brachial artery:** reduction of the dislocation:

- If pulse returns → follow-up.
- If no pulse (within 20 minutes) → explore artery & repair it according to the type of injury.



## Complications of injuries around the elbow





## Fractures of the forearm

These are classified as follows:

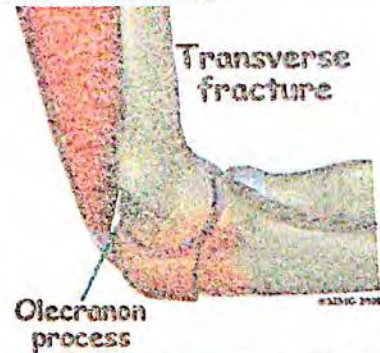
1. Fractures of the proximal ulna: olecranon and coronoid.
2. Fractures of the radial head.
3. Fractures of the shafts of radius and ulna.
4. Monteggia and Galeazzi fracture-dislocations.

## Fractures of proximal ulna

### 1) Fracture Olecranon

#### Trauma and morbid anatomy:

- fall onto the point of the elbow.
- The olecranon will be broken by the distal end of the humerus.
- The fracture line is transverse and usually runs through the narrowest point of the bone.
- Comminution of the proximal segment may occur.



#### Displacement:

- Separation of the fracture ends depends on the integrity of the triceps expansion:
  - 1- Intact Triceps expansion → no separation (No gap is detected).
  - 2- Torn Triceps expansion → the proximal fragment will be pulled up producing a wide palpable gap.



#### Clinical Picture and Treatment

	Intact triceps expansion	Torn triceps expansion
Clinically	Bruising, swelling and tenderness.	
Active extension of elbow	Possible	Lost
Palpable gap	Not detected	Detected
Treatment	- Does not need reduction. - By an above elbow plaster cast for 6 weeks followed by gentle mobilization.	By open reduction and internal fixation followed by early movement of the elbow.

- Comminuted fractures and those with a very small proximal segment are treated by excision of the fragments and reattachment of the Triceps.

#### Complications:

1. Loss of some movements especially full extension.
2. Ulnar nerve damage is rare.
3. Secondary osteoarthritis of the elbow.



## 2) Fracture Coronoid process

### Types

1. Isolated → avulsion by brachialis muscle.
2. With posterior dislocation of the elbow.

### Treatment

- Reduction + Plaster cast for 3 weeks.
- Occasionally operative repair is needed.





## Fracture distal Radius and Ulna (Colles' Fracture)

### Definition

- It is an **extra-articular** fracture which occurs about 1 inch above the distal end of radius with **postero-lateral shift & tilt** of the lower segment occurs in elderly women.

### Site

- Extra-articular.
- Lower radius (1 inch above the distal end of radius) in the cancellous part

Smith fracture



Colles' fracture



### Incidence

- Most common in **female > 50 years** (postmenopausal osteoporosis).

### Trauma

- Fall on the palm of outstretched hand.

### Displacement

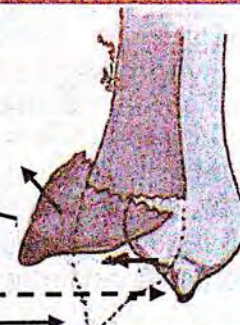
- Posterolateral shift & tilt  $\pm$  upward impaction & supination.
- There is always an associated injury to the inferior radio-ulnar joint and the ulnar styloid process may be avulsed.
- The fracture is often comminuted especially on the dorsal aspect.

- Common fractures in post-menopausal females:

- Fracture surgical neck of humerus.
- Fracture neck of femur.
- Colles' fracture.

Radius

Upward



Lateral view



### Clinical Picture

#### Symptoms

- History of trauma.
- Pain above wrist.
- Swelling above wrist.
- Partial** affection of movement around wrist joint.

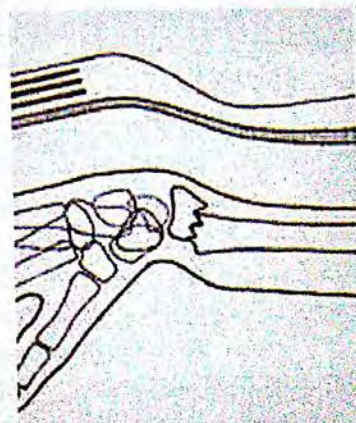
#### Signs

##### 1. Inspection:

- Swelling
- Ecchymosis, bruises
- **Dinner fork deformity.**

##### 2. Palpation:

- Tenderness around wrist.
- No Crepitus.
- Radial styloid process is **no longer** lower than that of ulna, (reflection of shortening of the Radius).





3. **Movement:**
  - Loss of active movement + painful passive movement.
4. **Neurovascular evaluation:**
  - Radial a. may be affected so **Allen's test** is needed.
  - Median n. injury:
    - o Deformity → Ape hand.
    - o Sensory loss - Lat 2/3 of palm.
    - o Palmar aspect of lat 3 1/2 finger with dorsal of their terminal phalanges.
  - o Tests for motor power - Counting finger.



- Pencil test.

## Complications

*The most important complications include:*

- 1- **Malunion:** While union is the rule, there is often some residual deformity because:
  - Redisplacement may occur inside the cast especially if the posterior cortex is comminuted.
  - A Colles' plaster does not control the supination element of the deformity.
- 2- **Sudeck's atrophy:** (unknown etiology)
  - This is a form of reflex sympathetic dystrophy with increased blood flow to peri-articular areas
  - Severe pain causing sympathetic stimulation & VC → local osteoporosis → more pain (vicious circle).
- 3- Epiphyseal dislocation in children → **Madelung** deformity.
- 4- **Radial artery injury.**
- 5- **Median nerve injury.**
- 6- **Carpal tunnel syndrome:**
  - Late complication with mal-union due to compression of median n.
  - As usual C/P of median n. injury (**BUT** sparing sensation of palm).
- 7- **Other complications:-**
  - Skin → tear, blisters & necrosis.
  - Muscles & tendons → **rupture of extensor pollicis longus tendon.**
  - **Wrist stiffness & arthritis** (on longstanding cases).



Madelung deformity

## DD

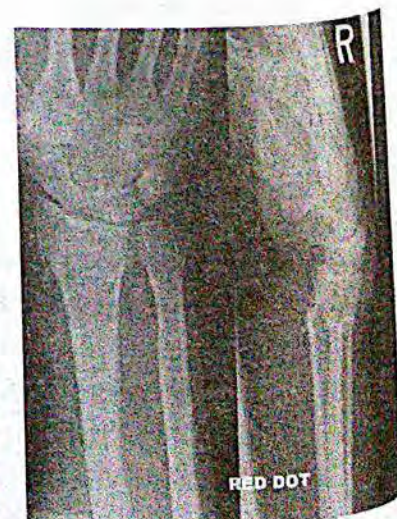
1. **Smith** fracture (reverse of Colles').
2. **Chauffeur** fracture (fracture styloid process of radius).
3. **Scaphoid** fracture.

## Investigations

- **X-ray:**
  - **AP view:**
    - Fracture line (in metaphysis of radius).
    - Lateral shift or tilt.
    - Radial shortening (= upward impaction).
  - **Lateral view:**
    - Dorsal displacement or tilt of the distal fragment
    - Subluxation of inferior radioulnar joint.

▪ Possible deformities that can occur with Colles' fracture:

- Dinner fork.
- Madelung.
- Ape hand.



RED DOT



**Treatment**

- If a part of poly-traumatized patient → ABCD then R&M.

**Reduction & Fixation for 4 – 6 weeks****1. Closed reduction & fixation by cast under GA:**

- Traction of the hand "as if shaking hands".
- Counter traction of humerus.
- Done through **3 Grips** :
  - a- Traction along the long axis of the limb in order to disimpact the fragments.
  - b- Pressing the distal segment anteriorly with palmar flexion and pronation to correct the posterior displacement and tilt.
  - c- Pushing the distal fragment towards the ulna to correct the radial displacement and tilt.



Hand grip method

- If isolated Colles' → below elbow cast holding the wrist in palmar flexion and ulnar deviation.
- If associated with fracture ulnar process → above elbow cast.

**After care**

The circulation to the fingers should be carefully watched in the initial 24 hours for fear of a tight plaster cast.

**Rehabilitation**

- Physiotherapy from 1st day to avoid Sudek's atrophy.
- Active movement (fingers – elbow – shoulder).

Active mobilization of hand & arm above head daily to prevent stiffness.

**Treatment of complications**

- **Sudek's atrophy**: sympathectomy + splinting + analgesics + physiotherapy.
- **Radial artery injury**: reduction of the fracture:
  - If pulse returns → follow up.
  - If no pulse (within 20 minutes) → Explore artery & repair it according to the type of injury.
- **N. injury**:
  - Closed → expectant treatment for 6 weeks + massage + electric stimulation (neuropraxia or axonotmesis)
    - If failed → explore & repair the nerve.
  - Open → mark the nerve at 1st by black silk
    - Then delayed suturing (no 1<sup>st</sup> repair).
- **Rupture of Extensor pollicis longus tendon** → transfer of extensor indices.
- **Carpal tunnel syndrome** → surgical division of the flexor retinaculum after confirmation of the diagnosis by nerve conduction studies.

**Smith Fracture:**

- It is the reverse of Colles' fracture, Due to fall on the dorsum of the hand.
- cause Garden spade deformity
- treated by Reduction and fixation by an above elbow plaster for 6 weeks or by ORIF.
- Intra-articular fracture is called **Barton's fracture** in which chips of the anterior portion radius is fractured.



# Monteggia Fracture Dislocation

## Definition & Types

1. Extension type 60%: (consists of anterior angulation (apex anterior) of the ulna and anterior dislocation of the radial head).
2. Flexion & lateral types are less common.

= fracture upper 1/3 ulna + superior radio-ulnar joint dislocation  
 ↓ ↓



## Treatment

= ORIF + closed reduction of radial head

→ It may be complicated by posterior interosseous n. injury and it may be missed in children.

### ▪ Galeazzi Fracture Dislocation:

= inferior radio-ulnar joint dislocation + fracture lower 1/3 radius  
 ↓ ↓  
 = closed reduction of head of ulna + ORIF of radius

## Fracture Shafts of radius & ulna

### Site

Upper, middle or lower of forearm

### Trauma

- Direct trauma → fracture both bones at same level
- Indirect trauma e.g. twisting → oblique fracture at different levels

### Displacement

→ occur due to unbalanced pull of the supinator and pronator muscles attached to the radius, may be:

- Overlap
- angulation
- side displacement
- Rotation :

- Above insertion of pronator teres → proximal fragment is in supination by biceps & supinator
- Below insertion of pronator teres → proximal fragment is in midpronation.

### Complications

- Malunion, Non-union
- Synostosis "cross union"
- Acute compartment syndrome → treated by fasciotomy
- Nerve injury "uncommon"





## Treatment

- **Undisplaced** → full arm plaster cast with 90° elbow flexion and neutral rotation for 6-9 weeks
- **Displaced:**
  - a) Adults:
    - Done by ORIF.
    - It is necessary to achieve perfect reduction to avoid loss of pronation and supination.
    - If internal fixation is not rigid enough it should be supplemented by an above elbow plaster cast for 6 weeks.
  - b) Children:
    - closed reduction & plaster fixation.
    - Residual angulation of about 5° can be accepted as it will be corrected by remodeling.

### Fracture of one bone without angulation:

- Caused by direct trauma.
- It requires immobilization in an above elbow plaster for 6 weeks in adults and for 3 weeks in children.

## Fractures of the hand

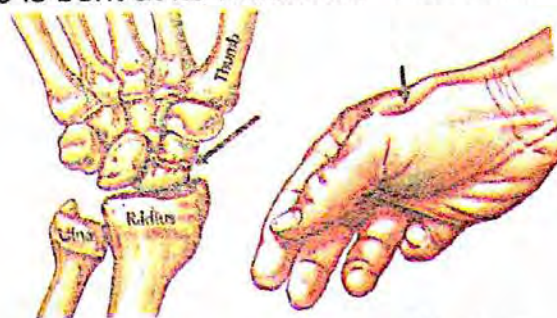
### 1) Fracture of Scaphoid Bone

#### Site Most common hand fracture

- 1- Waist of scaphoid (the commonest site): as the bone is bent at its waist over the radial styloid process.
- 2- The proximal third (proximal pole fracture).
- 3- The distal tubercle.

#### Trauma

- Fall on outstretched hand.
- Typically in young adults.



#### Clinical Picture

- Physical signs often appear trivial and suggest a sprained wrist rather than a fracture.
- 1- History of trauma, little swelling and no bruising.
  - 2- Pain in wrist with no gross impairment of function.
  - 3- Tenderness below radial styloid process (in anatomical snuff box).

*Wrist function may not be impaired grossly*

#### X-ray

- Including AP, lateral and oblique views.
- May not show the fracture immediately → often misdiagnosed as "wrist sprain".
- May be informative after 2 weeks →
  - As the fracture is hair line which is usually missed and difficult to interpret, but 2 weeks decalcification around fracture line rendering it more evident.
  - If there is still doubt → isotope bone scan or MRI.

#### Complications

- 1- Non-union (as it's completely intra-articular)
- 2- Avascular necrosis (of proximal fragment) due to interruption of blood supply (The blood supply to the scaphoid comes from distal to proximal)
- 3- Sudeck's osteoporosis
- 4- Wrist stiffness



### Treatment

- We treat the patient on clinical grounds even if the X-ray is negative → which is repeated 2 weeks later.
- 1- **Plaster of paris** : below elbow including the proximal phalanx of the thumb ( **abducted thumb**) for 8 weeks.
- 2- **Internal fixation with screw (Herbert screw)**
- 3- **Treatment of complications:**  
E.g. avascular necrosis → bone graft & internal fixation.



## 2) Fracture of the phalanges

- These are often transverse and the fragments are often angulated forwards by the tension of the lumbrical and interosseous muscles.
- The angulation is corrected and the finger is immobilized in semiflexion over a finger wire splint incorporated in a forearm plaster cast.

## 3) Mallet Finger

- Avulsion of the extensor expansion from the base of the terminal phalanx → flexion deformity of that phalanx.
- Loss of active extension of the distal interphalangeal joint.
- **Treatment:** The finger is immobilized with the proximal interphalangeal joint in flexion and the distal interphalangeal joint hyperextended for 6 weeks.

### Fall on the outstretched hand produces these common fractures:

- (1) Clavicle fracture.
- (2) Supracondylar fracture in children.
- (3) Posterior elbow dislocation.
- (4) Colles' fracture in the elderly.
- (5) Scaphoid fracture.



## Points to remember (Upper Limb)

### Fracture Clavicle

- ▶ The commonest fracture in the body.
- ▶ **Etiology:** indirect, direct trauma
- ▶ **C/P:** as scheme + step ladder deformity + position of lactating mother.
- ▶ **Comp.:** as scheme + Malunion + injury of (brachial plexus, Subclavian B.V.).
- ▶ **Invest.:** X-ray.
- ▶ **TTT:** as trauma + broad arm sling (3wks).

### Fracture proximal Humerus

- ▶ **Types:** anatomical neck, surgical neck, greater or lesser tuberosities.
- ▶ **Etiology:** fall on outstretched hand, in elderly.
- ▶ **Neer's classification:** (1,2,3 or 4 part fracture).
- ▶ **C/P:** as scheme.
- ▶ **Comp.:** Axillary n., circumflex n. injury.
- ▶ **Invest.:** X-ray
- ▶ **TTT:** - 1 part → sling. - 2,3 parts → ORIF or sling.  
- 4 parts → replacement of the head + cuff repair.

### Supracondylar Fracture of Humerus

- ▶ Commonest elbow injury in children.
- ▶ **Etiology:** extension type, flexion type
- ▶ **C/P:** - painful passive extension of fingers.  
- equidistant Δ on flexed elbow.  
- supracondylar ridge → interrupted.
- ▶ **Comp.:** - Brachial a. → \*acute ischemia (6Ps).  
- Nerve injury (median > ulnar > radial).  
- Malunion (cubitus varus, valgus).
- ▶ **Invest.:** X-ray.
- ▶ **TTT:** - post. plaster slap & collar + (Radial pulse).  
- Reduction (open or closed) & fixation.

### Fracture Olecranon

- ▶ **Trauma:** fall onto the point of the elbow.
- ▶ **C/P:** Intact triceps expansion, Torn expansion

↓	↓	
Active extension of elbow:	-Possible	-lost
palpable gap:	-Not detected	-detected
- ▶ **TTT:** -above elbow cast      -ORIF
- ▶ **Comp.:** loss of extension, ulnar n. injury, osteoarthritis.

### Fracture shaft Radius & Ulna

- ▶ **Trauma:** direct, indirect.
- ▶ **Displacement:** unbalanced pull of the supinator and pronator muscles.
- ▶ **C/P & Comp.:** as scheme + compartmental \$.
- ▶ **TTT:** - undisplaced → full arm plaster cast with 90° elbow flexion. / - displaced → ORIF.

### Anterior Shoulder Dislocation

- ▶ **Etiology:** Forced extension and ext. rotation of the abducted arm → subcoracoid.
- ▶ **C/P:** as scheme + patient holds the injured limb by the other hand in position of slight abduction + flat shoulder + empty glenoid.
- ▶ **Comp.:** inj. of axillary n. & art. + rotator cuff tear + \*recurrence (Bankart operation).
- ▶ **Invest.:** X-ray
- ▶ **TTT:** reduction by Kocher's method

### Fracture shaft Humerus

- ▶ **Etiology:** indirect, direct trauma
- ▶ **C/P:** as scheme.
- ▶ **Comp.:** radial n. injury.
- ▶ **Invest.:** X-ray.
- ▶ **TTT:** as trauma + - (undisplaced → U shaped plaster or a hanging cast).  
- ORIF.

### Elbow Dislocation

- ▶ **Etiology:** post.\* (coronoid), ant. (olecranon)
- ▶ **C/P:** as scheme + disturbed Δ on flexed elbow
- ▶ **Comp.:** as supracondylar fracture.
- ▶ **Invest.:** X-ray
- ▶ **TTT:** - Post.: reduction + above elbow cast  
- Ant.: ORIF

### Colles' fracture

- ▶ **Trauma:** Fall on the palm of outstretched hand → Posterolateral shift & tilt.
- ▶ **C/P:** >50 years with:  
as scheme + partial affection of movement around wrist joint + dinner fork deformity + radial styloid process is no longer lower than that of ulna + Allen's test (radial art. affection)
- ▶ **Comp.:** sudeck's atrophy, Madelung deformity, carpal tunnel \$, inj. of (radial art., median n.)
- ▶ **Invest.:** X-ray
- ▶ **TTT:** Closed reduction (3Grips method) & fixation (below elbow cast)

### Fracture Scaphoid

- ▶ Most common hand fracture
- ▶ **C/P:** as scheme (trivial, suggest a wrist sprain).
- ▶ **Invest.:** X-ray: after 2 wks (hair line)
- ▶ **Comp.:** scheme + avascular necrosis.



# Lower Limb

## Fracture Pelvis

### Definition

- It's the fracture of the pelvic ring with or without soft tissue injury.

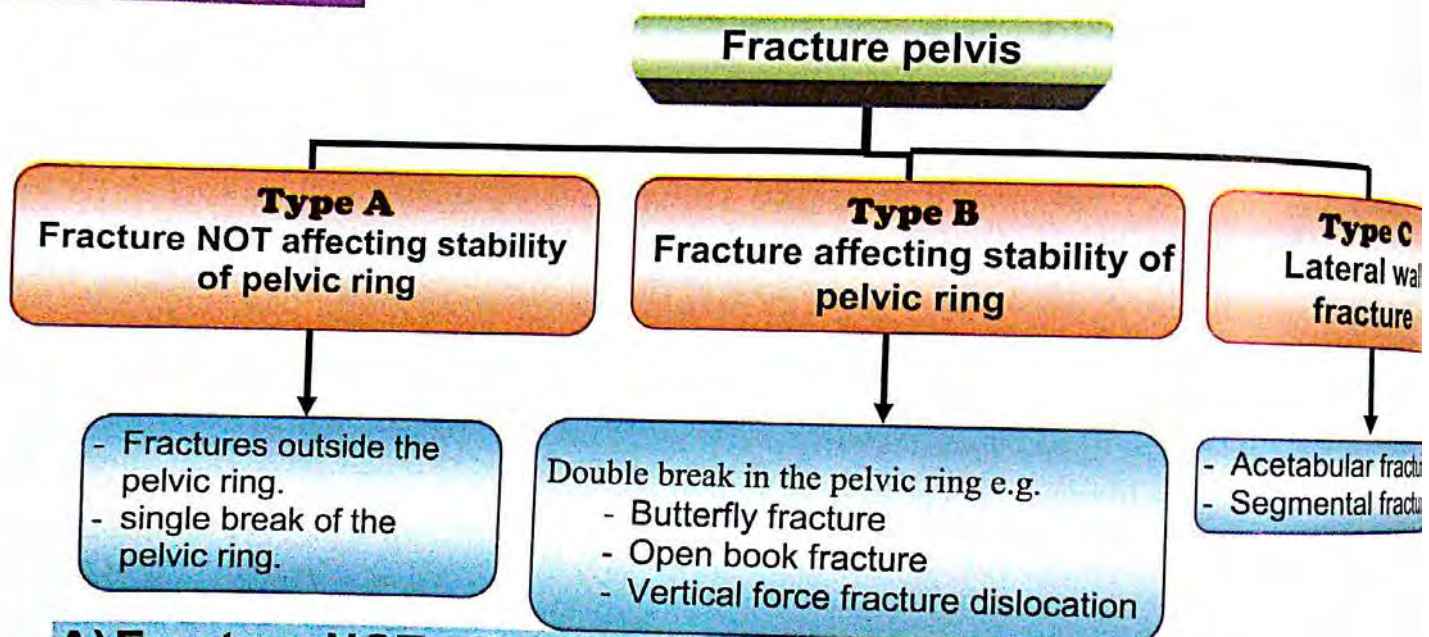
### Incidence

- 3% of all fractures.
- Road traffic accidents in persons < 60 years old.
- Falls at home in the elderly.

### Trauma

- Direct: A-P Compression or lateral Compression.
- Indirect: vertical shear.

### Classification



### A) Fracture NOT affecting stability of pelvic ring (Low energy injuries)

- Fractures outside the pelvic ring
  - Avulsion injuries e.g., anterior superior and inferior iliac spines and the ischial tuberosity.
  - Fractures of the iliac wings.
  - Fractures of the sacrum.
  - Fractures of the coccyx.

- Single break of the pelvic ring.

Broken only in one place, no significant displacement occurs at the fracture site.

#### Avulsion fracture:

Results from sudden violent muscular contraction: e.g. epilepsy

- Fracture A.S.I.S. with sartorius violence.
- Fracture A.inferior.I.S. with rectus femoris violence.

#### Diagnosis:

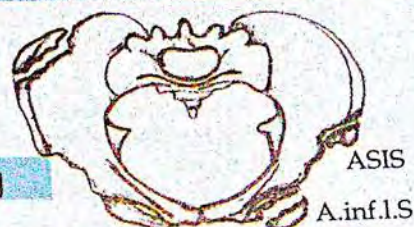
- History of trauma - acute pain - the pt. can lift his leg & can stand on it.
- On examination: Bruises - localized tenderness.



**X-ray:**

- Fracture line.
- Be sure that sacroiliac joint is undamaged.

**Treatment:** → Bed rest & Analgesics for 6 wks.



Avulsion fracture

**B) Fracture affecting stability of pelvic ring****➤ Incidence:**

- uncommon
- High energy injuries → high mortality
- Associated with other major injuries in 65%

**➤ Trauma & displacement:**

- Butterfly fracture (tetraramic): (Compression force fracture → double break in anterior segment with posterior displacement of central segment).  
→ The urethra is often sheared off at the apex of the prostate in a male.
- Open book fracture [Hinge subluxation] (Hinge force fracture → wide separation of the symphysis pubis with little separation of one of sacroiliac joint).
- Vertical force fracture dislocation: 3 subtypes:
  - 1- **Dislocation of symphysis pubis & sacro-iliac joint** with upward displacement
  - 2- **Malgaigne fracture:** unilateral double pelvic fracture with upward dislocation i.e. fracture both pubic rami with fracture ileum.
  - 3- **Total pelvic disruption** = Bilateral pelvic ring fracture.



Butterfly fracture



Open book fracture (Hinge subluxation)



Malgaigne fracture



Dislocation of symphysis pubis &amp; sacro-iliac joint

**Diagnosis****History**

- Trauma.
- Swelling.
- Disturbance of function (inability to stand up or move the pelvic ring)
- Inability to pass urine.

- Pain.



## Examination

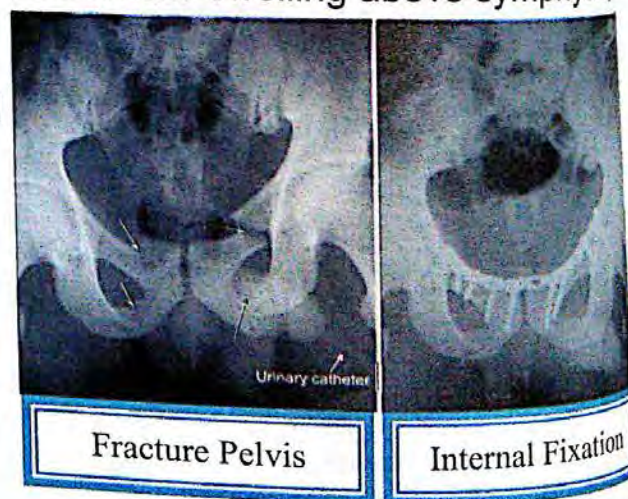
- **General:**
  - Shock.
  - Other injuries.
  - Retro-peritoneal hemorrhage may cause ileus and simulates visceral injury
- **Local:**
  - **Inspection:**
    - Ecchymosis, bruises, swelling
    - One leg may be externally rotated due to opening up of the pelvis and/or short due to upward displacement of the injured side of the pelvis.
  - **Palpation:**
    - Gap at the symphysis pubis may be felt.
  - **Movements:**
    - ▶ Limitation of movements.
    - ▶ The patient can not stand or lift his legs, but passive movements at the hip may be elicited
  - **Visceral injury:**
    - Uro-genital: **ask the patient to pass urine:**
      - If clear urine is passed → all is well.
      - If not & suspected urethral injury → do gentle retrograde urethrography.
    - Examine for neuro-vascular injury of the lower limb as sciatic nerve.
    - Rectal, vaginal:
      - **DRE:**
        - For associated rectal or prostatic injuries or bleeding,
        - Earle sign → large hematoma or palpable fracture line on DRE.
      - **PV:** for associated vaginal injuries.

## Complications of Pelvic Fracture

- 1- **Hemorrhagic shock:** Blood loss may be up to 2.5 liters.
- 2- **Visceral injury :**
  - A. Intrapelvic urethra (membranous part) bleeding per urethra, retention of urine
  - B. Extraperitoneal bladder rupture (localized tender swelling above symphysis, catheter pass easily).
  - C. Injury of rectum and vagina.
  - D. Paralytic ileus due to retro-peritoneal hematoma
- 3- **Sciatic nerve injury.**
- 4- **DVT** from prolonged recumbency.
- 5- **Osteoarthritis of hip joint.**
- 6- **Pelvic mal-union:** Causes no significant problems except in females (cesarean section may be needed).
- 7- **Secondary osteoarthritis** commonly occurs after disruption of the sacroiliac joints or acetabular fractures.

## Investigations

- **X-ray:**
  - Fracture line.
- **CT scan:**
  - For rapid evaluation of head, chest, abdomen & pelvis.
  - For associated injuries & sacral fractures.
- **U/S:** an alternative for abdominal evaluation





## Treatment

### First Aid

#### General → If poly-traumatized patient

##### A. Primary Survey

This includes a pre-hospital phase and a hospital phase

### ABCDE

##### B. Secondary Survey

- After establishment of the general condition of patient, 2<sup>nd</sup> survey has to be done.

## Treatment of Fracture

### A. Not affecting the stability of pelvic ring:

- Bed rest & analgesics for 6 weeks.

### B. Affecting the stability of pelvic ring:

#### 1. In Vertical shear & open-book fracture (Hinge subluxation):

##### ➤ The Aim:

- To reduce the displacement by applying skeletal traction to the leg.
- To correct leg length and to reduce outward rotation of the hemi-pelvis.

##### ➤ The Options are:

- Closed reduction by a pelvic sling.
- An external fixator may be applied to each hemi-pelvis (for reduction and fixation).
- Open reduction and internal fixation using plates & screws may be needed.
  - Traction is maintained for 6-8 weeks, then, Mobilization can begin.
  - But weight-bearing on the injured side is not allowed for 12 weeks.

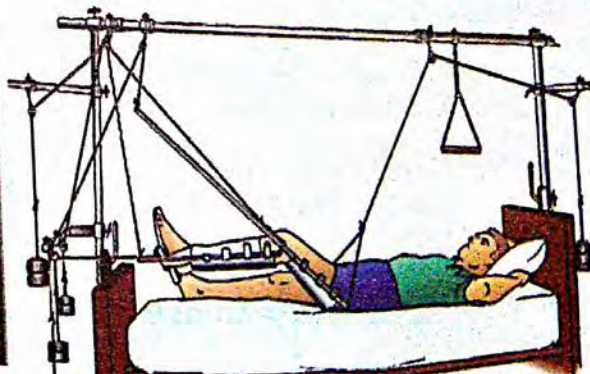
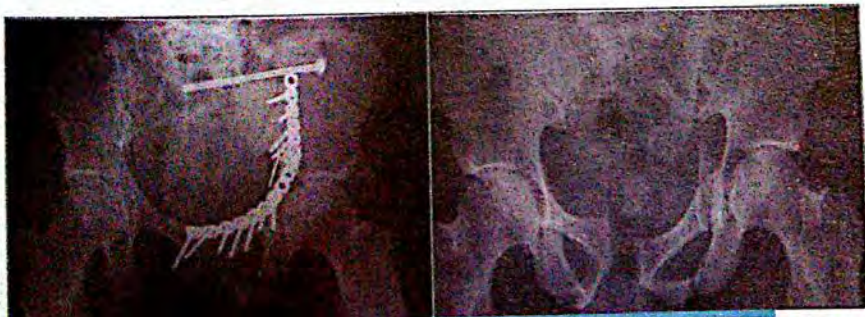
#### 2. In Butterfly fracture (Tetraramic) fracture:

- Uncomplicated fractures require bed rest for 6 weeks.

## Treatment of Complications

→ Associated injuries usually take priority over the treatment of bony injuries.

- Bladder → Closure of the bladder to be water tight then Foley's catheter.
- Urethra → suprapubic cystostomy, later dilatation.
- Rectum → colostomy.





# Hip Dislocation

## Types

- Congenital.
- Traumatic.
  - **Posterior** dislocation (commonest 80%).
  - Anterior dislocation.
  - Central dislocation.
- Pathological: T.B. hip joint.
- Paralytic: e.g. with polio, CP or spina bifida.

## Normal Mechanism of Stability of Hip Joint

- **Passive:**
  - Normal anatomy (deep acetabulum).
  - Capsule.
  - -ve intra-articular pressure.
  - Ligaments: → minimal role ≠ knee joint.
- **Active:** muscle action → Tone & contraction.

## a) Posterior Dislocation (80%) *Cerv. Med.*

## Types

- Pure dislocation: if hip flexed & adducted during trauma.
- Fracture dislocation: if hip is flexed only during trauma.

## Trauma

- **Forcible flexion + adduction + internal rotation.**
- ↳ - Dash board accident in person who is cross legged.
- Fall of heavy object on back of stooping individual.

**N.B.:** Dash-board dislocation.

- The same trauma may also
- Fracture the patella and/or the femoral shaft.

## Displacement

- Sciatic or ischeal.

## Clinical Picture

## Symptoms

- History of trauma.
- Pain.
- Swelling.
- Inability to stand or walk (disturbance of function).

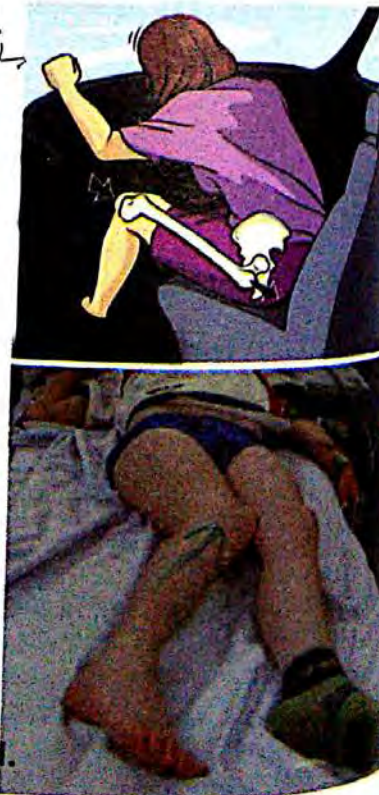
## Signs

### 1) Inspection

- Ecchymosis, bruises, swellings
- Lower limb is **flexed**, **adducted** and **internally rotated**.
- **Supratrochanteric shortening** (shortening with fixed greater trochanter-condyle distance).

### 2) Palpation

- Femoral head palpated post. empty femoral  $\Delta$ .





- **Narthes sign** (i.e. Difficulty to palpate femoral pulse due to backward migration of femoral head).

### 3) Movement

- Painful limitation of all hip movements.

### 4) Neurovascular evaluation :

- Sciatic n. injury →
  - a. Motor: drop foot.
  - b. Sensory loss:
    - Back of thigh
    - The leg & foot (except small area on the medial aspect)

## Complications

### General

- Neurogenic shock.
- Complications of prolonged recumbancy e.g. DVT & pulmonary embolism.

### Local

- Sciatic nerve injury: Either immediate, post reduction or post operative.
- Bone complications:
  - Associated fracture acetabulum.
    - Small fragment → falls in place with reduction so, traction for 6 wks.
    - Large fragment → int. fixation with screw.
  - Avascular necrosis of femoral head especially if reduction is delayed.
- Joint complications:
  - Secondary osteoarthritis.

## Investigations

### A. X-ray (A-P view):

- Confirm the diagnosis:
  - Displaced femoral head.
  - Empty acetabulum.
  - **Interrupted Shenton's line** (a regular arcade formed by the lower border of femoral neck & the lower margin of the superior pubic ramus ).
- Associated fracture:
  - A chip fracture of the posterior wall of the acetabulum.
  - Disappearance of shadow of lesser trochanteric due to internal rotation.



### B. CT scan → Essential:

- Evaluate intra-articular structures & femoral head.
- Confirm reduction.

## Treatment

### ▪ Emergent reduction:

⇒ Aims:

- Relief pain, relief pressure on sciatic nerve.
- ↓ Risk of avascular necrosis of femoral head.

⇒ Methods:

- Closed

#### ➤ Allis method:

- GA & muscle relaxant.
- Patient lies on blanket on the floor.
- Assistant steadies the pelvis.





## o Surgeon:

- Flex hip & knee to 90°
- Pulls the thigh vertically upwards at same time → lat. rotation of femur.
- Once click is observed → limb is extended
- Open → if closed reduction failed i.e. associated fracture acetabulum.

**Immobilization**

- Skin traction (3-6 wks).

**Treatment of Complications**▪ e.g. Sciatic nerve injury:

- Closed → expectant treatment for 6 weeks + massage + electric stimulation (neuropraxia or Axonotmesis)  
→ If failed → explore & repair the nerve.
- Open → mark the nerve at 1st by black silk  
→ Then delayed suturing (no 1<sup>st</sup> repair).

**B) Anterior Dislocation****Trauma**

(فتحة الركبة) - رطلها انشردت وظهر مفردة (قائمة الركبة)

- Forcible abduction and external rotation in flexed hip.

**Clinical Picture**

- Limb is slightly flexed, abducted & externally rotated.
- May be lengthening.
- Head may be felt over pubic bone or in perineum.

**Types**

- **Obturator:** If hip is flexed during trauma (more common).
- **Pubic:** If hip is extended during trauma.

**Complications**

- Injury of femoral & obturator nerves and vessels.
- Injury of femoral vessels.

**Treatment**

- Reduction under GA (allis method or internal reduction).
- Skin traction 3 wks by Thomas splint.

**C) Central Dislocation****Mechanism**

Due to direct trauma to greater trochanter → drive femoral head inward → comminuted fracture of floor of acetabulum, and may be accompanied by other fractures of the pelvis

**Treatment**

- Closed and open methods of reduction are both difficult and unsatisfactory.
- The best form of management is to mobilize the hip with tibial skeletal traction as soon as pain allows.





# Fracture Neck Femur

## Blood Supply of Femur Head & Neck

### 1- Extra capsular arterial ring:

- Present at the base of the neck formed by branches of medial & lateral circumflex femoral arteries (from profunda femoris)

### 2- Ascending cervical branches (Retinacular vs):

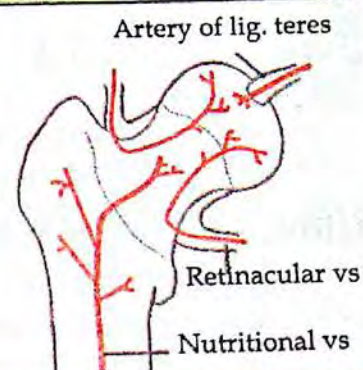
- Arising from the extra capsular ring & penetrate the capsule to be subsynovial.
- enter the head by piercing the bone at the junction of head and neck.

### 3- Artery of ligamentum teres:

- Usually arise from obturator artery.
- Fully developed at 8th years (absent in 15% of cases).

### 4- Nutritional vessels:

- Terminal branches of the ascending nutrient arteries.
- From the shaft along the medulla.



## 1) Intra-capsular Fracture of Neck Femur

### Incidence

- Old age > young due to senile osteoporosis.
- ♀ > ♂ due to postmenopausal osteoporosis (most important).
- Pathological fracture can occur from secondaries.

### Trauma (mechanism of injury)

- Elderly pt. → minor trauma:
  - As when foot catches the edge of a carpet → **Intracapsular fracture.**
  - Direct fall over greater trochanter.
- Young patient or old → major trauma.

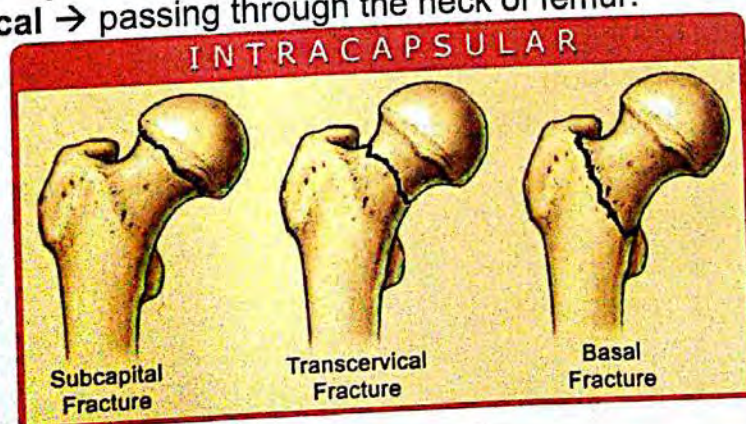
**N.B.:** DD of osteoporosis caused fractures :

- 1- Neck of femur.
- 2- Surgical neck of humerus (fracture proximal humerus).
- 3- Colles' fracture of UL.
- 4- Vertebral collapse.

### Classification

#### According to Site

- **Intracapsular:** (the proximal fragment often loses part of its blood supply)
  - **Sub-capital** → just below femur head.
  - **Trans-cervical** → passing through the neck of femur.





## According to displacement

- Impacted.
- Unimpacted (displaced).

## Clinical Picture

### Impacted

- Usually no rotation, the lower limb appears to be abducted rather than adducted with only tenderness over fracture site (missed fracture).

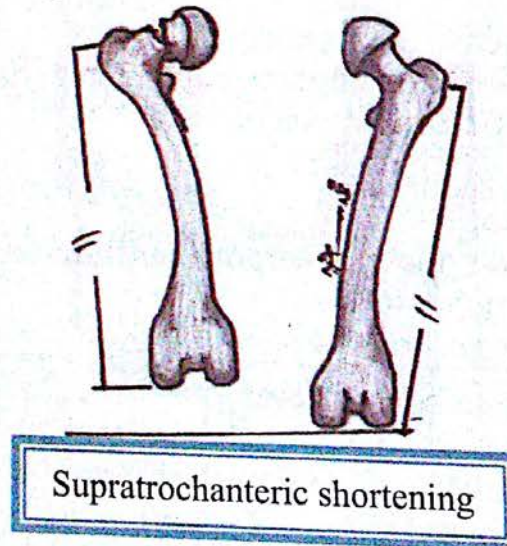
### Unimpacted Fracture

#### Symptoms:

- History of trauma.
- Pain in hip region → refers to groin & medial side of knee.
- Swelling in hip region.
- Inability to walk (even inability to get up after falling).

#### Signs

- Inspection:
  - Ecchymosis over the greater trochanter (more in extracapsular type)
  - Deformity →
    1. External rotation.
    2. Adduction.
    3. Shortening of the limb



- Palpation:
  - Tender greater trochanter & raised.
- Movement (straight leg raising test):
  - Inability to raise extended leg.
  - Movements of the hip are painful.
- Neurovascular:
  - Sciatic n. injury:
    - a. Drop foot.
    - b. Sensory loss → - back of thigh.
  - Leg & foot (except small area on medial aspect)



## Complications

### General

Mortality in first 3 month is 20%

- Complications of prolonged recumbency:
  - DVT & pulmonary embolism in 25% of cases.
  - Bed sores.
  - Osteoporosis.
  - Renal stones.
  - Constipation.

### Local

#### ✓ AVN **Avascular necrosis** (most common): 15-35%

- **Cause:** occurs in **intra-capsular type** (not in extra-capsular) due to cut of blood supply of femoral head causing its necrosis & mal-union.
- **X-ray:** head will become denser then shrinks
- **Sequale:** 1- Delayed or even non-union  
2- 2ry osteoarthritis.
- **Delayed or Non-union:** may occur due to:
  - a. Adequate immobilization is difficult to achieve even by internal fixation.
  - b. Poor blood supply to the proximal fragment.
- **Mal-union:**
  - More with extracapsular fracture.
  - Coxa vara.                      - Coxa vulga.
- **Neurovascular injury** → sciatic n. injury. → foot drop (Resid. v. vulg. mal-union)
- **Secondary osteoarthritis.**

## Investigations

### ▪ **X-ray:**

- An exact diagnosis requires X-ray examination.
- However, even on X-ray examination, impacted fractures with minimal displacement may be missed.



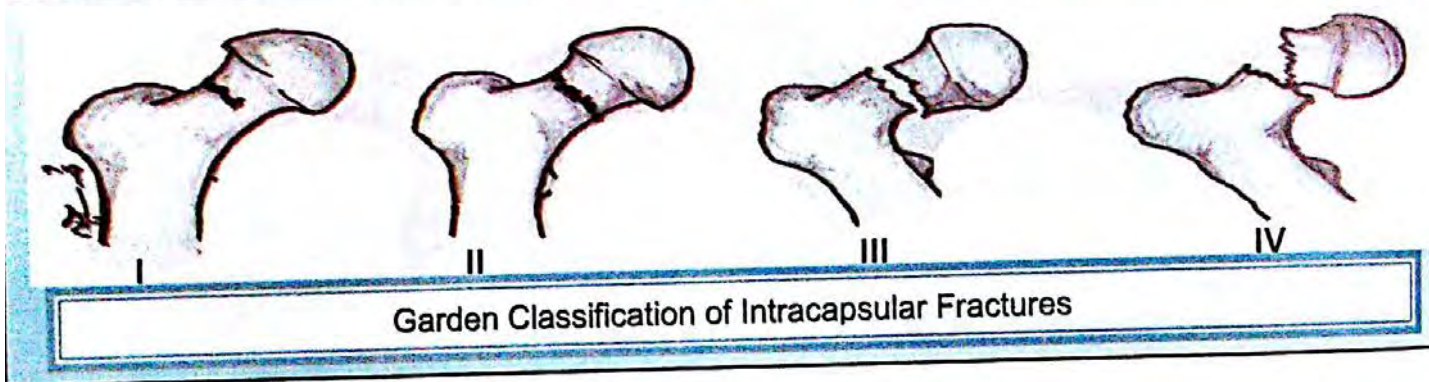
## Treatment

- If a part of poly-traumatized patient → ABCD then R&M.

- Treatment is usually operative because the proximal fragment can neither be properly manipulated nor immobilized by conservative means.
- Internal fixation also helps early mobilization of these elderly patients who are prone to the complications of prolonged recumbency.



Type I	Type II	Type III	Type IV
Incomplete fracture (abducted or impacted type)	Complete fracture without displacement or impacted.	Complete fracture with partial displacement. <i>dis impacted</i>	Complete fracture with full displacement.
Rest in bed.	No reduction is required. Internal fixation, preferably with 2 cannulated screws.	<div>Under 65 years old</div> <ul style="list-style-type: none"> <li>Closed reduction followed by internal fixation as above.</li> <li>If satisfactory closed reduction can't be obtained, open reduction should be performed.</li> </ul>	<div>Above 65 years old</div> <div>As Type IV</div> <div><i>Replacement by:</i></div> <div>1-Tompson</div> <div>2-Austinmoor</div> <div><i>نوع آخر</i></div>
			The treatment of choice is replacement of the head and neck of the femur with a metal prosthesis ( <b>hemiarthroplasty</b> ) because the incidence of non-union or avascular necrosis is high. <i>by</i>



## Postoperative

- In all cases, the patient should be ambulated once the general condition allows.



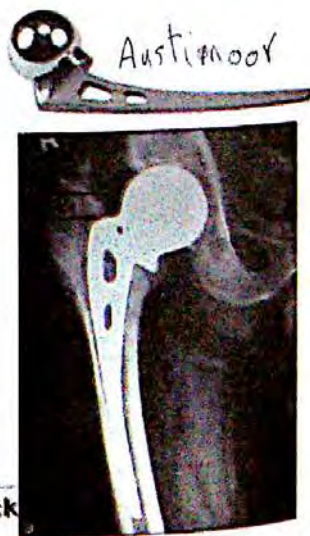
Inter-trochanteric fracture treated by internal fixation



Impacted femoral neck fracture treated by internal fixation with 3 parallel lag screws



displaced femoral neck fracture treated by femoral head replacement with a prosthetic device.





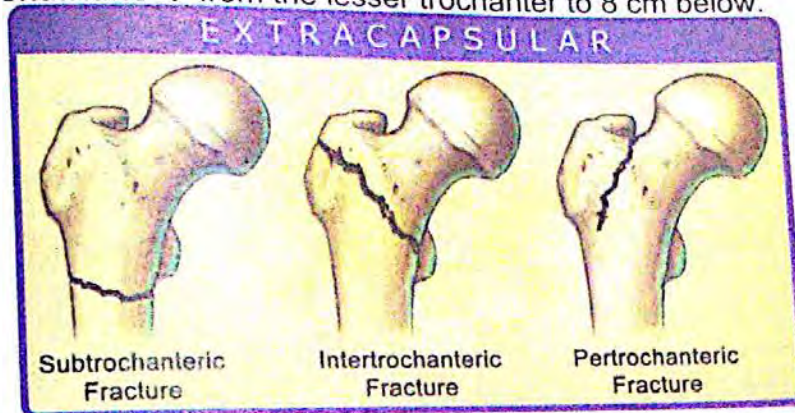
## 2) Extra-capsular Fracture of Neck Femur

### Site & Types

- Fractures extending from the base of the neck of the femur to 8 cm below the lesser trochanter.

#### They are divided into:

- 1) **Inter-trochanteric** → connects the 2 trochanters together.
- 2) **Per-trochanteric** → passing in the space between the 2 trochanters.
- 3) **Trochanteric** → fracture of greater or lesser trochanter.
- 4) **Subtrochanteric** → from the lesser trochanter to 8 cm below.



### Mechanism of injury and morbid anatomy

- In young persons trochanteric and subtrochanteric fractures are usually the result of major trauma. In the elderly trochanteric fractures may occur secondary to a fall on the side producing a blow over the greater trochanter.
- Extracapsular fractures differ from intracapsular ones in 2 aspects:
  1. The blood supply of the two fragments is good and so avascular necrosis and non-union do not occur.
  2. The operative treatment is not mandatory, as the proximal fragment can be controlled conservatively.



### Clinical features

- 1- External rotation and shortening of the limb.
- 2- Tenderness over the fracture site.
- 3- Inability of the patient to raise his leg.

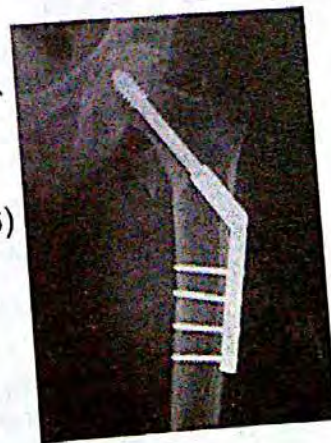
### Complications

- 1- Thromboembolism.
- 2- Malunion leading to shortening, adduction and external rotation.

*AVN may occur but not common*

### Treatment

- a) Trochanteric fractures:
  - In Elderly (most common): ORIF by a dynamic hip screw (DHS)
  - In young: treated by immobilization and traction to the limb.
- b) Subtrochanteric fractures are treated by internal fixation by plate and screws.







## Fracture Shaft Femur

## Trauma &amp; Incidence:

- Occur in children and adults.
- In young adults, usually due to severe violence and, therefore, associated injuries are common.

	Upper Third	Lower Two Thirds
Displacement	- Abduction by <u>Gluteal muscles</u> - Flexion by <u>Iliopsoas</u> - everted by the external rotators.	- Forward → by <u>quadriceps</u> .
Proximal fragment	- Adduction by <u>Adductors</u> - Up by → <u>Hamstrings, quadriceps</u> - everted by the weight of the limb.	- Backward → by <u>Hamstring</u> .
Distal fragment		

## Complications

## General

✓ Shock *hypovol. shock*

- Complications of prolonged recumbency e.g. bed sores.
- ✓ Fat embolism.

## Local

## 1) Vascular injury:

- Displaced fractures of the lower third may injure the femoral or popliteal vessels.

## 2) Nerve injury:

- The lateral popliteal nerve may be injured by the outer bar of a Thomas splint.

## 3) Non-union: is uncommon:

## ► Causes:

- a- Soft tissue interposition.
- b- Distraction.
- c- Infection.
- d- Insufficient immobilization.

► **Treatment:** by internal fixation and cancellous bone grafting.

## 4) Malunion:

- Includes shortening, varus and external rotation.

## 5) Knee stiffness:

- Is a serious complication especially after treatment by closed reduction & traction.

## 6) Muscles:

- Myositis ossificans. (especially vastus intermedius)
- Volkman's ischemic contracture.
- Tear.

C/P

General for shock

Local: --- + leg raise test

## Investigation

- X-ray: should be to rule out

## Treatment

## I) First Aid

## General →

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## Investigations

- **X-ray:**  
should be performed to the pelvis and knee to rule out associated injuries.

## Treatment

### I) First Aid

#### General → If poly-traumatized patient

##### C. Primary Survey

This includes a pre-hospital phase and a hospital phase

## ABCDE

##### D. Secondary Survey

- After establishment of the general condition of patient, 2<sup>nd</sup> survey has to be done.

## II) Treatment of Fracture (Limb Saving)

### A. General principles:

1. Proper alignment is important to avoid osteoarthritis of the knee joint.
2. Shortening more than 2 cm should not be allowed.

### B. Conservative treatment:

- Reduction and fixation by applying traction to the distal segment, and counter-traction to the proximal fragment,

#### • Done by two methods:

##### 1. Sliding traction:

→ Traction is applied to the distal fragment by weights and pulleys.

- The applied weight must be adjusted accurately to avoid distraction of the two fragments → delayed union.

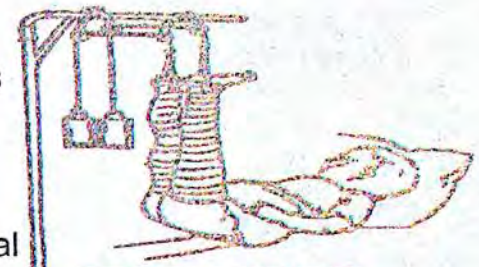
→ It is also done to treat femoral fractures in Children below 2 years by using **Gallows' splints**.

- Traction is just enough to raise the buttocks from bed.
- Child weight should be less than 12 Kg.

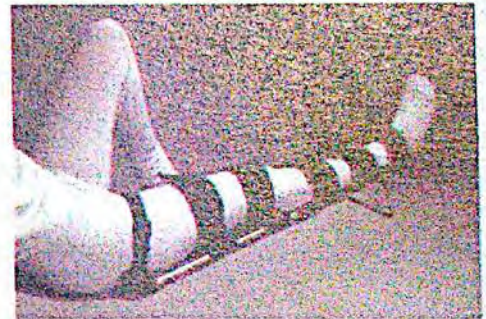
##### 2. Fixed traction by using a **Thomas splint**.

#### • Disadvantages of conservative treatment (traction):

1. Prolonged immobilization with all its side effects especially in elderly persons.
2. Liability to stiffness of the knee.
3. Reduction may be impossible if there is soft tissue interposition between the fragments.
4. Difficulty in adjusting ideal traction. Excess traction may lead to diatractation.
5. Lateral popliteal n. injury due its compression by Thomas splint.



Gallow's traction





**C. Operative treatment:**

- Avoids the disadvantages of conservative treatment.

- **Indications:**

1. Inability to perform closed reduction due to interposition of soft tissues.
2. Associated vascular injury.
3. Double-level fractures.

- **Methods of ORIF:**

1. Fractures of the proximal shaft → by plate and screws.
2. Fractures of the middle two quarters → by an intramedullary nail.



Plate &amp; screw



Interlocking

## Fracture Distal Femur

### 1) Supracondylar Fracture

#### Displacement

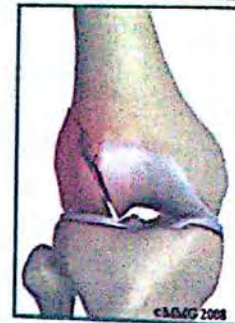
- Distal fragment is flexed by gastrocnemius muscle → posterior angulation (backward displacement).

#### Complications

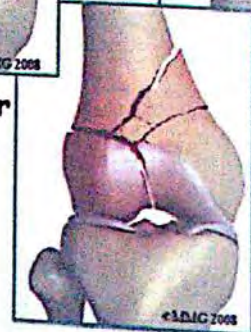
- Injury of the popliteal artery.

#### Treatment

- Very difficult to treat conservatively.
- by internal fixation of the fragments using plate and screws, followed by early mobilization of the knee.



Supracondylar fractures of the femur



#### N.B.: Supracondylar fractures:

- Of the femur may injure the popliteal artery.
- Of the humerus may injure the brachial artery.

### 2) Intracondylar Fracture

- These fractures take the shape of T or Y fractures.

#### Trauma

1. Indirect violence, e.g. A fall from a height → drive the tibia upwards into the intercondylar fossa.
2. Direct violence, e.g. a blow to the anterior aspect of the flexed knee → drives the patella backwards, splitting the two femoral condyles from the femoral shaft.

#### Treatment

##### ► Aim:

- Reconstruct the joint surface especially in young patients to avoid osteoarthritis of the knee.

##### ► Method:

- Open reduction and internal fixation by screws.



**Fracture-separation of lower femoral epiphysis**

In an adolescent, the lower femoral epiphysis may be displaced.

➤ **Complications:**

1. Injury of the popliteal artery.
2. Interference with growth from damage of the growth plate may occur.

➤ **Treatment:**

- The displacement is corrected under G.A. and the position is maintained in plaster of Paris for 6 weeks.

**Extensor apparatus injury****Definition**

- Fractures or injuries occurring while quadriceps femoris is contracting

**Elderly**

Above the patella

- Elderly & patients on long term corticosteroids.
- Rectus femoris rupture:
  - Mass in the thigh.
  - No TTT except in athletes → early suturing to maintain power.
- Avulsion of the quadriceps tendon from the upper pole of the patella:
  - operative repair is essential.

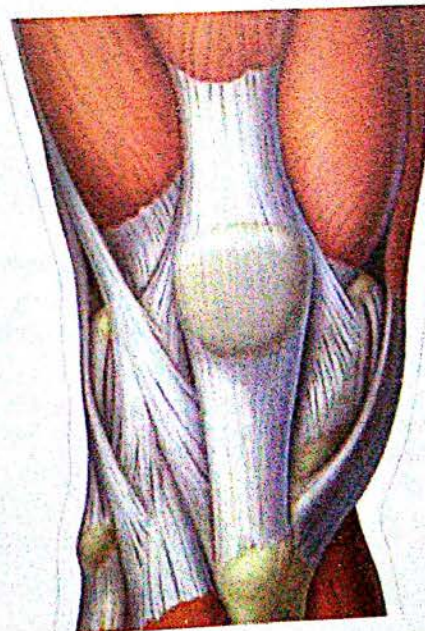
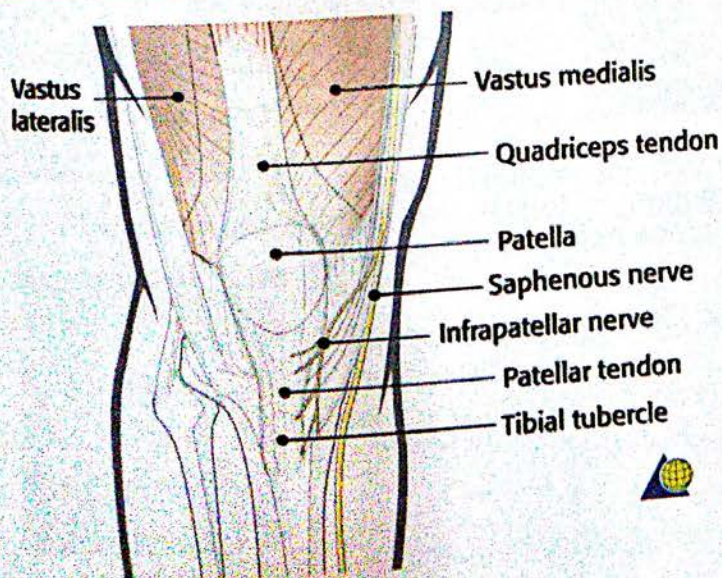
**Middle life**

Patellar fractures

**Young adults**

Rupture of patellar ligament

- Operative repair is necessary





# Fracture Patella

## Functions of Patella

- Extensor mechanism.
- Protection of femoral condyles.
- During movement, protect the tendons.

(So, try to conserve as far as possible)

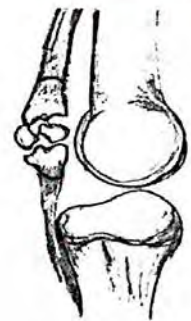
## Incidence

- Adults > children.

## Trauma

- Indirect trauma: forced flexion of the knee with contracted quadriceps muscle  
→ transverse fracture "either undisplaced or displaced"
- Direct trauma: trauma to the anterior aspect of the flexed knee  
→ comminuted fracture.

	Displaced Transverse fracture	Undisplaced Transverse fracture (Subperiosteal fracture)
<b>Trauma</b>	More severe trauma which destroys the patellar retinaculæ.	Less severe trauma Fracture is transverse with
<b>Bony fragments</b>	- Separated - The proximal segment of the patella is drawn upwards by the quadriceps muscle.	- Not separation. - They are held in position by the pre patellar expansion of the quadriceps tendon and patellar retinaculæ.
<b>Extensor mechanism</b>	Lost extensor mechanism, so no active extension.	Intact extensor mechanism, so intact active extension.
<b>Clinically</b>	a gap is palpable in the patella.	pain and tenderness at the site of the fracture.
<b>Treatment</b>	- ORIF by tension band wiring technique. - Early physiotherapy after the operation to prevent knee stiffness.	Immobilization of the knee in plaster for 6 weeks combined with quadriceps exercises.



- Comminuted fracture
  - **Partial fragmentation**: Treatment by partial patellectomy.
  - **Total fragmentation**: Treatment by total patellectomy & repair of the soft tissue component of the extensor apparatus.

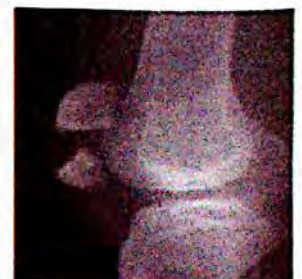
## Complications

1. Secondary osteoarthritis.

2. Chondromalacia patellae.

## Investigations

- **X-ray**: - Different types.  
- A-P view, lateral view, skying view.





# Injuries of the knee joint

## I- Meniscus tears

### Function of knee Menisci

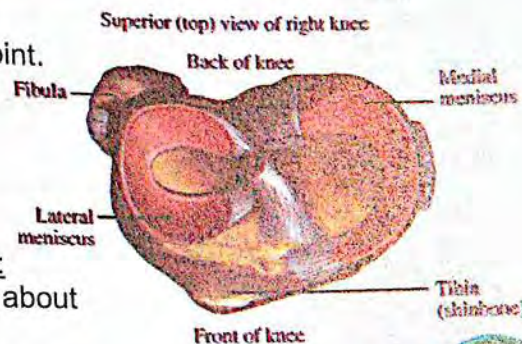
1. Increase stability of the knee.
2. Control complex rolling & gliding action of the joint.
3. Distribution load during movement.

### Trauma

- Twisting strain on flexed knee.

### Pathological Anatomy

- Meniscus injuries are **more common on the medial** than on the lateral side, because:
    - a- The medial compartment of the knee carries about 90% of the load during weight bearing.
    - b- The medial meniscus is much less mobile than the lateral, partially because of its attachment to the capsule.
  - The tear is usually **longitudinal (bucket-handle tear)**.
  - may be transverse (parrot-beak tear).
- A meniscus is avascular and a tear does not heal unless it is peripheral (outer third) which is vascularized from the capsule.



### Clinical picture

#### Symptoms

- History of knee injury.
- Can't resume game but can walk to home with a limp.
- Complain of locking of the knee joint with recurrent effusion.

#### Signs

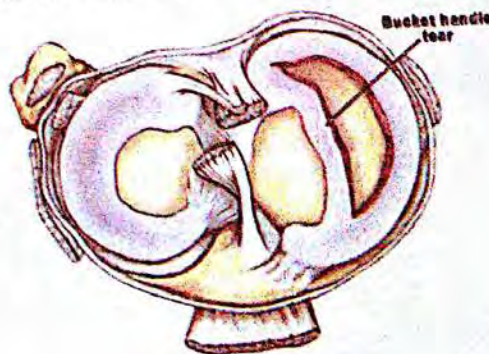
- Knee effusion
- Incomplete knee extension when it's locked
- Tenderness on joint line medially
- atrophy of quadriceps in chronic patient
- +ve McMurray's sign**  
Click is elicited when the knee is rotated in certain degree of flexion

### Investigation

- Plain X-ray.
- MRI "**most reliable**":  
→ may even reveal tears that are missed by arthroscopy.
- Arthroscopy (**diagnostic & therapeutic**)

### Treatment

- Conservative:** If there is no lock knee
  - Rest, ice, compression, elevation, NSAID.
  - The joint is held straight in a posterior slab for 3-4 weeks with quadriceps exercise.
- Operative:**
  - Indication:**
    - Joint can't be unlocked
    - Recurrent





- **Operation:** Meniscectomy (open or arthroscopic):  
→ The damaged part of the meniscus and loose fragments are removed.
- **Postoperative:** quadriceps strengthening exercise.

## II- Knee ligament injuries

- Two types of injuries : Cruciate & collateral ligament

### Injuries of cruciate ligament

ACL prevent sliding of the tibia forward while PCL prevent the opposite movement

#### Trauma

- ACL → Sudden twist movement (more commonly injured).
- PCL → Blow in front of the knee (usually cause ligament sprains rather than injury because the ligament was pulled or stretched too far).

#### Clinical picture

##### Symptoms

- May not cause pain
- The person may hear a popping sound.
- Leg may collapse on standing as there is instability (ACL injuries produce more instability).

##### Signs

- Swelling & tenderness
- Abnormal joint mobility:
  - a- With ACL tears: the tibia can be made to glide excessively in an anterior direction in relation to the femur.
  - b- With PCL tear: the tibia can be made to glide excessively in a posterior direction in relation to the femur.

#### Investigation

- Plain X-ray
- MRI
- Arthroscopy

#### Treatment

##### Conservative:

As meniscus injury

##### Surgery:

- When conservative treatment fails, particularly in athletes who require full joint function.
- Reconstruction surgery for the ACL by a segment of another larger ligament "Patellar ligament" to replace the torn ACL.
- Postoperative physiotherapy is essential



### Injury of collateral ligament

- Due to excessive valgus or varus movement
- MRI is Diagnostic
- Treatment mainly conservative as Meniscal injury

### Osgood - Schlatter disease (tibial tubercle epiphyseal traction injury):

- It is irritation of patellar ligament by tibial tuberosity

#### Site & f

- Bot
- Fra

#### Trauma

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#### Signs

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#### Comp

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#### Inves

#### Treat

- a) AB
- b) Tre

1.

2.

3.

4.

c) TT



# Fracture Leg Bones

## Site & incidence

- Both bones are fractured; rarely the tibia or fibula may be fractured alone
- Fracture is commonly open due to subcutaneous position of the tibia.

## Trauma

- Direct** e.g. road traffic injury:  
→ fractures occur at the same level in the two bones and are transverse or oblique.
- Indirect** e.g. twisting movement (torsion or bending injury).

## Displacement

- To any direction according to the direction & severity of trauma.

## Clinical Picture

### Symptoms

- History of trauma.
- Pain.
- Inability to move the affected limb or to bear weight on it.
- Swelling.

### Signs

- Inspection:** ecchymosis, bruises and swelling.
- Palpation:** tenderness, crepitus.
- Movement:** abnormal range of mobility.
- Neuro-vascular evaluation:** tibial nerves & vessels.

## Complications Scheme +

- ✓ **Compartment syndrome.**
- Skin damage:** Early closure by skin flaps is vital for healing of the fracture and for prevention of infection.
- Delayed and non-union:** occur in up to 20% of fractures of the tibial shaft.

## Investigation X-ray

## Treatment

a) ABCD then R&M for poly-traumatized patient.

b) Treatment of fracture according to type:

1. Closed reduction and plaster fixation:

- In patients under the age of 16.
- In older patients when stable reduction can be obtained.

2. Skeletal traction:

- If stable reduction cannot be maintained by plaster alone.

3. External skeletal fixation:

- For compound fractures of the tibia, as it:
  - allows proper reduction, leaves the wound exposed for dressings, skin grafts or plastic flaps if needed.

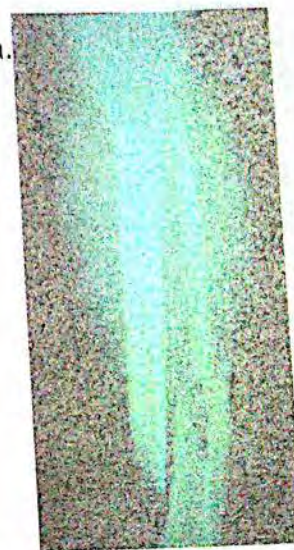
4. Internal fixation with a compression plate or an intramedullary nail:

- In multiple fractures.
- When reduction cannot be obtained by closed methods.

c) **TTT of complications:** e.g. compartment \$ → decompression (fasciotomy).

### Isolated fractures of the tibia

- Usually due to torsion leading to a spiral fracture with slight displacement.
- Treatment is usually conservative by an above-knee plaster cast.





# Ankle fractures

## Fracture & fracture dislocation of the ankle

### Anatomy

- The ankle joint is between fibula, tibia & talus;
- Supported by a complex ligamentous system (e.g. deltoid ligament).

### Definition

- Fracture lower end of tibia & fibula **involving** the ankle joint.
- Most ankle fractures are produced by abnormal motion of the talus,
- Compression produces oblique fractures, and avulsion produces horizontal fractures

### Pott's Classification

- Unimalleolar → only one malleolus.
- Bimalleolar → medial & lateral malleoli.
- Trimalleolar → medial, lateral & posterior malleoli.

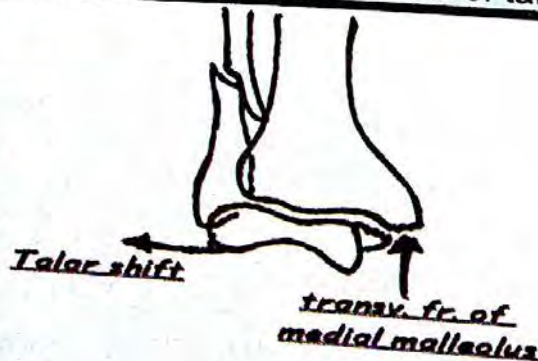
The tarsal bone that is most prone to avascular necrosis is talus that is because there are no muscles nor tendons associated with this bone making its blood supply in somehow low.

### Trauma

- Forcible eversion or inversion.
- Axial loading (falling from a height).
- Forcible rotation.

### Types

	External rotation Fracture (Pott's fracture) (Most common)	Internal rotation Fracture (rare)
Trauma	Forcible external rotation.	Forcible internal rotation.
1 <sup>st</sup> deg.	Oblique fracture of <u>lateral</u> malleolus. No displacement	Oblique fracture of <u>medial</u> malleolus. No displacement
2 <sup>nd</sup> deg.	1 <sup>st</sup> + rupture of deltoid ligament or <u>transverse</u> avulsion fracture of <u>medial</u> malleolus + <u>lateral</u> displacement of talus	1 <sup>st</sup> + rupture of deltoid ligament or <u>transverse</u> avulsion fracture of <u>lateral</u> malleolus + <u>medial</u> displacement of talus
3 <sup>rd</sup> deg.	2 <sup>nd</sup> + fracture posterior margin of tibia + posterolateral displacement of talus	2 <sup>nd</sup> + fracture posterior margin of tibia + posteromedial displacement of talus





Abduction (eversion) fracture		Adduction (inversion) fracture	
Trauma	Fall on everted foot.	Fall on inverted foot	
	<b>1<sup>st</sup> deg</b> Transverse avulsion fracture of <b>medial</b> malleolus No displacement		<b>1<sup>st</sup> deg</b> Transverse avulsion fracture of <b>lateral</b> malleolus No displacement
	<b>2<sup>nd</sup> deg</b> 1 <sup>st</sup> + <b>oblique</b> fracture of <b>lateral</b> malleolus + lateral displacement of talus.		<b>2<sup>nd</sup> deg</b> 1 <sup>st</sup> + <b>vertical</b> fracture of <b>medial</b> malleolus + medial displacement of talus.
<b>3<sup>rd</sup> deg</b>	2 <sup>nd</sup> + fracture posterior margin of tibia + posterolateral displacement of talus		2 <sup>nd</sup> + fracture posterior margin of tibia + posteromedial displacement of talus



1<sup>st</sup> degree



2<sup>nd</sup> degree

Pott's fracture in abduction



1<sup>st</sup> degree



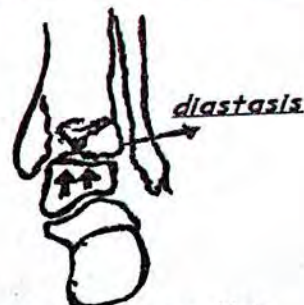
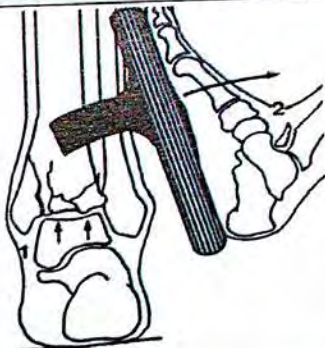
2<sup>nd</sup> degree

Pott's fracture in adduction

Vertical compression fracture		
Posterior marginal fracture of the Tibia	Anterior marginal fracture of the Tibia	Burst fracture of the ankle
Fall on planter flexed foot	Fall on dorsi-flexed foot	Fall on plantigrade foot
Fracture posterior margin of Tibia & posterior dislocation of the ankle.	Fracture anterior margin of tibial articular surface & anterior subluxation of the ankle.	Diastasis of the inferior tibio-fibular joint &/or central dislocation of talus & comminution of tibial surface.



Planter flexion



Vertical impaction

## Clinical Picture

### Symptoms

- History of trauma.
- Pain & discomfort around the ankle.
- Swelling is usually severe.
- Inability to bear weight on the affected limb.

### Signs

- Variable deformity & tenderness.
- Neuro vascular: tibial nerve & vessels.





## Complications

- Malunion
- Non-union.
  - Occasionally occurs in fractures of medial malleolus, due to infolding of periosteum producing soft tissue interposition.
  - so this fracture is always best treated by ORIF.
- Joint complications:
  - a- Secondary degenerative osteoarthritis.
  - b- Ankle stiffness.
- Sudeck's osteodystrophy.
- Neurovascular: tibial nerve & vessels.
- Tendon injury.

## Investigation

- **X-ray:**
  - Stress X-rays: are very important to determine ligamentous tears.

## Treatment

### First Aid

- If poly-traumatized patient → ABCD + R & M.

### Emergency Treatment

- Trial of reduction for displaced fracture (1<sup>st</sup> step).
- Open wounds & abrasions should be cleaned.

### Definitive treatment

- ➔ **Aim:** to restore
  1. The anatomical position of the talus.
  2. The joint parallel to the ground.
  3. The smooth articular surface.
  4. Stability until the fracture unites by plaster cast or ORIF.
- **Stable fracture** e.g. "Unimalleolar" → Below knee plaster cast for 6 weeks
- **Unstable fracture** e.g. "bi & trimalleolar" → ORIF of fractured malleoli by screw.
- **comminuted** → arthrodesis
- **compound fracture** → external skeletal fixation.

### Treatment of complications

E.g. sudeck's atrophy → sympathectomy.





## Points to remember (lower limb)

### Fracture Pelvis

- ▶ **Class.:** type A, B (stability of pelvic ring), type C.
- ▶ **C/P:** as scheme + no urine + shorter limb ± visceral injury.
- ▶ **Comp.:** as scheme + shock, sciatic n. injury, DVT, visceral injury, osteoarthritis.
- ▶ **Invest.:** X-ray, CT, U/S
- ▶ **TTT:** as trauma + (associated injuries more imp.)
  - stable pelvic ring → bed rest and analgesics.
  - Not stable → external fixation or ORIF.

### Posterior Hip Dislocation

- ▶ **Etiology:** forced flexion + adduction + int. rotation
- ▶ **C/P:** as scheme + supratrochanteric shortening + Narthe's sign.
- ▶ **Comp.:** as scheme + avascular necrosis of femoral head + sciatic n. injury + associated fracture acetabulum.
- ▶ **Invest.:** X-ray (Interrupted Shenton's line), CT.
- ▶ **TTT:** reduction & fixation:
  - closed (Allis method) or open.

### Intra-capsular Fracture Neck Femur

- ▶ **Etiology:** old ♀, when foot catches a carpet.
- ▶ **C/P:** - Impacted: only tenderness (missed).
  - Unimpacted: as scheme + ext. rotation, adduction, short limb, -ve leg raising test.
- ▶ **Comp.:** - general (prolonged recumbency).
  - local (avascular necrosis, sciatic n. injury).
- ▶ **Invest.:** X-ray.
- ▶ **TTT:** as trauma + (Garden classification)
  - Type I: rest in bed.
  - Type II (Impacted): internal fixation.
  - Type III:
    - < 65 y.: closed reduction + int. fixation or ORIF.
    - > 65 y. or Type IV: hemiarthroplasty.

### Extra-capsular Fracture Neck Femur

- ▶ From the base of the neck to 8 cm below the lesser trochanter.
- ▶ **C/P:** as scheme + ext. rotation, short limb, patient can't raise his leg.
- ▶ **Comp.:** thromboembolism, malunion.
- ▶ **TTT:** - Trochanteric:
  - a- Elderly → ORIF by DHS.
  - b- young → immobilization and traction.
- Subtrochanteric: I.F. (plate & screws).

### Fracture shaft Femur

- ▶ **C/P:** as scheme + subtrochanteric shortening
- ▶ **Comp.:** as scheme + shock, injury of (femoral a., popliteal a. & n.), knee stiffness\*.
- ▶ **Invest.:** X-ray.
- ▶ **TTT:** as trauma + A) Conservative:
  - 1- Sliding traction (Gallows' splint in children < 2y.)
  - 2- Fixed traction by using a Thomas splint.
- B) Operative: plate & screws, intramedullary nail.

### Fracture Distal Femur

- ▶ **Supracondylar fracture:**
  - Distal fragment is flexed by gastrocnemius ms.
  - **Comp.:** Injury of the popliteal artery.
  - **TTT:** By internal fixation using plates & screws.
- ▶ **Intracondylar fracture:**
  - **Trauma:** indirect, direct.
  - Take the shape of T or Y fractures.
  - **TTT:** ORIF by screws.

### Fracture Patella

- ▶ **Trauma:** indirect: transverse. / direct: comminuted.
- | <u>Displaced</u>   | <u>Undisplaced</u>   |
|--|--|
| <ul style="list-style-type: none"> <li>▶ <b>C/P:</b> <ul style="list-style-type: none"> <li>- bony fragments: -separated</li> <li>- extension: -Lost</li> </ul> </li> <li>▶ <b>TTT:</b> -ORIF</li> <li>- <u>Comminuted:</u> patellectomy (partial, total).</li> <li>▶ <b>Comp.:</b> osteoarthritis &amp; Chondromalacia patellae.</li> <li>▶ <b>Invest.:</b> X-ray.</li> </ul> | <ul style="list-style-type: none"> <li>- Not separated.</li> <li>- Intact.</li> <li>- plaster cast.</li> </ul> |

### Injuries of Knee Joint

- ▶ **Meniscus tears:**
  - **Trauma:** Twisting strain on flexed knee.
  - More common on the medial than the lateral side.
  - Usually longitudinal tear (bucket-handle tear).
  - **C/P:** locked knee, incomplete extension, tenderness, +ve McMurray's sign.
  - **Invest.:** X-ray, MRI\*, arthroscopy.
  - **TTT:** - Conservative: rest, ice, elevate., NSAID.
  - Operative: Meniscectomy (open or arthroscopic)
- ▶ **Cruciate ligament injury:**
  - **Trauma:** -sudden twist → ACL (commonest).
    - Blow in front of the knee → PCL.
  - **C/P:** collapse on standing, abnormal joint mobility
  - **Invest.:** X-ray, MRI\*, arthroscopy.
  - **TTT:** - Conservative: as meniscus injury.
  - Operative: Reconstruction using patellar lig.



### Fracture Leg Bones

- ▶ **Etiology:** direct, indirect trauma.
- ▶ **C/P:** as scheme + inability to move the limb.
- ▶ **Comp.:** as scheme + compartment \$.
- ▶ **Invest.:** X-ray
- ▶ **TTT:** as trauma +
  - Closed reduction and plaster fixation.
  - Skeletal traction: failed closed reduction.
  - Open fracture: ext. skeletal fixation.
  - ORIF: multiple fractures, failed closed.

### Ankle Fractures

- ▶ **Etiology:** forcible (eversion, inversion, ext. rotation "Pott's", int. rotation), axial loading.
- ▶ **C/P:** as scheme + inj. of Tibial nerves & vessels.
- ▶ **Comp.:** as scheme + Sudeck's osteodystrophy, non union (with medial malleolus fr.).
- ▶ **Invest.:** stress X-ray.
- ▶ **TTT:** as trauma +
  - Unimalleolar: below knee cast
  - Bi/Trimalleolar: ORIF.
  - Comminuted: arthrodesis.
  - Compound: ext. skeletal fixation.



# Bone Inflammation

## Classification

### Acute

- Acute Haematogenous Osteomyelitis.
- Acute Osteomyelitis secondary to open fracture.
- Acute Osteomyelitis in associated with orthopedic implants.

### Chronic

- **Non specific:**
  - Chronic osteomyelitis as a sequel to acute osteomyelitis
  - Chronic septic osteomyelitis.
  - Brodie's abscess.
  - Chronic sclerosing osteomyelitis (Garre's type).
- **Specific:** - TB. - Syphilis. - Mycotic infection.

## Acute Hematogenous Osteomyelitis

### Definition

- Acute non specific inflammation of cancellous tissue of bone & its medullary cavity.

### Incidence

- **More common in child male with low standard due to:**
  - Hyperkinetic → repeated trauma.
  - Active bone with rich blood supply at metaphysis.
  - Septic foci are common.
- It may even affect the neonates, particularly premature babies.
- There is no acute hematogenous osteomyelitis in adults but it is 2ry due to operation, open fracture or activation of latent focus.

### Etiology

### Organism

- **Gm +ve:**
  - Staph. aureus (The commonest 80%) → all age groups.
  - Strept. pyogenes, pneumoniae.
  - GBS → newborn.
- **Gm -ve:**
  - E.coli → new born.
  - Salmonella (in sickle cell anemia or after splenectomy).
  - H. influenza (common < 4 years of age).
- **Mixed.**

### Route of Infection

- **Hematogenous:** from septic focus (the commonest).

### Predisposing Factors

- **General**
  - Low immunity.
  - Specific fever in children.
- **Local**
  - Trauma → hematoma formation.
  - Over exertion → epiphyseal strain.
  - Endarteritis → myxomatous degeneration.

- Over fatigue in old age.
- Bad hygiene.



Osteomyelitis



## Pathology

## Site

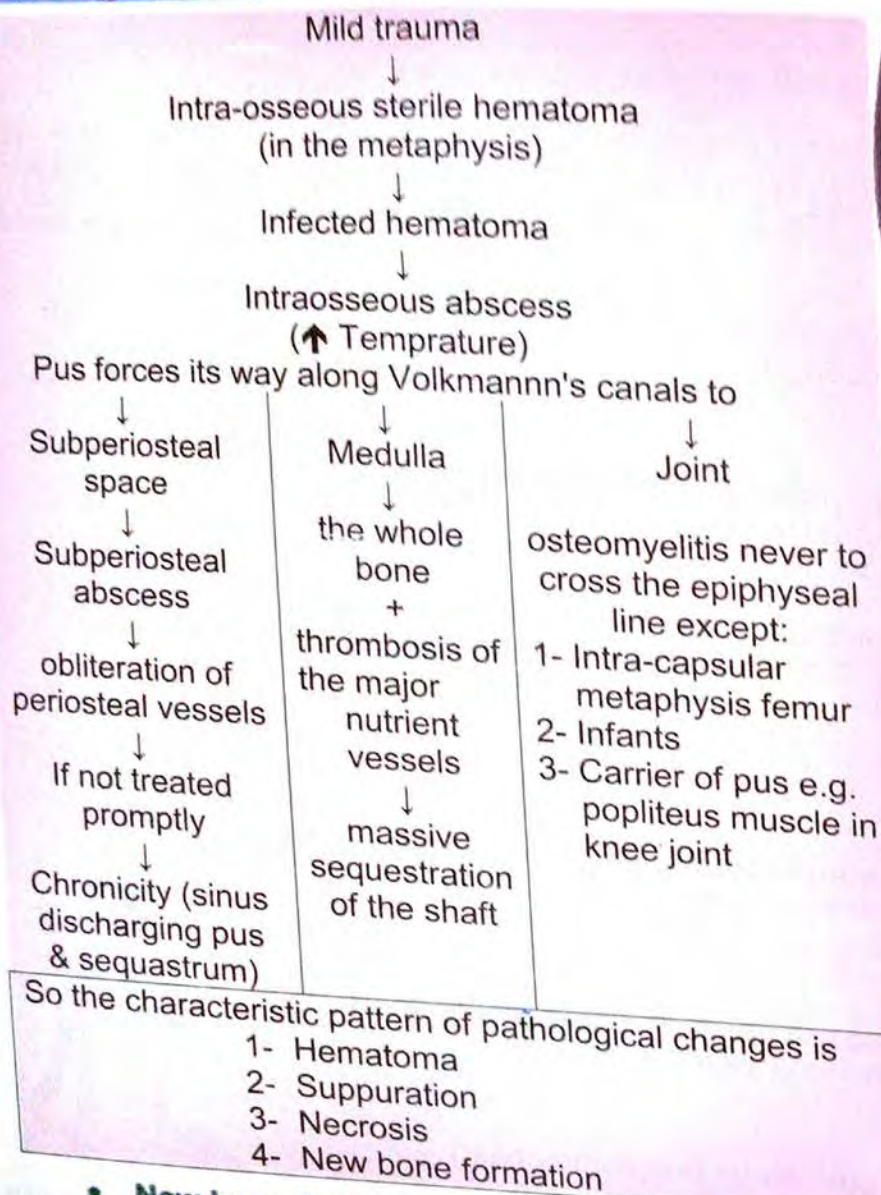
▪ **Metaphysis**

- Most common in the metaphysis of long bone.
- Commonly upper end of tibia, lower end of femur (around knee) & upper end of femur.

▪ **Due to**

- The metaphysis is supplied by end arteries in children.
- The metaphysis is the part most liable to trauma.
- It is the actively growing end of bone.
- Attachment of the ligaments and muscles to the metaphysis makes it subjected to strain.

## Pathogenesis



Pathogenesis of Acute Haematogenous Osteomyelitis

• **New bone formation forms in two sites:**

**A. The deep layers of the stripped periosteum** by the end of the 2<sup>nd</sup> week.

With time the new bone thickens to form an involucrum enclosing the infected tissues and sequestra. If the infection persists, pus may continue to discharge through perforations (cloaca) in the involucrum and track by sinuses to the skin surface; the condition is now established as chronic osteomyelitis.

**B. Around the Haversian canals** resulting in bony sclerosis.



### Resolution:

- a- The bone around the zone of infection is at first osteoporotic (probably due to hyperaemia).
- b- With healing there is fibrosis and oppositional new bone formation, together with the periosteal reaction, results in sclerosis and thickening of the bone.
- c- Remodeling may restore the normal contours.
- d- In others although healing is intact, the bone is left permanently deformed.  
→ Chronic osteomyelitis is rare nowadays due to the use of antibiotics and early release of increased intraosseous pressure.

### Clinical Picture

#### Type of Patient

- Usually ♂ child (may be with history of trauma).
- History of septic focus e.g. sore throat – otitis media.

#### Symptoms

- General
  - Very bad general condition (fever, pallor & sweating).
- Local
  - Severe pain (of sudden onset).
  - Swelling.
  - The parents noticed that child fears to use the limb (Pseudoparalysis)



Acute Haematogenous Osteomyelitis

#### Signs

- General: High grade fever – tachycardia.
- Local:
  - Inspection: redness & edema over the skin.
  - Palpation
    - a) Localized tenderness over the bone (The earliest sign).
    - b) Sympathetic effusion of the adjacent joint.
  - Movement: restricted joint movement (but it can be moved passively with gentleness unlike septic arthritis).

#### Complications

- General:
  - a) Toxemia.
  - b) Septicemia & pyemia (Metastatic infection) → if immunocompromised.
- Local:
  - Chronic osteomyelitis.
    - Mild pain & low grade fever (more at night) with loss of weight.
    - Tenderness & thickness of bone with multiple sinuses.
  - Spread: suppurative arthritis (only if metaphysis is intra-capsular e.g. Hip joint).
  - Disturbed bone growth (deformity and/or shortening).
  - Pathological fractures.

#### DD

- 1- Ewing's sarcoma.
- 2- Cellulitis (in osteomyelitis, tenderness is elicited along the bone away from redness).
- 3- Septic arthritis → all movement are **limited** (passive & active).
- 4- Rheumatic arthritis → **fleeting** in character.
- 5- Haemarthrosis.



## Investigations

- **Laboratory:**
  - 1- CBC:  $\uparrow$ TLC &  $\uparrow$ ESR.
  - 2- Blood culture (at time of fever).
  - 3- The **most certain** is to aspirate pus from metaphysis + C&S.
- **Radiological :**
  1. U/S  $\rightarrow$  Subperiosteal abscess + Joint effusion + **U/S guided aspiration**
  2. MRI (investigation of choice )  $\rightarrow$  Contraindicated if metal implant
  3. CT scan (when M.R.I. is contraindicated )
  4. Radioscintigraphy with  **$^{99m}\text{Tc-HDP}$**  (hydroxymethylene diphosphate)  $\rightarrow$  reveals increased activity in the very early stage, but it has relatively low specificity.
  5. X-Ray
    - 1<sup>st</sup> 2 weeks  $\rightarrow$  -ve
    - End of 2<sup>nd</sup> wk  $\rightarrow$  faint extra-cortical outline (periosteal new bone formation).
    - After 3 weeks (**chronic**)  $\rightarrow$  sequestrum – cloaca – involucrum.
    - Exclude Ewing's sarcoma.



## Treatment

(Start immediately once suspected)

### General

- Hospitalization, bed rest .
- **Immobilization:** Splinting of the affected part, continued until the inflammation subsides and the X-ray shows that there is no risk of a pathological fracture.
- (Full weight bearing is usually possible after 3-4 weeks).

### Medical

- Analgesic.
- Antipyretics + fluids.
- **Antibiotics: It is the core of treatment.**
  - Delayed for few hours to obtain a valuable blood culture and/or U/S guided aspiration.
  - Early administration of high dose empiric broad-spectrum antibiotics (flucloxacillin, augmentin or vancomycin) + gentamycin for gram -ve organisms then specific antibiotic according to culture and sensitivity.
  - If the patient is sensitive to flucloxacillin  $\rightarrow$  fusidic acid or a course of second generation cephalosporin and gentamycin can be used.
  - Parenterally for 1-2 wks then Oral for 4-6 weeks (minimum duration 6 weeks)

### Surgical (better)

- **Indications:**
  1. Obvious collection of pus which must be drained.
  2. If no improvement on antibiotics within 48 hours (from onset of fever) (we have to interfere before chronicity = subperiosteal elevation)
  3. If the patient is first seen after 48 hours.
- **Procedure:**
  - $\rightarrow$  Under general anaesthesia and under a tourniquet.
  - $\rightarrow$  Drainage of subperiosteal abscess + drill holes in the cortex (6-8 holes)



# Chronic Non-specific Osteomyelitis

## Etiology

## Organism

- Usually mixed infection.
- In the presence of implant the usual organism is staph. epidermidis. .

## Route of Infection

- Follows an open fracture.
- Follows an operation.
- Blood spread

## Predisposing Factors

- Bone cavity surrounded by dense sclerosis.
- Sequestrum, which acts as an irritant and harbours bacteria.
- Bacteria are imposed in the fibrous tissue where they remain dormant, and may be activated at any time.
- Sinuses, which lead to skin surface favouring 2ry infection.

## Pathology

- Cavities containing pus & sequestrum (dead bone).
- Multiple sinuses burst through the skin.
- Involucrum (new bone formation).
- Cloaca = perforation in the involucrum.
- Pathological fracture.

## Clinical Picture

## Symptoms

- History of acute osteomyelitis.
- Pyrexia.
- Pain at rest (especially at night).
- Discharging sinus.

## Signs

- **General:**
  - Chronic toxemia (mild).
- **Local:**
  - **Inspection:**
    - Skin → multiple discharging sinuses lined by red granulation tissues discharging pus and sequestra (the commonest presentation).
    - Muscles → There may be atrophy of the surrounding muscles.
  - **Palpation:**
    - bone → tender + thickened.
    - When the sinus is probed, the probe will reach the bone.

## Complications

- Acute exacerbation.
- Pathological fractures.
- Arrested growth and deformity (when the epiphyseal cartilage is destroyed by the disease).
- Toxemia.
- Amyloidosis.(rare)



Chronic Hematogenous Osteomyelitis



Chronic osteomyelitis showing sequestrum of the tibia



**Investigations****Laboratory**

- ↑ ESR & ↑ TLC during flares.
- Culture & sensitivity of discharge from sinus (often misleading), or better from abnormal bone.

**Radiology**

- **X-ray:** The most important investigation
  1. Sequestrum: (dense white loose fragments with irregular but sharply demarcated edges).
  2. Involucrum.
  3. Osteoporotic area.
  4. Periosteal thickening & elevation.
- **Radioisotope scan:** (using labelled leukocytes) → It shows hidden foci of infection.
- **CT scan & MRI:** (valuable in planning operative treatment)  
→ show the extent of bone destruction and reactive oedema, hidden abscesses and sequestra.

**Treatment (Surgery is the main line of treatment)**

→ Antibiotics alone are of little value because they cannot reach the bacteria hidden in avascular tissue and sequestra.

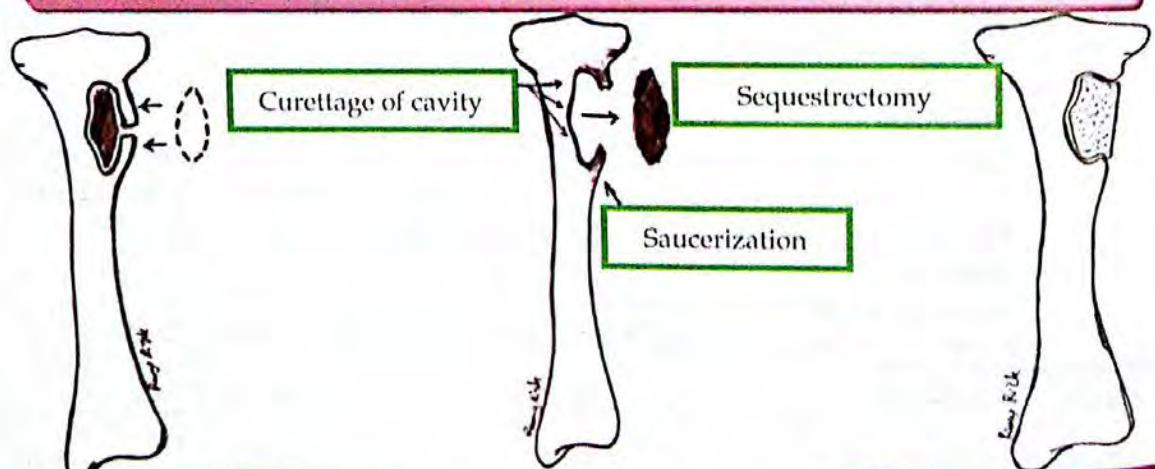
- **Prophylactic** → proper treatment of acute osteomyelitis (see before)
- **Curative :**
  - A. Elderly patients with severe infection and multiple co-morbidities:  
→ Amputation or prolonged suppressive antibiotic therapy.
  - B. Suitable patients:  
→ Surgery to arrest infection:

**Saucerization + Sequestrectomy + Sinusectomy + Bone graft**

## o Postoperative:

- I.V. antibiotics for 4-6 weeks with oral suppression for a further 6 weeks or until union have been achieved.
- Support of the limb to avoid pathological fractures until healthy strong bone regenerates.

Later on, filling the cavity with muscles pedicle or cancellous bone graft.





# Brodie's Abscess

## Definition

- Chronic abscess (chronic osteomyelitis): insidious onset, near the end of long bone.

## Incidence:

- commonly affects adolescents and sometimes adults.

## Organism

- Staph. aureus + high resistance of patient.
- Staph. albus + low resistance of patient.

## Pathology

### Site

- It consists of an abscess at the end of long bone (at upper end of tibia, lower end of femur & upper end of humerus).
- Usually located in the centre of metaphysis.

## Macroscopic

- Pus is often sterile on culture & apple jelly in appearance.
- The wall consists of granulation tissue or fibrous tissue & the surrounding bone is often sclerosed.

## Clinical Picture

- **Intermittent pain** near end of long bone especially after effort & at night.
- localized swelling and tenderness over the bone.
- The joint may contain **sympathetic effusion**.
- The **overlying skin** becomes congested & edematous.

## X-ray

- Abscess cavity:  
= translucent area surrounded by bone sclerosis.

## Treatment

- Under antibiotic coverage.
- Excision is very often required.
- Saucerization & grafting by cancellous bone chips if the cavity is not small.





# Acute Pyogenic Arthritis

## Incidence

- Like osteomyelitis is common in children.

## Etiology

## Organism

- The usual organism is *Staphylococcus aureus*.
- In children below 3 years of age, it is mainly due to *Hemophilus influenza*.

## Route of Infection

- Hematogenous.
- Direct through:** Penetrating wound or arthroscopy (iatrogenic).
- Adjacent acute osteomyelitis** (in some conditions → if intra-capsular metaphysis).

## Pathology

- Septic arthritis is commonly occurring in the knee and the hip joints, yet any joint may be infected.
  - The organisms first settle in the synovial membrane (synovitis), which becomes red, swollen and exudes pus.
  - The production of chondrolytic enzymes by the infecting organism results in articular cartilage destruction with exposure of the bone ends.
  - Pus may burst out of the joint to form abscesses and sinuses.
  - Later with healing, the raw articular surfaces may adhere, producing fibrous or bony ankylosis.

### N.B.:

- Recovery of joint mobility can be achieved if treatment begins early at the stage of synovitis before damage of the articular cartilage. Therefore septic arthritis is considered a surgical emergency.

## Clinical Picture

### Symptoms

- General:** F A H M.
- Local:**
  - Pain** (night and rest pain are characteristic): severe, sudden, throbbing (later on).
  - Swelling at the joint area.
  - Inability to move the joint.

### Signs

- General:** Fever & tachycardia.
- Local:**
  - Inspection:**
    - Redness, swelling and discharging sinus (if neglected).
    - Muscle spasm keeps the joint in the position of greatest ease (Rest).
    - Deformity (late)
  - Palpation:**
    - Hotness and tenderness.
  - Movement:**
    - Complete loss of all movements** (active & passive).



## Complications

- Secondary osteoarthritis.
- Pathological dislocation.
- Growth disturbance.
- Chronicity → Bony ankylosis.
- Toxemia, septicemia & pyemia.

## Investigations

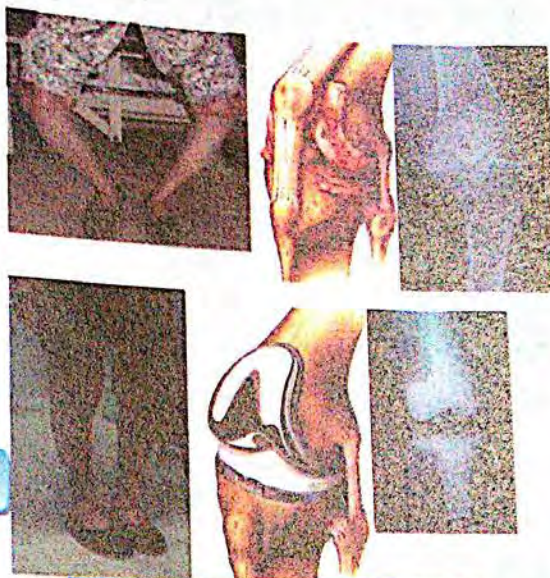
### Laboratory

- ↑ TLC. ↑ ESR and CRP +ve.
- Joint aspiration +/- U/S guidance :
  - Diagnostic:
    - Shows fluid rich in pus cells  
→ Confirm the diagnosis.
    - Culture & sensitivity.
  - Therapeutic.

After aspiration, the joint should be splinted.

### Radiology

- **X-ray:**
  - Early (first 2-3 weeks) → No abnormalities detected.
  - Later → rarefaction of the articular ends followed by narrowing of joint space, irregularity of joint surfaces and subchondral sclerosis.



Clinical Picture, X-ray & Treatment of Arthritis

## DD

- Haemarthrosis: (History of trauma, aspiration reveals blood).
- Acute osteomyelitis: (passive movement is preserved)
- Gout.
- Rheumatic fever: (Polyarticular, fleeting, less severe general manifestations, relieved by salicylates).
- Tuberculous arthritis: (insidious onset, chronic, a cold abscess may be Present, muscle atrophy is marked, X-ray shows rarefaction of bone ends).

## Treatment

### General

- Bed rest.
- Immobilization: (splinting until inflammation subsides → Later gradual physiotherapy starts).
- Antibiotics.
- Analgesics + fluids.
- Antipyretics.

### Specific It is a surgical emergency

- **Washout of the infected joint:**
  - In knee, ankle and shoulder joints → arthroscopic washout or open arthrotomy + washout
  - In hip joint sepsis → only open arthrotomy.
- **If eroded cartilage** → arthrotomy then traction for weeks.
- **If completely separated cartilage** → arthrodesis.



# Tuberculosis of bones

## Pathology

- ▣ Tuberculous osteomyelitis is always secondary.
- ▣ Route: haematogenous from primary focus elsewhere in the body.

## Common sites

- ▣ The commonest site of TB osteomyelitis is the spine.
- ▣ This is followed by the ribs, sternum, pelvis, tibia, femur and the short long bones of the hands and feet.

## Special features of TB of bones

1. Bone destruction and rarefaction predominate over new bone formation.
2. Caseation results in cold abscess and sinus formation.
3. Healing occurs by fibrosis.
4. Sequestration is unusual.
5. Tuberculosis can destroy the epiphyseal cartilage plate and eventually involve the neighbouring joint (unlike pyogenic osteomyelitis).

## Complications

1. Cold abscess formation.
2. Involvement of a joint.
3. Sinus formation.
4. Toxemia.
5. Miliary TB.
6. Amyloidosis.

**N.B.:** The commonest site of bone and joint tuberculosis is the spine, followed by the hip joint.

## Clinical features

1. TB osteomyelitis is usually a disease of **children**.
2. General manifestations of TB in the form of malaise, pallor, weakness, loss of weight and appetite, night fever and sweating.
3. Local manifestations:
  - Pain: It is of insidious onset, aching in nature and more at night.
  - There may be swelling near the joint with marked muscle atrophy.
  - There may be a cold abscess or sinus formation.

## Investigations

1. ESR is elevated, CBC shows anaemia, leucopenia and relative lymphocytosis. Tuberculin test is positive.
2. X-ray. There is **localized bone destruction** with widespread rarefaction with no **new bone formation**.

## Treatment

1. General management by providing adequate normal diet, ttt of anemia.....
2. Anti-Tuberculous drugs.
3. Immobilization. Fixation of the limb in position of function in a splint or plaster is performed for up to 6 months where clinical, laboratory and radiological evidence of healing have occurred.
4. Operative treatment. If there is cold abscess or if conservative treatment failed, operative drainage and curettage are to be performed. In certain sites like TB of ribs, resection of the rib may be performed.



**▶ Other forms of bone tuberculosis.**

1. TB of flat bones (periostitis):
  - The surface of the bone is eroded and abscess forms which often opens on the surface with sinus formation.
2. TB of short long bones (TB dactylitis):
  - Metatarsals, metacarpals and phalanges are involved.
  - The infection starts in the diaphysis. There is central destruction, and the periosteum is raised by TB granulation tissues, with subperiosteal new bone formation. The bone thus becomes fusiform in shape (spina ventosa).

## Tuberculosis of joints

### Pathology

- ▣ Joints commonly affected are the hip and knee, but no joint is immune.
- ▣ Infection reaches the joint by hematogenous spread from a latent focus from the intestine or the lung or by direct spread from a focus in the adjacent bone.
- ▣ The site of initial infection may be synovial which is more common in children and in the knees, or osseous where a bone focus may open into the joint.
- ▣ All the joint compartments are affected in the untreated cases.
- ▣ The synovial membrane is thickened with multiple tubercles, which may form a caseous mass. A synovial pannus may form resulting in cartilage damage.
- ▣ Subchondral bone is invaded by granulation tissue.
- ▣ There is marked osteoporosis and bone destruction without new bone formation.
- ▣ The surrounding muscles are markedly atrophied.
- ▣ Resolution with restoration of complete joint movement never occurs in tuberculous arthritis, which always proceeds to complete joint destruction with any of the following sequelae:
  1. Healing with fibrous ankylosis.
  2. Cold abscess formation.
  3. Pathological dislocation.
  4. Generalized dissemination.
  5. Amyloidosis.

### Clinical features

- The patient is usually a child or young adult.

### Symptoms

1. Pain is the earliest symptom.
2. The child is unwilling to move the joint and muscle spasm keeps the joint fixed in position. During sleep muscle spasm decreases and as soon as the joint moves the child wakes up crying. This is called night starts or cries.
3. General manifestations of TB; night sweating, fever, loss of weight and appetite.

### Signs

1. Swelling results from synovial thickening and rarely effusion.
2. Muscle wasting is characteristic.
3. Joint movements are limited in all directions.
4. The joint becomes stiff and severely deformed.
5. In late cases there may be a cold abscess and sinus formation.



**Investigations****A. X-ray**

- Shows soft tissues swelling, rarefaction of the bone on both sides of the joint, narrowing of the joint space and blurring of the joint from erosion of subchondral bone.

**B. Laboratory investigations.**

- CBC shows anaemia, leucopenia and relative lymphocytosis.
- Elevated ESR.
- Tuberculin test is positive.
- Synovial fluid assessment by aspiration → reveals low or absent sugar, elevated white cell count and poor mucin precipitate.  
→ Bacteriological assessment may reveal tubercle bacilli.
- Synovial membrane or regional LN biopsy may reveal the diagnosis.

**Treatment****A. Early cases:**

- The mainstay in treatment is anti-tuberculous drugs. If started early, the joint may heal and the function be completely restored.
- Local measures include rest, traction and occasionally operation. Splintage should be continued for several months.

**B. Late cases:**

- If the articular surfaces are destroyed, the joint is immobilized until all signs of disease activity have disappeared, then the joint is arthrodesed in the position of maximum function.

## TB of Spine "Pott's Disease"

The spine is the commonest extra-articular TB

**Incidence**

- Commonest form of skeletal TB.
- Age:
  - Children are more affected than adults but no age is immune.
  - Peak incidence <5 years (75% below 10 years).
  - In adults the prognosis is bad.

**Etiology**

- Organism** → Mycobacterium tuberculosis.
- Route** → mainly 2<sup>nd</sup> blood born from lung or mediastinal LN.
- Predisposing factors** → immuno-suppression (skeletal TB is increased in patients with HIV).

**Pathology****Commonest Site**

- Incidence:** dorsal spine "lower dorsal" > lumbar > cervical.
- More in the dorso-lumbar region because the stress of weight bearing is maximal at this level.
- It affects adjacent parts of the bodies of 2 vertebrae (or three) with the discs in between.
- In children the disease starts in the cancellous bone in the center of the vertebral body.
- In adults the disease starts subperiosteally under the anterior longitudinal ligament.

Macro

Micro

Clinic

Sym

Sign

Kyp

The ve



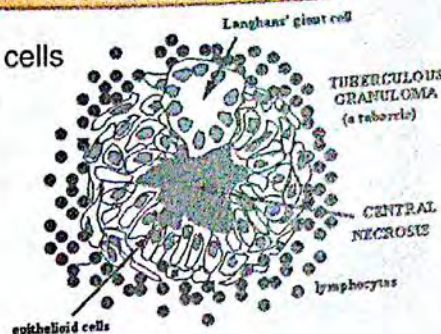
## Macroscopic

- The vertebral body is destroyed (2 or more adjacent vertebrae) & replaced by caseous material
- Early destruction of the disc.
- Collapse of the vertebrae.

- Collapse of the vertebrae results in:
  - 1-Angular kyphosis.
  - 2-Cold abscess.
  - 3-TB sinus
  - 4-Paraplegia.

## Microscopic

- Tubercles are formed of epithelioid cells & giant cells (Langhans' cells) surrounded by lymphocytes & fibroblasts.
- Tubercles fuse together forming larger follicles.
- Depending on the immunity of the patient → caseation or fibrosis.



## Clinical Picture

- More common in children.

## Symptoms

- General:**
  - Manifestations of TB toxemia (night fever, night sweat, loss of appetite, loss of weight)
- Local:**
  - Severe back pain (dull aching(1)) more at night (commonest 1<sup>st</sup> presenting symptom).
    - insidious onset
    - ↑ At night and on movement.
  - Limitation of movement of the vertebral column.
  - Manifestations of complications:
    - retropharyngeal cold abscess interferes with respiration, swallowing and phonation.



## Signs

- General:**
  - Fever + pulmonary TB ± other organ affection by TB.
- Local:**
  - Inspection:**
    - Swelling, cold abscess.
    - TB sinus with undermined edge & cyanotic margin (as TB ulcer).
    - Kyphosis(4) : according to affected region:
      - Thoracic region → angular and is evident
      - Cervical and Lumbar regions → masked by the normal lordosis present which is just obliterated and the spine looks straight.
  - Palpation:**
    - Tenderness opposite the affected vertebrae.(2)
  - Movement:**
    - Limitation of movement in all directions (the most important sign)(3)
    - Coin test → limited spinal mobility.
  - Neurological examination:**

Kyphosis, cold abscess(5) and paraplegia(6) are a triad essential for clinical diagnosis.

The yellow numbers = The classical symptoms of tuberculosis of the spine as described by Pott



## Complications

### General

- Spread.
- Secondary amyloidosis → renal failure.

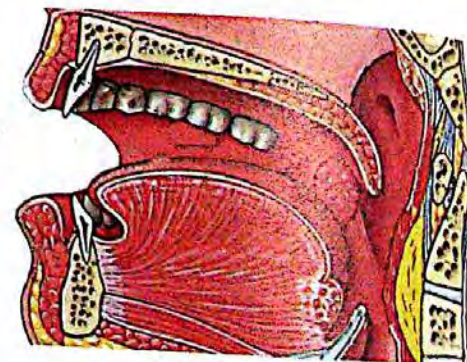
### Local

#### 1- Deformity (angular Kyphosis), (Gibbus):

- Due to collapse of the vertebral body anteriorly, while the posterior arch is intact.  
→ the disease leads to more deformity rather than pressure on the spinal cord and paraplegia.
- More with **osseous type** → Angular Kyphosis.
- More marked in **thoracic** region (As cervical and lumbar are normally lordotic).
- The deformity is permanent.

#### 2- Cold Abscess

- At first, the abscess collects under the anterior longitudinal ligament in front of the vertebral body.
  - Also it collects on the sides of the spine behind the prevertebral fascia, (paravertebral cold abscess).
  - **It spreads along the fascial planes:**
- In cervical region the abscess may appear:
  1. Retropharyngeal abscess (bulges in the pharynx in the middle line).
  2. In the posterior triangle of the neck.
  3. Axilla.
- In thoracic the abscess may extend to:
  - a) Mediastinum.
  - b) Along the intercostal nerves.
    - Paravertebral (posterior branch)
    - Mid-axillary (lateral branch)
    - Parasternal ( anterior branch) → along the perforating branches of the internal mammary artery.
- In lower thoracic and lumbar regions the abscess may:
  - It passes into the sheath of the psoas muscle to form the famous psoas abscess which presents as a cystic swelling in the posterior abdominal wall, or it may pass under the inguinal ligament to present in the femoral triangle lateral to femoral vessels with cross fluctuation between the 2 collections.



#### 3- Pott's paraplegia (10% of cases)

- More with **peri-osteal type**.
- **Usually in upper dorsal spine (the narrowest part).**
  - **Early Reversible** on decompression) due to:
    - Compression of the cord by cold abscess, granulation tissue or by the sequestered disc.
    - Edema, thickening and congestion of the Dura.
  - **Late (Irreversible) due to:**
    - Stretching of the spinal cord over an angular kyphosis due to collapse of vertebral bodies.
    - Reactivation of the disease.
    - Ischemia (thrombosis of anterior spinal artery).

#### 4- T.B. Sinus

- Due to **faulty drainage of cold abscess.**



## Differential diagnosis

1. Developmental kyphosis in children. Potts kyphosis is characterized by being angular.
2. Other causes of back pain in adults.

## Investigations

### X-ray spine (lateral View)

#### Early

- 2 or more vertebrae are affected.
- Rarefaction of the vertebrae (osteoporosis).
- Decreased joint space.

#### Late

- Destruction of vertebral bodies and amalgamated Inter-vertebral discs.
- $\pm$  Kyphosis.
- Bone destruction with **NO** new bone formation.
- Paravertebral abscess shadow.

### CT-Scan, MRI. (The most accurate)

### For pulmonary T.B. :

- Blood  $\rightarrow$  leucopenia with relative lymphocytosis,  $\uparrow$  ESR
- Chest x-ray  $\rightarrow$  pulmonary lesions.
- Tuberculin test (good -ve test).
- Sputum examination, Z.N. stain, culture on Lowenstein Jensen media & PCR.



T.B of the spine: osteolytic lesion

## Treatment (Mainly conservative)

### Conservative treatment

- 1- Anti-tuberculous medications for 9 months.
  - 2- Rest.
  - 3- Good nutrition.
  - 4- Spine support by plaster cast for short period. When the disease become quiescent this is changed into a spine brace.
  - 5- Periodic clinical, haematologic and radiographic assessment.
- ◆ Under conservative treatment most cases are cured.
  - ◆ Early paraplegia patients respond favourably to this treatment in 60% of cases.
  - ◆ Late Pott's paraplegia is due to increasing severity of kyphosis and responds neither to conservative nor surgical treatment.

## Surgery

### Indications

- Early Pott's paraplegia with :
  - 1- No sign of recovery after 3-4 weeks of conservative treatment.
  - 2- Paraplegia getting worse in spite of conservative treatment.

### Aim of surgery

- Decompression of the spinal cord.

### Technique

- ◆ The caseous material and dead bone are removed by either of two methods :
  - 1- **Costo-transversectomy:** In this operation the posterior ends of one or two ribs and the corresponding transverse processes of the vertebrae are excised and the cold abscess is evacuated.
  - 2- **Antero-lateral decompression:** In this operation, in addition to costotransversectomy the pedicles and part of the vertebral bodies are excised to achieve decompression.



**Later treatment**

- 1- Life-long follow-up.
- 2- Spine fusion may be needed after clearance of infection, using bone graft.

**Treatment of complications****➡ Paraplegia :****A. Early:**

- Anterior decompression and debridement followed by spinal fusion.
- About 80% recover, usually within a few weeks.

**B. Late:**

- If MRI shows a block, operative debridement is still effective even in late cases.
- If there is no block, conservative management of bed-ridden patients.

**N.B. about all the infectious diseases**

- Always keep in mind the possibility of acute osteomyelitis and septic arthritis in children. They may even affect neonates.
- Both conditions require urgent treatment.
- For acute osteomyelitis give high-dose intravenous antibiotics. Get samples for blood culture before starting antibiotics.
- For septic arthritis emergency drainage is required.
- Tuberculosis of bones and joints is a chronic disease.



## Points to remember (inflammation)

### Acute Haematogenous Osteomyelitis

- ▶ **Etiology:** child ♂, G+ve "staph. aureus" 80%, H. influenza (<4y.), blood, septic focus.
- ▶ **Most common site** is the metaphysis of long bone.
- ▶ **Pathology:** Hematoma, Suppuration, Necrosis, New bone formation.
- ▶ **C/P:** as any infection + pseudo-paralysis + Localized tenderness (earliest) + sympathetic effusion + ↓ active movement only.
- ▶ **Comp.:** General (toxemia)+ Local (Chronicity, spread, ↓ bone growth, fractures).
- ▶ **Invest.:** - Lab.: (CBC+ blood culture+ aspirate).  
- Imaging: (U/S, MRI\*, CT, X-ray).
- ▶ **TTT:** - Medical: (rest+ immobilization+ "AAA")  
- Surgical: (drainage+ drill holes in cortex).

### Brodie's Abscess

- ▶ **Etiology:** staph. (aureus+↑resist./ albus+↓resist.)
- ▶ **Pathology:** at end of long bones, sterile pus.
- ▶ **C/P:** intermittent pain, effusion, localized tender.
- ▶ **Invest.:** X-ray.
- ▶ **TTT:** Saucerization+ grafting (antibiotic coverage).

### Tuberculosis of Bones

- ▶ The commonest site is the spine.
- ▶ **C/P:** children, TB toxemia, pain, swelling, sinuses.
- ▶ **Comp.:** Cold abscess, Miliary TB, Amyloidosis.
- ▶ **Invest.:** as TB + X-ray: localized bone destruction with no new bone formation.
- ▶ **TTT:** as TB + immobilization (splint), ttt of comp.

### Tuberculosis of Joints

- ▶ The commonest sites are the hip and knee.
- ▶ **C/P:** child or young adult, pain (earliest), TB toxemia, swelling, limited movement.
- ▶ **Comp.:** Ankylosis, Cold abscess, Miliary TB, Amyloidosis.
- ▶ **Invest.:** as TB + X-ray: soft tissues swelling, narrowing of the joint space.
- ▶ **TTT:** as TB + immobilization (splint), ttt of comp.

### Chronic Non-Specific Osteomyelitis

- ▶ **Etiology:** mixed inf., "direct, blood"
- ▶ **Pathology:** Sequestrum, sinuses, Involucrum, Cloaca, Pathological fractures.
- ▶ **C/P:** as chronic inf. + draining sinuses\*.
- ▶ **Comp.:** as inf. + fractures.
- ▶ **Invest.:** - Lab.: (ESR, TLC, C&S).  
- Imaging: (X-ray\*, MRI, CT, isotope scan).
- ▶ **TTT:** Surgical: Saucerization + Sequestrectomy + Sinusectomy+ bone graft.

### Acute Pyogenic Arthritis

- ▶ **Etiology:** - Staph., H.influenza (<3y.)  
- "direct, blood"
- ▶ **Pathology:** synovitis, articular cartilage inj., abscesses, sinuses, fibrous or bony ankylosis.
- ▶ **C/P:** as inf. + night / rest pain + complete loss of all movements.
- ▶ **Comp.:** Destruction, Dislocation, Disturbed growth, Deformity (ankylosis)
- ▶ **Invest.:** - as inf. + U/S guided aspiration.  
- Imaging "X-ray\*\*".
- ▶ **TTT:** - General: rest, immobilization, "AAA".  
- Specific: urgent arthroscopy or arthorotomy.

### Tuberculosis of the Spine "Pott's ds."

- ▶ **Etiology:** M. tuberculosis, blood, ↓immunity.
- ▶ **Site:** lower dorsal > lumbar > cervical.
- ▶ **C/P:** as TB + dull aching back pain, kyphosis, ↓mobility in all directions, tenderness.
- ▶ **Comp.:** General, angular kyphosis, cold abscess, paraplegia, TB sinuses.
- ▶ **Invest.:** - Imaging: (X-ray spine, CT, MRI).  
- For pulmonary TB: TLC, ESR, CXR, Tuberculin test, Sputum examination.
- ▶ **TTT:** - Conservative: rest, nutrition, anti TB drugs, spine support.  
- Surgical: costotransversectomy or antero-lateral decompression.



# Bone Tumors

## Classification

### Benign

- The most common bone tumors.

### Malignant

- Primary
- Secondaries: the most common malignant tumors of bone.

## Primary bone tumors

Types	Benign	Malignant
Bone forming tumors	Ivory osteoma Osteoid osteoma	Osteosarcoma
Cartilage forming tumors	chondroma Osteochondroma	Chondrosarcoma
Fat forming tumors		Liposarcoma
Fibrous tumors	Fibroma Fibrous dysplasia	Fibrosarcoma
Vascular tumors	Hemangioma	angiosarcoma
Uncertain	Giant cell tumor	Malignant giant cell tumor
Marrow tumors		Ewing's sarcoma Multiple myeloma Reticulum cell sarcoma

## i- Benign Bone Tumors

### Osteoma

#### A. Ivory (compact) Osteoma

### Incidence

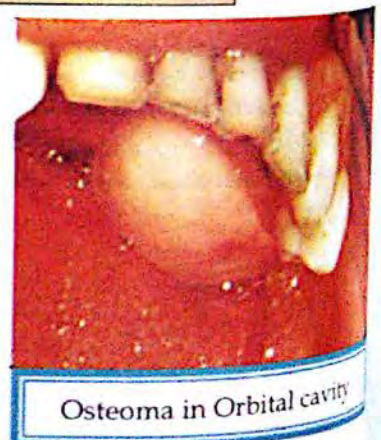
- Rare.

### Site

- Membranous bones (almost restricted to the Skull)
- May occur in the Mandible.

### Clinical Picture

- An adolescent or young adult presents with a painless hard lump, usually on the outer surface of the skull.
- The tumor is commonly hemispherical:
  - According to site e.g.:
    - Inner table → ↑ ICT.(focal epilepsy)
    - Outer table → cosmetic(alopecia), or adventitious bursa formation.
    - Orbital cavity → proptosis.
    - Auditory meatus → deafness
    - Into air sinuses → infection and obstruction.



Osteoma in Orbital cavity



**Investigation**

- **X ray** → A sessile plaque (dense bone swelling) with a well-circumscribed edge.

**Treatment**

- The tumor never turns malignant.
- **Excision** if causing pre symptoms:
  - If small → removed with a trephine.
  - If large → removed with a piece of surrounding bone by Gigli's saw or electric saw (to avoid concussion by chiseling).

## B. Osteochondroma (cartilage-capped exostosis)

**Incidence**

- **Common** (35% of benign bone tumors)
- **Age:** Starts in adolescence.
- **Sex:** Male.

**Pathology**

- **Metaphysis** of long bones
- (distal femur, proximal tibia and proximal humerus) never affect flat bones.
- Grows **away** from joints.
- Formed of **bony stalk + cap of cartilage** + bursa above it.
- The tumor continues to grow till the time of closure of epiphyseal cartilage, any further growth is suggestive of malignant transformation.

**Types**

- It may be **single** (hamartoma) or **multiple** (may be associated with **Gardner's syndrome** (Sebaceous cyst, Desmoid tumor, FPC & exostosis) → precancerous → **chondrosarcoma**).

Metaphyseal aclasis " hereditary multiple exostosis" is the most common of all dysplasias

**Presentations**

- Painless lump.
- Present with **one** of complications e.g.: pain, malignant transformation.
- May be associated with Gardner's syndrome (see GIT) or dwarfism.

**Complications**

- Bursitis.
- Pathological fracture.
- Pressure on neurovascular tissue.
- Malignant transformation → chondrosarcoma (rapid growth, painful, invasion, metastasis, recurrence after excision).

**Investigations**▪ **X-ray:**

- Well defined exostosis emerging from metaphysis (looks smaller because cartilaginous cap doesn't appear in X-ray).





## Treatment

- **If single** → excision including the cartilage cap but, don't remove it in a child till epiphyseal plate closure.
- **If multiple** → removal of complicated one.

## C. Osteoid Osteoma

### Incidence

- **Common** (15% of benign bone tumors)
- **Age:** <30 years.
- **Sex:** male.
- **Origin:** bone cortex.
- **Site:** Any bone except the skull may be affected, but >50% of cases occur in the femur or tibia.

### Pathology

- It is formed of a dark brown or reddish nidus (<1cm in cortex of femur or tibia) surrounded by dense bone.
- It consists of immature osteoid tissue With trabeculae of newly formed bone, in a vascular connective tissue matrix.
- There is no risk of malignant transformation.

### Clinical Picture

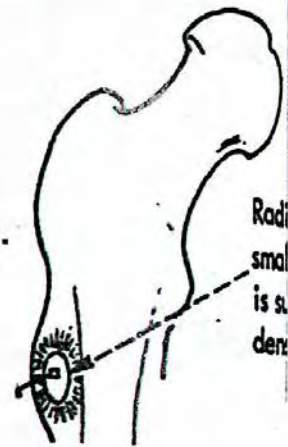
- **Painful small nodule in diaphysis of femur (38%) or tibia(19%).**
- Pain increases at night and relieved by aspirin .

### Investigations

- **X-Ray:**
  - Central radiolucent area surrounded by dense sclerosis.
  - If >2cm → named **osteoblastoma**.
- Bone scan: shows marked activity(hot spot)

### Treatment

- The lesion is localized by multiple X-rays
- Excision + salicylates for pain.
- The excised specimen should be X-rayed to confirm that it contain the little tumor.





## D. Chondroma

- Ecchondroma (periosteal or juxtacortical chondroma) → (grow outwards).
- Enchondroma → (grow inwards).

### Definition

- It is a benign cartilaginous tumor formed of lobular mass of hyaline cartilage.

### Cell of origin

Chondroblast

### Types

1. Ecchondroma.
2. Enchondroma.

### Pathology

- **Number:** usually solitary, but in enchondroma multiple enchondromatosis may be present → Ollier's disease (non-hereditary).
- **Site:**
  - Ecchondroma → long tubular bones (usually metaphysis).
  - Enchondroma → - Short bone (hand & feet): **most commonly affected**
    - Flat bones (ribs & scapula)
    - Ends of long bones
- **Macroscopic picture:** a white, soft & multilobulated mass having a fibrous pseudocapsule
- **Microscopic picture:** 1. Chondrocytes. 2. Cartilaginous matrix.
- **Malignant transformation:** Enchondroma turn malignant **except** Enchondroma of short bone of hand & foot in children.

### Clinical picture

- Seen at any age, but mostly in young people.
- Ecchondroma → symptomatic (local pain & swelling).
- Enchondroma → usually asymptomatic (if , just a swelling).
- The main Complication is pathological fracture.

### Investigations

- **X-ray:** - Ecchondroma → soft tissue mass eroding the cortex calcification is common
- Enchondroma → well defined lesions with some calcification & may show cortical expansion.
- **CT & MRI:** for intracranial or spinal lesions.



#### N.B:

Solitary-chondroma must be differentiated from a benign cyst (which shows no calcification).

### Treatment

- Not always necessary unless it is large, presents as a pathological fracture or malignancy is suspected.
- Ecchondroma → mostly needs wide excision including the underlying cortex without rupture tumor capsule.
- Enchondroma → Chiseling



## ii- Malignant Bone Tumors

### A. Bone Seconadries (50%)

#### Incidence

- 50% of malignant tumors of bone (most common).
- Age: usually above 50 years.

#### Source

- 2/3 cases: → from cancer breast or prostate.
- 1/6 cases: → from other cancers e.g.: thyroid, lung, kidney or GIT
- 10% of cases: → occult 1ry.

#### Route of spread

- Systemic circulation: from tissues which drain into the vena cava → heart → lung → penetrate the capillaries → systemic circulation.
- Direct connection between pelvic venous plexus and vertebral vein.
- Direct invasion as tumors of rectum in pelvic bones.
- Metastases in cancer prostate are either direct to the pelvic bones or due reversal of blood flow from prostatic plexus (veins of Santorini) to the axial skeleton through valveless veins of Batson.
- Metastases in cancer breast are either direct to ribs or via intercostal veins which communicates with paravertebral veins via Azygous vein.

#### Pathology

- **Usually osteolytic**: destroy and replace bone, by expansion and by stimulating active bone resorption by direct action of the tumor cells or tumor derived factors that stimulate osteoclastic activity.
- Rarely osteoblastic especially in cancer prostate.
- Site:
  - Where **red marrow** is plentiful e.g.
    - Trunk bones (vertebrae 15%, skull, pelvis 25%, ribs).
    - Root bones (upper end femur & humerus) 45%.
- Macroscopic & Microscopic:
  - Correspond to that of the 1ry.

#### Clinical Picture

##### Symptoms

- General:
  - Symptoms of primary tumor (painless breast lump, prostatism...etc).
  - Symptoms of secondaries to other sites. e.g. hemoptysis.
- Local:
  - Bone aches (pain): is the commonest and often the only clinical feature.
  - Swelling.
  - Disturbance of function:
    - Pathological fractures.
    - Manifestations of hypercalcemia:
      - G.I.T.: nausea, vomiting & constipation.
      - C.N.S.: confusion & fatigue.
      - Others: polyuria (nephrogenic D.I.), renal stones...etc.



## Signs

### General:

- Cachexia, signs of the primary tumor. e.g. breast mass with Peau d'orange appearance in cancer breast.

### Local:

- Inspection:
  - Redness & swelling.
- Palpation:
  - Hotness & tenderness.
- Movement:
  - Limited mobility due to pain.

## Investigations

### For the primary tumor

#### E.g. breast carcinoma:

- Imaging:
  - Mammography.
- Pathology.
  - FNABC.

- U/S.

-  $\pm$  Corecut biopsy.

## Enzymes

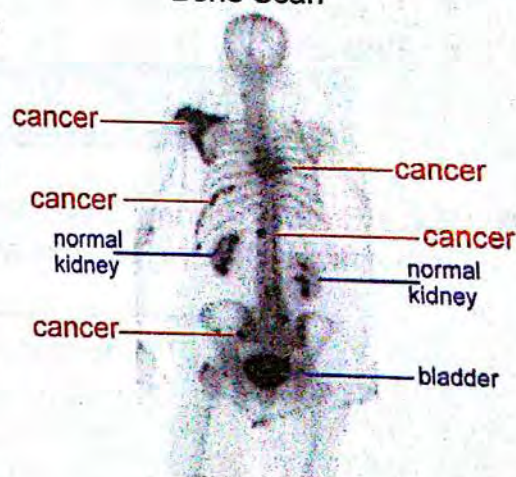
- **Acid Phosphatase + PSA ( Prostatic specific Ag):**  $\uparrow$  with cancer prostate.
- **Alkaline Phosphatase:**  $\rightarrow \uparrow$  with bone destruction.
- Elevated ESR + Low hemoglobin.

## Radiology

► Always multiple, If solitary  $\rightarrow$  the primary origin may be R.C.C. or Thyroid carcinoma, but bone sarcoma must be excluded.

- **Bone scan Tc<sup>99</sup>:** very early diagnosis may reveal unknown secondaries as "hot spots".
- **Plain x-ray:**
  - Osteolytic  $\rightarrow$  more common in area of destruction with no new bone formation.  
 $\rightarrow$  (moth-eaten appearance in the cortex of bones).
  - Osteogenic  $\rightarrow$  prostatic cancer.

Bone Scan



dye collects in kidney and bladder

## Treatment

### ► The treatment is palliative:

1. Painful deposits are treated by radiotherapy.
2. Pathological fractures are treated by a combination of internal fixation and radiotherapy.
3. Chemotherapy.

► **But, metastatic carcinomas usually have a bad prognosis.**

**N.B. Metastases are more frequent than primary malignancies in the following organs:**

1. Lungs

2. Liver

3. Bones

4. Brain



## B. Malignant Primary Bone Tumors

- Osteoclastoma = giant cell tumor.
- Osteosarcoma.
- Ewing's tumor.
- Chondrosarcoma.
- Fibrosarcoma.

### Scheme for Malignant Tumors

#### Incidence

- Percentage of occurrence.

- Age.

- Sex.

#### Pathology

- Site.

- Cell of origin.

- Macroscopic

- Microscopic.

- Spread

#### Clinical Picture

#### DD

#### Investigations

- For diagnosis:
- X-ray, CT scan, MRI.
- Biopsy.

- For staging.
- For preoperative preparation.

#### Treatment

- Surgical → excision or amputation
- Radiotherapy or chemotherapy.

### Staging of Malignant Bone Tumors

#### (TNM system)

- ➔ This system is applied to all primary bone tumors except multiple myeloma, juxtacortical chondrosarcoma and paraosteal osteosarcoma.

• Tx	Primary tumor can not be assessed.
• T0	No evidence of primary tumor.
• T1	Tumor confined within the cortex.
• T2	Tumor invades beyond the cortex.
• Nx	Regional LNs can not be assessed.
• N1	No regional LNs metastases.
• N1	Regional LNs metastases.
• M0	No distant spread.
• M1	Evidence of distant metastases.



# I- Giant Cell Tumor (Osteoclastoma)

## Incidence

- Giant cell tumor accounts for 5-9% of all primary bony tumors.
- Age: 20 - 40 years (**third decade**).
- Sex: female > male

## Pathology

### Site

- Epiphysis of long bones.
- Around knee and away from elbow (most often the distal femur & proximal tibia 50%, distal radius 12%, and proximal humerus 6%).

### Cell of origin

- Unknown (thought to be osteoclasts hence the old name osteoclastoma).
- Osteolytic.
- It occurs only in mature bone.

## Macroscopic

- It characteristically extends up to the subarticular bone but usually does not invade the articular cartilage.
- The tumor has a reddish brown, fleshy appearance; it comes away in pieces quite easily when curetted, but is difficult to remove completely from the surrounding bone.

## Microscopic

- Multinucleated giant cells.
- Spindle shaped or ovoid stromal cells, which may be responsible for determining the aggressiveness of the tumor.  
all giant cell tumor are considered potentially malignant.
- Blood vessels → large thin walled.
- Little collagen.

## Spread

- Locally malignant (aggressive)
  - Starts **eccentric**, expands bone around it.
  - The affected bone cortex is thin like eggshell, liable to fractures.
  - The tumor is separated from medullary cavity by medullary plug.



Giant cell tumor

- Giant cell tumor of bone is a benign lesion that is a usually solitary and locally aggressive.
- It is believed by some to be potentially malignant.
- In the very rare instances this lesion has the potential for metastasis to the lungs (<10%).
- The numerical grading system (I, II and III) has now largely been discarded as a useful predictor of biological behavior. Accordingly, all giant cell tumors are considered potentially malignant.



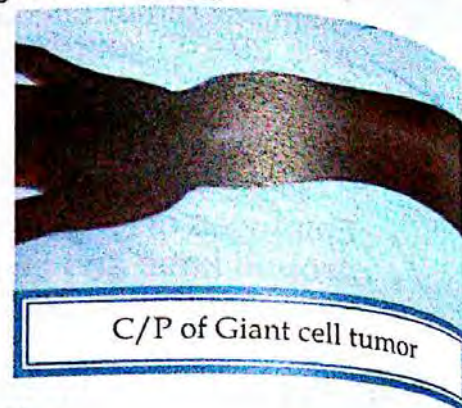
## Clinical Picture

### Symptoms

- **Local:**
  - Pain (at the end of a long bone): slowly progressive (**late**).
  - Swelling.
  - History of trauma and pathological fractures in 10-15% of cases: (**early**).
- **General:** rarely manifestations of metastasis.

### Signs

- **Local:**
  - Bony swelling at the end of a long bone
  - **Inspection:**
    - Globular.
    - Skin → stretched.
    - The neighboring joint is often irritated.
  - **Palpation:**
    - Sharply defined edges.
    - The consistency depends on the degree of thinning of the cortex, it may be soft, firm or egg-shell crackling sensation.
    - No palpable LNs.
- **General:** rarely manifestations of metastasis.



## Investigations

### For diagnosis

- **Radiology**
  - **X-Ray:**
    - Eccentrically placed.
    - Radiolucent area at the end of long bone, bounded by the subchondral bone plate.
    - Soap bubble appearance.
    - Thin expanded cortex.
    - Medullary plug (operculum).
    - Absence of this plug may signify malignant osteoclastoma or bone metastases.
- **Lab:** ↑ ESR.
- **Biopsy:**
  - percutaneous needle or Tru-cut techniques.
  - Limited open biopsy.



### For staging

- CXR, some authors recommend a chest CT scan for all patients newly diagnosed.
- CT, MRI.
- Arthroscopy → detect articular surface damage.

### For preoperative preparation

- Organ profile.

## Treatment

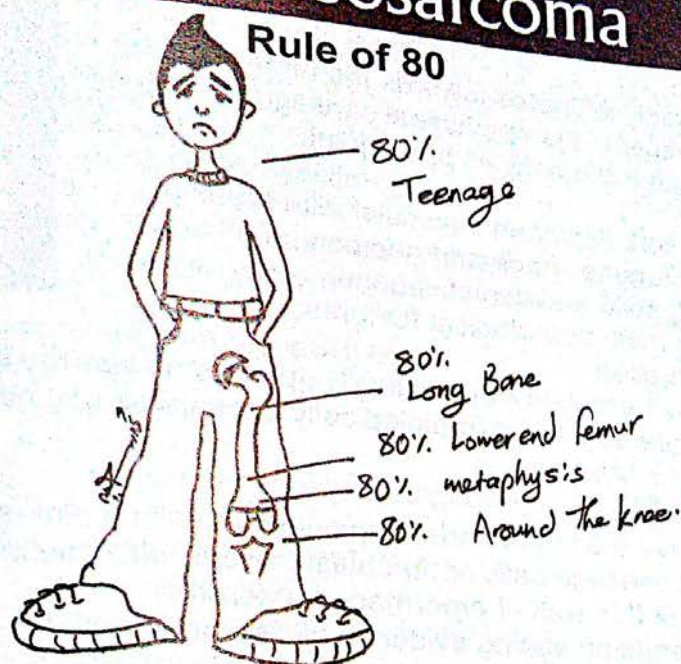
- **Important bone:** e.g. femur:
  - Curettage + bone graft. (50% recurrence)
  - Excision + reconstruction (prosthesis or osteocartilagenous grafts).
- **Unimportant bone:**
  - e.g. fibula → excision with safety margin.
- **Inaccessible bone:** e.g. pelvis → radiotherapy.

- If recurrent tumors with suspicious of malignancy → amputation.



## II- Osteosarcoma

### Rule of 80



### Incidence

- Most common primary malignant bone tumor (in children).
- It is the 8<sup>th</sup> malignant tumor of pediatrics.
- About 20% of all 1<sup>st</sup> degree bone tumors are osteosarcoma.
- It is a highly malignant tumor.

### Age

- 10-25 Years (2<sup>nd</sup> decade).
- 80% in teenage.
- Second peak occurs after 50 years of age due to malignant changes in Paget's disease.

### Sex

- Males > Females.

### Predisposing Factors

- Paget's disease of bones (in elderly >40Yrs).
- Extensive Irradiation.
- Fibrous dysplasia.
- Diaphyseal aclasis (very rare).

### Paget's disease of bones (Osteitis deformans)

- ▶ Starts by Osteoclastic resorption Then osteoblastic regeneration of a primitive coarse-fibred bone (bone cirrhosis).
- ▶ C/P: mostly accidentally discovered ....thickened bones and it may be painful.
- ▶ TTT: calcitonin

### Pathology

#### Site

- Metaphysis of long bone (rule of 80).

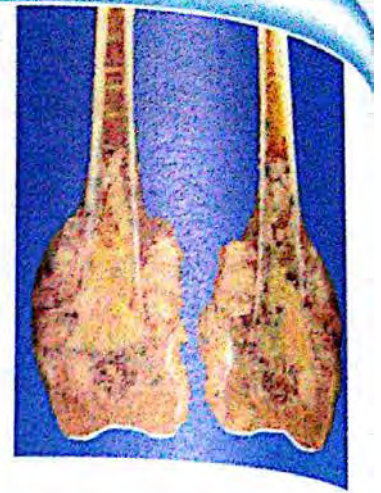
#### Cell of Origin

- Primitive Osteoblasts → Osteogenic.



### Macroscopic picture

- Osteosarcoma destroys and replaces the normal bone.
- It is also characterized by the formation of bone or osteoid tissue.
- The tumor rapidly infiltrates towards the bone marrow early, but it respects the epiphyseal cartilage and hence does not invade the epiphysis or the joint.
- It may be:
  - a- Osteolytic: soft, fleshy and vascular with areas of haemorrhage and necrosis.
  - b- Osteogenic: solid and contains bone.
- There are four main pathological features:
  1. Bone destruction.
  2. Tumor bone formation (radiologically appears as sun-ray appearance).
  3. Reactive bone formation (radiologically appears as codman's triangle).
  4. Soft tissues infiltration.



### Microscopic picture

- Some areas have the characteristic spindle cells with a pink-staining osteoid matrix.
- Others contain cartilage cells or fibroblastic tissue with little or no osteoid.
- Blood vessels → thin wall - hemorrhage – necrosis.
- Diagnosis depends on seeing evidence of osteoid formation.

### Spread

- Direct (course) starts central & respect epiphyseal plate:
  - **Invades** medullary cavity (**no plug**).
  - **Penetrates** cortex (**no expansion**) → phantom bone.
  - **Raise** periosteum.
  - Perforate periosteum → soft tissue infiltration.
- Blood: → BLBL (80% lung metastasis).
- Lymphatic → Rare & late.

*In osteosarcoma: osteosclerotic lesion has better prognosis than osteolytic.*

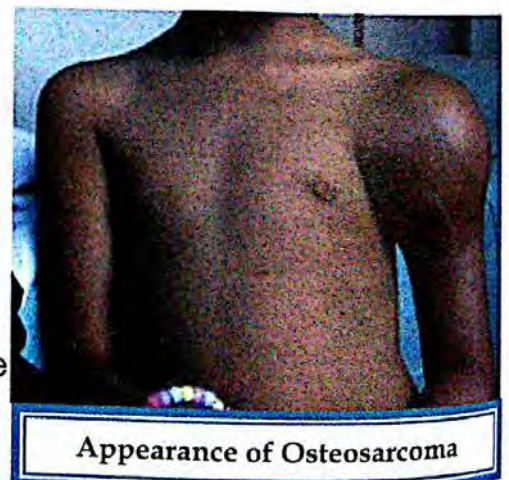
### Clinical Picture

#### Symptoms

- **General:**
  - Anemia, cachexia, fever, malaise, lethargy.
  - Metastasis (e.g.: cough, hemoptysis...).
- **Local:**
  - Pain is **early**. It is constant, worse at night and gradually increases in severity.
  - Swelling.
  - Pathological fracture is **uncommon** because the patient is bed ridden due to pain).

#### Signs

- **General:** fever, cachexia.
- **Local:**
  - **Inspection:**
    - Swelling.
    - Overlying skin: dilated veins.



Appearance of Osteosarcoma



o **Palpation:**

- Bone swelling (In later cases) which is:
  - Warm, tender, identified.
  - Firm to hard with soft areas.
  - Local tenderness.
- LNs: affected late.

**Differential diagnosis**

1. Chronic non-specific osteomyelitis.
2. Giant cell tumor.
3. Other malignant bone tumors as chondrosarcoma, fibrosarcoma, Ewing's sarcoma and reticulum cell sarcoma.
4. Secondary carcinomatous deposits.

**Investigations****For Diagnosis**

- **Radiology:** No single feature is diagnostic

- **X-Ray:**o Ill-defined destructive lesion:

- Start in metaphysis.
- Destroys the cortex.
- Invades the soft tissue.

o New bone formation:

- **Sun ray appearance** (stretched blood vessels around which new bone formed).
- **Codman's Δ.** (Reactive at the angle between the periosteum and the shaft called a Codman's triangle).



Neither sun ray nor codman's triangle is pathognomonic of osteosarcoma.

o Soft tissue mass around the bone.

- CT, MRI.

- **Lab:** ↑ESR, may be ↑ALK. Phosphatase.
- **Biopsy:**
  - Percutaneous, Tru-cut biopsy or open biopsy.

**For staging**

- E.g.: CXR, U/S.

**For preoperative preparations**

- Organ profile.

**Treatment**

1. **Local control of the disease:** is by either
  - a- Amputation: The level of amputation should be proximal to the joint above the tumor, e.g., osteosarcoma of the tibia is treated by above knee amputation.

or

- b- Wide local excision and prosthetic replacement.
2. **Adjuvant chemotherapy** has markedly improved the prognosis.





# III- Ewing's sarcoma

## Incidence

- The **second** most common primary malignancy of bone in **pediatric** age.
- **Age:** 10-20 years.
- **Sex:** male > female.

## Pathology

### Site

- **Diaphysis** of long bones and gives rise to periosteal reaction.
- It commonly affects tubular bones, especially in the tibia, fibula or clavicle.
- Also flat bones as scapula and pelvis.

### Origin

- Vascular endothelium in the bone marrow  
→ **Round cell** (BM reticulocytes).

### Macroscopic picture

- Soft grayish brain like tissue + areas of hemorrhage and necrosis.

### Microscopic picture

- Round cells forming rosettes around blood vessels → rosette-shape appearance.
- Intracellular glycogen. (the presence of glycogen differentiates it from reticulum cell carcinoma and secondary from neuroblastoma )
- **No matrix.**

### Spread

- Direct.
- Blood: BLBL (**common**).
- Lymphatic: **common**.

## Clinical Picture

### Symptoms

(As osteosarcoma + constitutional symptoms (FAHM) → DD: acute osteomyelitis)

- **General:**
  - Anemia.
  - Cachexia.
  - Lethargy.
  - Fever (intermittent or continuous).
  - Malaise.
  - Metastasis: e.g. hemoptysis.
- **Local:**
  - Pain (early)
  - Pathological fractures are uncommon because patient is bed ridden due to pain.
  - Swelling.

### Signs

- **General:** fever, anemia, cachexia..etc.
- **Local:**
  - **Inspection:**
    - Swelling.
    - Overlying skin congested.
  - **palpation:**
    - Swelling: warm, tender & ill-defined.
    - LN: commonly palpable.



Ewing's sarcoma



## Investigations

### For diagnosis

#### ▪ Radiological:

##### ◦ X-ray:

- **Onion Peel Appearance** (osteolytic + periosteal new bone formation).
- More often the tumor extends into surrounding soft tissues and may show sun-ray appearance and Codman's triangle

##### ◦ CT & MRI → show the large extra-osseous component of the tumor and its local extent.

##### ◦ Bone scan → multiple areas of activity in the skeleton..

#### ▪ Laboratory

##### ◦ ↑ ESR.

##### ◦ leucocytosis

#### ▪ Biopsy: Tru-cut biopsy or open biopsy.

CXR, U/S.



### For staging

### For preoperative preparation

Organ profile

## Differential Diagnosis

- Acute osteomyelitis: biopsy
- Secondaries from neuroblastoma :
  - Child < 5 years
  - Catecholamines increased in urine.
  - No intracellular glycogen.
- Reticulum cell sarcoma
  - Patient > 20 years old.
  - Presence of reticulin fibers.
  - No intracellular glycogen.

## Treatment

#### ▪ Combination of :

1. Chemotherapy.
2. Irradiation.
3. Surgery.

→ Then, a further course of chemotherapy is continued for 1 year.

## Prognosis

Poor 5 years survival is 5-10%, despite the fact that the tumor is radiosensitive.



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# SPECIAL SURGERY

	Osteoclastoma	Osteosarcoma	Ewing's
Age & Sex	-15 - 45 years. -F > M	-10-25 years. -M > F -Most common 1ry malignant tumor.	-5 - 15 years. -M > F
Site	-Epiphysis of long bones. -Around knee and away from elbow.	-Metaphysis of long bone. -(Rule of 80).	-Diaphysis & metaphysis of long bones.
Cell of origin	- Unknown (thought to be osteoclasts hence the old name osteoclastoma) - Osteolytic.	-Osteoblasts → osteogenic.	-Round cell (BM reticulocytes).
Spread	-Locally malignant (aggressive).	-Direct . -Blood → BLBL -(80%lung metastasis). -Lymphatic→ Rare & Late.	1. <b>Direct</b> 2. Blood→BLBL(common). 3. Lymphatic→ common.

## Clinical Picture

Signs	Bony swelling which is:		
	<b>Swelling</b>	- Globular - Sharply defined edges. -Egg shell crackling sensation.	- Warm, tender, ill defined.
<b>LN</b>	-No LNs.	-Late affected.	-Common.
<b>X-ray</b>	- Soap bubble appearance. - Thin expanded cortex. - Medullary plug.	<u>Ill. defined destructive lesion:</u> - Start in metaphysis - Destroys the cortex - Invades the soft tissue <u>New bone formation:</u> - Sun ray appearance (stretched BVs around which new bone formed) - Codman's Δ <u>Soft tissue mass around the bone.</u>	-Onion peel appearance (Osteolytic + periosteal new bone formation).



## IV- Chondrosarcoma

### Definition

- Malignant tumor characterized by formation of cartilage.
- This tumor **commonly** occurs in the **pelvis, ribs** or **proximal** long bones in **middle-aged** people.

### Incidence

- Age: 30-60 years
- Sex: males > females

### Types

#### 1- Primary chondrosarcoma:

- Rarely seen below the age of 40 years old.
- It affects any bone developed from cartilage, especially femur, pelvis, ribs.
- It starts as a central (medullary) tumor similar to chondroma and expands slowly.

#### 2- Secondary chondrosarcoma:

- It occurs on a top of osteochondroma.
- Malignant transformation is suspected by:
  - Enlargement after closure of epiphyseal cartilage.
  - Rapid increase in size.
  - Pain.
  - Invasion of the mother bone.
  - Recurrence after local excision.

### Clinical Picture

- Slowly growing tumors, So:  
→ patients may complain of a dull ache or a gradually enlarging lump.
- Medullary lesions may present as a pathological fracture.

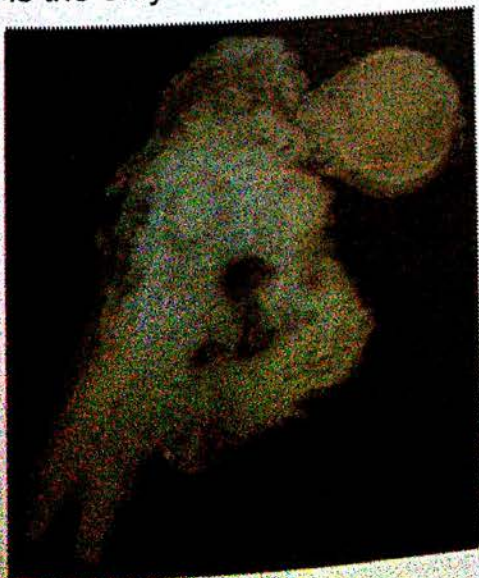
**It metastasizes late to the lung**

### Investigation

- **X-ray:** destructive medullary tumor containing characteristic flecks of calcification  
→ **fluffy calcification** (rings & arcs).

### Treatment

- The tumor is resistant to radiotherapy and chemotherapy.
- Surgery is the only line of treatment.





## V- Fibrosarcoma of bone

### Pathology

- Fibrosarcoma is rare in bone and is more likely to arise in previously abnormal tissue ( a bone infarct, fibrous dysplasia or after irradiation)
- The tumor is slowly growing.
- Histologically, it consists of mass of fibroblastic tissue with scattered atypia and mitotic cells.

### Clinical Picture

- It occurs in older age than osteosarcoma (20-60 years)
- Pain (less severe than that of osteosarcoma), Swelling ± pathological fracture.
- Invasion of the mother bone.

### Investigation

- X-ray: shows indistinct area of bone damage.

### Treatment

- Low grade, well-confined tumors : can be treated by wide excision with local prosthetic replacement.
- High grade tumors: require radical excision or amputation. If this can't be achieved, local excision must be combined with radiation therapy.

## VI- Multiple Myelomas

### Incidence

- The common age of affection is between 45-65 years.

### Pathology

#### Origin

- Plasma cells of the bone marrow.

#### Site

- Wherever there is red marrow, so:  
→ found in the trunk bones, the skull and the proximal ends of femur and humerus.

**N.B.:** Areas of red bone marrow in adults are the sites of affection with:

1. Metastases.
2. Multiple myeloma.
3. Reticulum cell sarcoma.

### Microscopic picture

- Sheets of plasma cells.
- A plasma cell has a large eccentric nucleus that contains a spike- like arrangement of chromatin.

### Clinical Picture

- Weakness.
- Bone pain → constant and backache is particularly common, sometimes with root pain and occasionally paraplegia.
- Pathological fracture.
- General ill-health → Anemia, cachaxia and chronic nephritis.



### Complications

1. Visceral involvement (liver, spleen and lymph nodes).
2. Myeloma kidney (blocking of tubules with protein casts).
3. Metastatic calcifications.
4. Amyloid disease.

### Differential diagnosis

1. Bone secondaries.
2. Parathyroid osteodystrophy.
3. Osteoporosis.

### Investigations

#### A. X-ray:

- There is overall reduction of bone density.
- Sometimes there are multiple punched out defects with no marginal new bone around them (similar to metastatic bone lesions)

**N.B.:** Myeloma is one of the causes of secondary osteoporosis.

#### B. Laboratory findings:

1. Urine analysis → Bence Jones protein (coagulates at 55°C and disappears at 85°C).
2. Plasma and urinary protein electrophoresis shows a characteristic pattern.
3. Sternal puncture → typical myeloma cells (plasma cells form 10% or more of the nucleated cells of the marrow).
4. Blood analysis:
  - Anemia.
  - Raised ESR.
  - Raised alkaline phosphatase.
  - Elevated gamma globulin.
  - Hypercalcaemia.
  - Sometimes plasma cell leukaemia (where myeloma cells enter the circulation and elevate the white cell count).

**N.B.:** osteoporosis + a high ESR = myelomatosis until proved otherwise

### Treatment

- Radiotherapy and chemotherapy relieve pain and pressure effects for a time, and may prolong survival.
- Surgery has a limited role for complicated cases.
- Pathological fractures in the limbs are best treated by internal fixation.
- Unrelieved cord pressure may need decompression.

#### Lesions that simulate primary bone tumors on radiography:

1. Secondary tumors.
2. Osteomyelitis.
3. Callus from unnoticed stress fracture.
4. Simple bone cyst.
5. Aneurysmal small bone cyst.
6. Brown tumor of hyperparathyroidism.
7. Fibrous dysplasia.
8. Myositis ossificans.



## Non-Neoplastic Tumor-like lesions

### Bone Cysts

1. Simple bone cyst (solitary cyst).
2. Fibrous dysplasia.
3. Cysts associated with parathyroid osteodystrophy.
4. Hydatid cyst.
5. Aneurysmal bone cyst.

### A. Simple Bone Cyst

#### Pathology

- **Site** → metaphysis of **upper humerus**, femur or tibia, but other bones may be affected. ( **The most common type of bone cyst** )
- **Patient** → child – adolescent (1<sup>st</sup> and 2<sup>nd</sup> decades of life).
- **Gross** → cyst:
  - Unilocular or multilocular.
  - Filled with clear straw colored fluid.
  - Lined by a CT membrane with few osteoclasts.

#### Clinical Picture

- **Asymptomatic** → discovered accidentally.
- Pain.
- Local thickening of bone (swelling).
- Pathological fracture ">50% of presentations" (disturbance of function).

#### Investigation

- **X-ray:**
  - Well demarcated – **central** – radiolucent.
  - Thin cortex.

#### Treatment

- Curettage & graft.
- Injection with corticosteroids into the cyst (80-160 mg of methyl prednisolone) may lead to its obliteration.
- Treatment of pathological fractures.



### B. Aneurysmal Bone Cyst

#### Incidence

- **Patient** → < 30 years. Females > males
- A relatively rare type of bone cyst

#### Pathology

- **Site** → **Metaphysic** of long bones and spine
- **Naked eye** → loculi filled with blood separated by septa. → containing trabeculae of bone or osteoid tissue and osteoclast giant cells.





### Clinical Picture

- Pain: dull.
- Tenderness.
- Swelling: mild **eccentric**, may become huge.
- Recurrence.

### Investigations

- **X-ray:** Well defined, Eccentric cyst, coarse trabeculae.

### Treatment

- Curettage & grafting.



X- Ray Aneurismal bone cyst

**N.B.:** Radiologically, it may resemble a giant-cell tumor, but that tumor extends to the articular surface where the aneurysmal bone cysts are confined to the metaphyseal side of the growth plate.

## Non ossifying fibroma (fibrous cortical defect)

### Incidence

- This is the commonest benign lesion of bone.

### Pathology

- It is a developmental defect.
- A nest of fibrous tissue appears within the bone.
- It is not a cyst, but it looks like one on X-ray (filled with radiolucent fibrous tissue).

### Clinical picture

- Asymptomatic.
- Almost always discovered in children as incidental finding on X-ray.
- But some may grow → pathological fracture.

### Investigations

- **X-ray:**
  - It appears as an oval radiolucent area surrounded by a thin margin of dense bone.
  - It is adjacent to or within the cortex, hence the alternative name fibrous cortical defect is used.

### Treatment

- Most of these defects heal spontaneously, Unless fracture occurs, they require no treatment.

Classification of bone tumors according to their site		
Vertebrae	Flat bones	Long bones
<ul style="list-style-type: none"> <li>- Osteoid osteoma.</li> <li>- Osteoblastoma.</li> <li>- Haemangioma.</li> <li>- Myeloma.</li> <li>- Secondaries.</li> </ul>	<ul style="list-style-type: none"> <li>- Secondaries.</li> <li>- Myeloma.</li> <li>- Chondrosarcoma.</li> </ul>	<p><b>Epiphysis</b></p> <ul style="list-style-type: none"> <li>- Giant cell tumor.</li> <li>- Chondrosarcoma.</li> </ul> <p><b>Metaphysis</b></p> <ul style="list-style-type: none"> <li>- Osteosarcoma.</li> </ul> <p><b>Diaphysis</b></p> <ul style="list-style-type: none"> <li>- Secondaries.</li> <li>- Ewing's sarcoma.</li> </ul>



## SPECIAL SURGERY

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# Points to remember (Tumors)

### Ivory (compact) Osteoma

- **Site:** Membranous bones (restricted to Skull).
- **C/P:** young adult, painless lump, outer surface of the skull.
- **Comp.:** according to site.
- **Invest.:** X-ray → sessile plaque.
- **TTT:** Excision with trephine or Gigli's saw.

### Osteoid Osteoma

- **Site:** cortex, >50% in femur & tibia.
- **Pathology:** nidus of osteoid tissue surrounded by dense bone, no risk of malignant change.
- **C/P:** Painful small nodule in diaphysis, pain at night, relieved by aspirin. ↑
- **Invest.:** X-ray, bone scan.
- **TTT:** Excision + salicylates for pain.

### Bone Secondaries (50%)

- **Etiology:** cancer breast, prostate (2/3 cases) systemic, direct spread.
- **Pathology:** osteolytic, areas of red marrow.
- **C/P:** as cancer + pain, fractures, ↑Ca++, ↓mobility
- **Invest.:** for 1ry, enzymes, bone scan, CT, X-ray.
- **TTT:** palliative.

### Osteosarcoma

- **Etiology:** Paget's dis., irradiation.
- **Pathology:** metaphysis, osteoblasts, lung metas.
- **C/P:** Teenage, early pain, swelling, L.Ns.
- **Invest.:** as cancer + X-ray (sun ray appearance, Codman's triangle), biopsy.
- **TTT:** Amputation or wide local excision + prosthetic replacement + adju. Chemo.

### Chondrosarcoma

- **Pathology:** - 1ry: rare <40y., femur, start central.  
- 2ry: on a top of Osteochondroma.
- **C/P:** Slowly growing, dull ache, fractures.
- **Invest.:** X-ray (fluffy calcification).
- **TTT:** Only surgery (chemo. & radio. resistant).

### Multiple Myeloma

- **Pathology:** plasma cells, areas of red marrow.
- **C/P:** bone pain, weakness, fractures, ill health.
- **Comp.:** Visceral involvement, Myeloma kidney, Metastatic calcifications, Amyloidosis.
- **Invest.:** X-ray, protein electrophoresis, Sternal puncture, blood & urine analysis.
- **TTT:** - Chemo. & radio.: relieve pain & pressure.  
- Surgery for complicated cases.

### Osteochondroma

- **Path.:** metaphysis, away from joints, bony stalk + cap of cartilage, grow till epiphy. closure
- **C/P:** painless lump, comp., with Gardner S.
- **Comp.:** Pathological fracture, Pressure, Bursitis, Malignant transformation.
- **Invest.:** X-ray.
- **TTT:** - Single: excision.  
- Multiple: removal of complicated one.

### Chondroma

- **Pathology:** solitary, metaphysis, short bones.
- **C/P:** - Ecchondroma: local pain & swelling  
- Enchondroma: asymptomatic
- **Comp.:** pathological fracture.
- **Invest.:** X-ray, CT, MRI.
- **TTT:** - Ecchondroma: wide excision without rupture of capsule.  
- Enchondroma: chiseling.

### Giant Cell Tumor (Osteoclastoma)

- **Pathology:** epiphysis, long bones, around knee, locally malignant, eccentric.
- **C/P:** pain (late) + fractures, globular swelling with egg-shell crackling sensation.
- **Invest.:** as tumor + X-ray, biopsy.
- **TTT:** curettage or excision + reconstruction.

### Ewing's Sarcoma

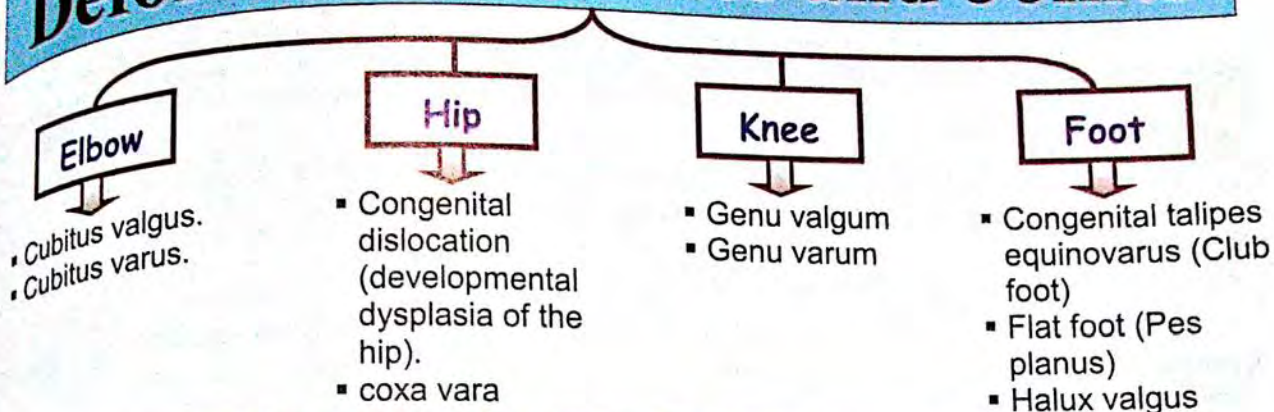
- **Pathology:** diaphysis, endothelium (round cell), blood and lymphatic spread.
- **C/P:** as osteosarcoma + FAHM.
- **Invest.:** as cancer + X-ray (onion peel), CT, MRI, biopsy.
- **TTT:** chemo. + radio. + surgery, then chemo.

### Non Neoplastic Tumor like Lesions

- **Simple Bone Cyst:**
  - Metaphysis, upper humerus, most common.
  - Asymptomatic or pain, swelling, fracture.
  - X-ray, Curettage & graft, steroids into the cyst.
- **Aneurysmal Bone Cyst:**
  - Metaphysis, loculi of blood, septa, trabeculae.
  - Dull pain, tenderness, eccentric swelling.
  - X-ray, Curettage & grafting.
- **Non-Ossifying Fibroma:**
  - Commonest benign lesion, nest of fibrous tissue, not a cyst (looks like one on X-ray).
  - Asymptomatic, incidentally found or fractures.
  - X-ray, heal spontaneously unless fractures.



# Deformities of Bones and Joints



## A. Deformities of the Elbow

### 1) Cubitus valgus

- The most common cause is nonunion of a fractured lateral condyle of the humerus.
- May give gross deformity and a bony knob on the inner side of the joint.
- Its significance is the liability for delayed ulnar palsy to develop.
- The deformity itself needs no treatment but for delayed ulnar palsy, the nerve should be transported to the front of the elbow.

### 2) Cubitus varus

- The most common cause is malunion of a supracondylar fracture of the humerus.
- The deformity is obvious when the elbow is extended and the arms are elevated.
- The deformity can be corrected by a wedge osteotomy of the lower humerus.



normal



cubitus valgus



cubitus varus



## B. Deformities of the Hip

### 1) Developmental Dysplasia of the Hip

(Old name: congenital dislocation of hip)

#### Definition

- Neonatal disorder in which the hip is dislocated either at birth or soon after birth, unless corrected it leads to permanent deformity & disability

#### Incidence

- 1 : 1000.

- Left > Right.

- Bilateral in 1/3 of cases.

#### Risk factors

- Female > male (hormonal joint laxity).
- 1<sup>st</sup> child.
- Breech, oligohydramnios.
- +ve family history of:
  - Developmental dysplasia of hip.
  - Very flexible ligaments or joint laxity.

#### Pathology

- The acetabulum is unusually shallow.
- The femoral head slides out posteriorly or laterally and then rides upwards.
- The joint capsule though stretched remains intact and by folding inwards may impede reduction.
- The fibrocartilagenous labrum is often turned into the acetabulum and this acts as a further obstacle to reduction.
- Maturation of the acetabulum and femoral epiphysis is retarded and the femoral neck is short and anteverted.
- Neglected cases may suffer hip osteoarthritis in later years.

#### Clinical Picture

(Presentation of DDH from birth to adult life)

- Neonates:** - mother observes: asymmetry, clicking hip or difficulty in applying the napkins (due to limited abduction).
  - After walking starts → asymmetry becomes more obvious and a limp also becomes apparent.

- **Special tests:**

Ortolani	Barlow
<p>To perform this maneuver correctly,</p> <ol style="list-style-type: none"> <li>The patient must be relaxed.</li> <li>Only one hip is examined at a time.</li> <li>1-The examiner's thumb is placed over the patient's inner thigh 2-The index finger is gently placed over the greater trochanter. 3-The hip is abducted, and gentle pressure is placed over the greater trochanter. 4-In the presence of DDH, a clunk, similar to turning a light switch on or off, is felt when the hip is reduced.</li> <li>The Ortolani maneuver should be performed gently, such that the fingertips do not blanch.</li> </ol>	<ul style="list-style-type: none"> <li>▪ Barlow's modification of Ortolani's sign.</li> <li>▪ Barlow described another test for DDH that is performed with the hips in an adducted position, in which slight gentle posterior pressure is applied to the hips.</li> <li>▪ A clunk should be felt as the hip subluxes out of the acetabulum.</li> </ul>



**N.B:** Unfortunately these tests are sometimes inconclusive and a mild instability may still be missed only to reappear as a full blown dislocation 3 months later.

## 2. Infant and child:

### Unilateral cases

Asymmetrical gluteal creases  
Present with a limb (the affected leg tends to be short and externally rotated)  
Trendelenburg gait (after walking)

### Bilateral cases

Broad perineum  
No asymmetry → difficult to be detected  
Waddling gait

### **N.B:** Trendelenburg's test:

- In unilateral cases Standing on one foot, on the side of the dislocated hip → the pelvis drops on the unsupported (healthy) side.
- This is caused by impairment of abductor muscles on the dislocated side.

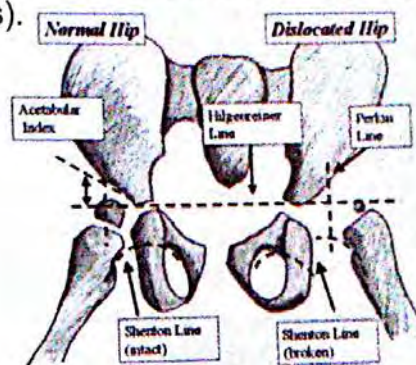
3. **Adolescent:** discomfort after exercise (X-ray may show dysplasia and possibly subluxation)

4. **Adult:** pain is the usual complaint as a result of degenerative osteoarthritis (X-ray may show dysplasia or degenerative changes).

## Investigations

### 1. X-ray:

- Of little value before the age of 1 yr. old as the head of femur is cartilaginous till this age.
- At the age of 1 yr or older:
  - Shallow acetabulum.
  - Ossification center of the head is underdeveloped and displaced upwards & outwards.



### 2. U/S:

- can visualize the shape of the acetabulum and the position of the femoral head with reasonable accuracy.
- It is particularly useful in the newborn, when radiography is undependable.



## Treatment

### a) Newborn:

- Most of neonates with instability sign at birth, spontaneously corrected, so it is better to wait till weeks 3 weeks before intervention.
- After 3 weeks → reduction & splinting in abduction.
- If U/S confirm the diagnosis of CHD → VonRosen splint for 3 – 6 months is a must (time needed until scanning could show a good acetabular roof).

### b) Discovered at the age of 6 months – 6 years:

- Reduction in plaster cast with maintained abduction for 6 wks.
- After 6 wks → replace the cast with splint that prevent adduction but allow movement.
- Follow up by serial X-ray films For 12 months → X-ray may show a nicely reduced femoral head with a normal acetabular roof, if so, the splint is removed.





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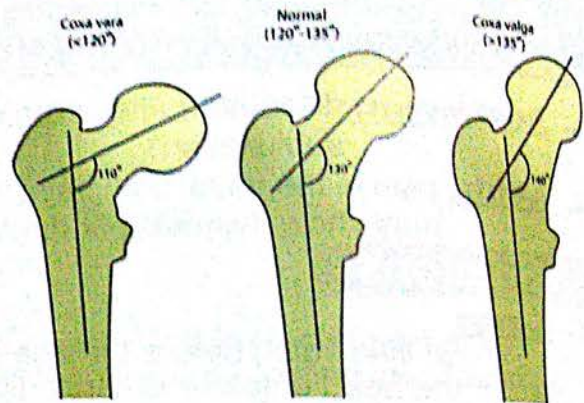
- If failed reduction → surgery is performed either:
  - Open reduction followed by fixation by plaster cast Or if the acetabulum is markedly shallow, it can be deepened by a concomitant pelvic osteotomy.

### c) Discovered after the age of 6 years:

- Unilateral dislocation → operative reduction + corrective osteotomy.
- Bilateral dislocation:
  - Painless not noticed waddling → better to avoid operative reduction.
  - If there is noticed waddling → operative reduction + corrective osteotomy.

## 2) Coxa Vara

- Coxa vara is a diminution of the neck shaft angle of the femur below the normal  $120^{\circ}$ - $140^{\circ}$ .



## 3) Perthes Disease

### Definition

- It is avascular necrosis of capital femoral epiphysis of the femur in children.

### Etiology

- Although no one has identified the cause it is known that there is reduction in blood flow to the joint.
- There are factors implicated in the pathogenesis:
  - a. Low birth weight.
  - b. High birth order.
  - c. Abnormalities in anthropometric measurements.
  - d. Delayed bone age.
  - e. Low socioeconomic status.

### Pathology

- The pathological process takes 2-4 years to complete
  - Stage 1: ischemia and bone death
  - Stage 2: revascularization and repair
  - Stage 3: distortion and remodeling.

### Clinical Picture

#### → Type of patient:

- Male: female 4:1.
- 5-12 years.



→ **Pain:**

- Usually in the hip but can also be felt in the back of the knee (referred pain).
- Onset of the pain up to 4 hours after inactivity and lasts for an hour and return nightly on inactivity.

→ **Limping:**

intermittent or continuous for few weeks particularly when tired.

→ **Movement:**

limited abduction & external rotation of the hip.

**Investigations**

→ **X-ray of the hip joint are absolutely necessary**

- Early → increased density of epiphysis.
- Late →
  - Head is flat and fragmented.
  - Osteoarthritic changes.

→ **Others:**

- Bone scan.
- Hip aspiration (if septic arthritis).
- MRI → for judging the extent of deformity.



**Treatment**

▪ The average duration of the disease is 1 – 2 years.

1. **75% of cases** heal within 2 years without treatment with good to excellent outcome.
2. **non-surgical treatment** (to maximize range of movement):
  - a. Physiotherapy, analgesics, some restriction of sporting activity is advisable.
  - b. Traction method (separates femur from pelvis).
  - c. Abduction brace.

3. **Surgical treatment:**

- ❖ Early → to prevent deformity as:
  - a. Failure of non-surgical treatment.
  - b. In older children who are not compliant with brace treatment (psychological).
- ❖ Late → to salvage a poor mechanical situation.
- ❖ Techniques:
  - Tenotomy (if the condition is long standing the muscle may have contracted or shrunk and cannot be stretched back out).
  - Femoral osteotomy.
  - Pelvic osteotomy.
  - Both femoral and pelvic Osteotomies.

**Causes of AVN:**

1. Steroids.
2. Infections.
3. Sickle cell disease.
4. Hypothyroidism.
5. Skeletal dysplasia.



# C. Deformities of the knee

## 1) Genu Valgum vs. Varum

	Genu Valgum (Knock knees)	Genu Varum (Bow legs)
<b>Definition</b>	<ul style="list-style-type: none"> <li>Fixed abduction deformity of the knees from the middle line.</li> <li>When the knees are placed in contact → the malleoli separate from each other.</li> </ul>	<ul style="list-style-type: none"> <li>A lateral bowing of the legs → the knees are widely separated when the malleoli are in contact, and the knees are held straight.</li> </ul>
<b>Etiology</b>	<ol style="list-style-type: none"> <li>Idiopathic (<b>the commonest</b>): usually bilateral.</li> <li>Bone softening: with rickets and rheumatoid arthritis.</li> <li>Bone injury: with epiphyseal damage or following a fractured lateral tibial condyle.</li> </ol>	<ol style="list-style-type: none"> <li>Physiological (<b>the commonest</b>):               <ul style="list-style-type: none"> <li>Some babies are born with slight bow leg or develop it while wearing napkins.</li> <li>These children nearly all grow straight.</li> </ul> </li> <li>Bone softening due to rickets and Paget's disease.</li> <li>Bone injury affecting the epiphyseal site and sometimes following fracture of the upper tibia.</li> </ol>
<b>Clinical Picture</b>	<ul style="list-style-type: none"> <li>The deformity appears when the patient stands but disappears when the knees are flexed.</li> <li>The patient walks with the knees partially flexed and separated and tends to fall during running (as knees tend to knock together).</li> <li>► <b><u>With idiopathic knock knee:</u></b> <ol style="list-style-type: none"> <li>Deformity is the only symptom.</li> <li>It appears at the age of 2-3 years and nearly always recovers by the age of 6 years.</li> <li>Other postural deformities such as flat foot may coexist but these children are normal in other aspects.</li> </ol> </li> <li>► <b><u>In the other varieties:</u></b> <ul style="list-style-type: none"> <li>There may also be symptoms and signs of the underlying cause.</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>The bowing may involve the tibia alone or the femur may also be affected.</li> <li>The deformity is ugly and causes the patient to look short and stunted.</li> </ul>



**Treatment**

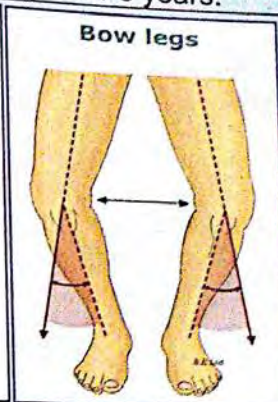
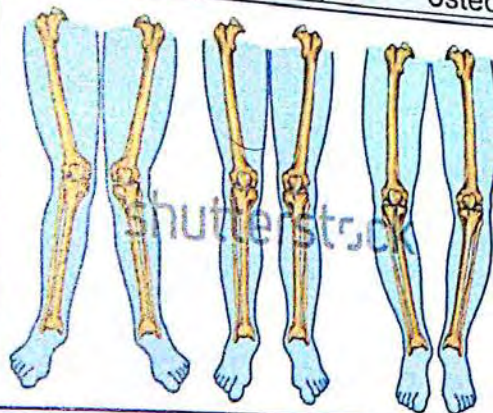
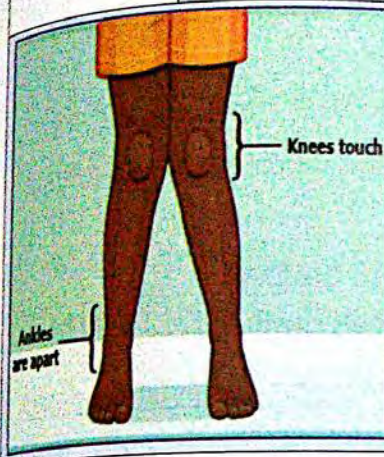
**Of the idiopathic type:**

- The parents should be reassured and the patient is observed as the condition usually requires no treatment.
- If by the age of 3 years the intermalleolar distance is more than 3 inches this is an indication for corrective osteotomy.

**Idiopathic bow legs usually recover.**

**If the bow legs are severe:**

- operation is indicated for cosmetic reasons and to prevent osteoarthritis.
- a- Stapling the lateral side of the lower femoral epiphysis.
- b- Infra-condylar tibial osteotomy after 5 years.



## D. Deformities of the Foot

### 1) Congenital Talipes Equino Varus "Club Foot"

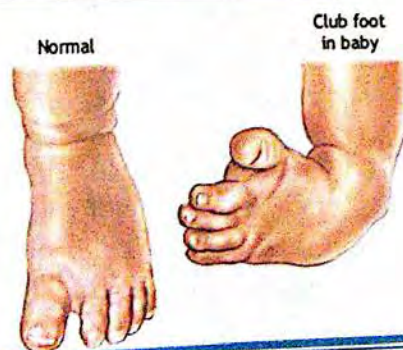
- Tali = Talus = Ankle } in Latin
- Pes = Foot.
- Equino = Plantar-flexion of ankle that looks like a horse's hoof.
- Varus = inward turning of the foot, The sole looks inwards.

**Incidence**

- 1:1000
- Boys : Girls ( 2 : 1 ).
- Bilateral in 1/3 of cases.

**Etiology**

- Idiopathic 95%.
  - 1- Imbalance between invertor planter flexors & evertor dorsi flexors.
  - 2- Mal-insertion of the tendons.
- Other causes → Prolonged malposition of fetus in utero.
- Predisposing factors:
  - 1. Positive family history.
  - 2. Male sex.



Congenital Talipes Equino Varus



## Pathology

### 1- Deformity:

- o Planter flexion of the foot at the ankle.
- o Inversion of the foot at sub-talar joint.
- o Adduction of the forefoot at the mid- tarsal and tarso-metatarsal joints.

### 2- Soft tissues are also affected:

- o Shortening of all ligamentous structures on the medial side of the foot.
- o Hypoplasia of the muscles of the calf leading to shortening of the flexors of the foot and toes.

### 3- If the condition is not corrected early, secondary growth changes occur in bones, these are permanent.

## Clinical Picture

- Deformity is the only symptom in infancy.
- If the deformity remains uncorrected → Painful callosities develops years later in the forefoot.
- The heel may be small and high and the calf is thin.
- Gentle trials of passive correction show the deformity to be fixed.
- The infant must be examined for associated disorders such as spina bifida or arthrogryposis.
- Complete neurological examination must be done to exclude paralytic & spastic types of deformity.

## Investigation

### ▪ X-ray:

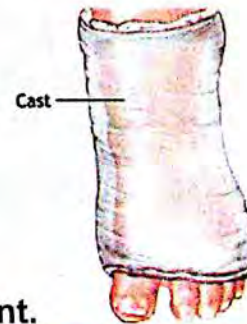
#### - A/P View

- Talo-calcaneal angle is ↓.
- A line projecting the long axis of talus forward passes laterally.

#### - Lateral View

- Tibio-calcaneal angle is obtuse.

#### - Helpful in assessing the progress after treatment.



## Treatment

### Conservative

- Treatment begins within 2 or 3 days of birth.
- **Correction** of the deformity (From distal to proximal):
  - Without anaesthesia.
  - First the forefoot adduction, then inversion and finally the equinus (ankle dorsi-flexion).
- **Maintenance** of the correction by:
  - Adhesive strapping (in the 1st 2-3 wks).
  - Plaster of Paris.
- The process is repeated weekly for 6-8 weeks until the foot is not only corrected but overcorrected.
- Finally correction must be confirmed by X-ray.

Cast for maintenance of the correction



## Operative Treatment

### ▪ Indications:

- Resistant cases.

- Older children.

### ▪ Procedure includes:

- Reduction by elongation of tendon Achillis and division of tight ligaments.
- Osteotomies are needed for children above 5 years.
- Maintaining reduction by casts then by splints.
- Triple arthrodesis is done for advanced cases.



## 2) Flat foot (Pes Planus)

- At birth the foot is flat and the normal arch is only acquired when the infant stands.
- The arch is maintained in adult life by:
  - Shape of the bones of the foot.
  - The connecting ligaments.
  - The action of the muscles of the calf and sole.
- Flat foot in adult life may be due to either collapse of normal arches or the persistence of the infant shape.



### ► Types of flat foot:

#### A. Congenital

- Due to congenital vertical talus.

#### B. Infantile

- This is physiological.

#### C. Spasmodic flat foot

- Uncommon painful condition which presents insidiously in adolescence.
- The foot is everted and hence the medial arch appears flat.
- The tendons of the peroneal and long toes extensors can be seen standing out in continuous contraction.
- Attempts to passively invert the foot are resisted by these muscles and are painful.

### Treatment

- By triple arthrodesis.

#### D. Idiopathic adult flat foot

### Incidence

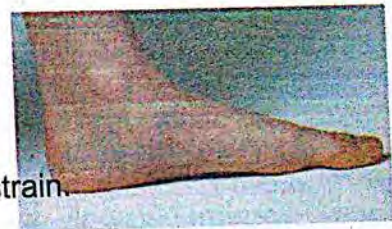
- This is the commonest form of symptomatic flat foot in adults.
- It is seen most commonly in people who spend long hours standing.

### Etiology

- May be the end result of repeated episodes of foot strain.

### Clinical picture

- The medial longitudinal arch gradually collapses → the condition is gradually progressive.
- Presents with aching pain in the foot after long continued standing centered in the medial part of the sole.
- Local tenderness may be found in the sole under the apex of the arch probably because the plantar ligaments are overstretched.
- Pain is provoked if these ligaments are stressed by dorsiflexing the forefoot.
- In later stages: the foot becomes painless and the gait shuffling and inelastic.
- The foot is rigid and flat.
- All joints of the hind-foot degenerate.



### Prevention

- Arch supports.
- Exercises to improve the function of the intrinsic muscles of the sole and the toe flexors.

### Treatment

- Only indicated if the flat foot is symptomatic.
  - The pain of foot strain is relieved by rest.
  - When the foot has finally collapsed, little can be done, so, the patient should be advised to accommodate his life to his feet by taking a sedentary job.



## 5. Traumatic flat foot

- Caused by fractures which abolish the longitudinal arch.
- Fractures of the os calcis may produce a severe flat foot with a rigid subtalar joint.

### 3) Hallux Valgus

- Outward deviation of the great toe at the metatarso-phalangeal joint.

#### Incidence

- It is the **commonest of the foot deformities** and probably of all musculoskeletal deformities.
- It is most common in adolescents and in the sixth decade.
- Sex:** in Females.

#### Etiology

- Usually due to badly fitting shoes with pointed fronts and high heels.
- Rarely due to congenital metatarsus varus in which the first metatarsal is deviated medially away from the other metatarsals.

#### Pathology

- Outward deviation of the first toe at the metatarso-phalangeal joint.
- The deformity tends to be progressive.

#### Clinical features

- Usually bilateral.
- The big toe may lie above or below the second toe.
- The other toes are pushed laterally and often develop a hammer toe deformity.
- The head of the first metatarsal projects on the medial side of the foot.
- Features of complications, e.g., pain from a bunion.

#### Complications

- Callosity in the overlying skin
- Adventitious bursa over the prominent head (bunion).
- Exostosis over the prominent part of the metatarsal head.
- Osteoarthritis of the metatarso-phalangeal joint.

#### Treatment

##### A. In Adolescents:

- Deformity is usually the only symptom.
- Treatment is only operative:  
→ Corrective osteotomy of the first metatarsal → becomes straight → the big toe assumes a more normal position.

##### B. In Adults:

- A) Careful attention to footwear:**  
→ The shoes should be wide, Padding may be used to protect the bunion of hammer toe.
- B) If the deformity is not too severe:** adequate correction obtained by:
  - Tendon release of the adductor hallucis on the lateral side of the big toe.
  - Trimming of the prominent metatarsal head.
  - Tightening of the medial capsule
- C) If the deformity is severe:** Excision arthroplasty is indicated, **Either:**
  - Keller's operation: the proximal part of the proximal phalanx.
  - Mayo's operation: the first metatarsal head.





## Points to remember (deformities)

### Cubitus Valgus vs. Varus

#### ► **Cubitus Valgus:**

- Most common cause is nonunion of a fractured lateral condyle.
- Delayed ulnar palsy may develop.
- The deformity itself needs no treatment.
- For delayed ulnar palsy → the nerve should be transported to the front of the elbow.

#### ► **Cubitus Varus:**

- Most common cause is malunion of a supracondylar fracture.
- Elbow extension, arm elevation: show deformity.
- Corrected by a wedge osteotomy of the lower humerus.

### Perthes Disease

- **Etiology:** Low birth weight, high birth order, Delayed bone age, Low socioeconomic status.
- **C/P:** male, pain in hip, intermittent or continuous limping, limited abduction & external rotation of the hip.
- **Invest.:** X-ray\*, bone scan, MRI.
- **TTT:** - 75% of cases heal within 2 years without treatment.
  - Non-Surgical: Physiotherapy, analgesics, Traction, Abduction brace.
  - Surgical: Tenotomy, Femoral or pelvic osteotomy, or both Osteotomies.

### Congenital Talipes Equino Varus (club foot)

- **Etiology:** idiopathic 95%, malposition in utero.
- **C/P:** deformity (Planter flexion, Inversion, Adduction of the forefoot), associations as spina bifida or arthrogryposis, neurological examination.
- **Invest.:** X-ray\* (AP, Lateral).
- **TTT:** - **Conservative:** start within 2-3 days of birth: correct deformity from distal to proximal, maintained by Adhesive strapping or plaster.
- **Operative:** (Resistant cases, older children): elongation of tendon Achillis, Osteotomies, maintained by casts, Triple arthrodesis.

### Hallux Valgus

- It is the commonest of the foot deformities.
- **Etiology:** badly fitting shoes, metatarsus varus.
- **C/P:** bilateral, big toe above or below the 2nd toe, other toes pushed laterally, pain from bunion.
- **Comp.:** Advent. bursa, Exostosis, osteoarthritis.
- **TTT:** - **In Adolescents:** corrective osteotomy.
- **In Adults:** Careful attention to footwear, if severe (Keller's or Mayo's operation).

### Developmental Dysplasia of the Hip

- **Etiology:** ♀, 1st child, oligohydramnios
- **C/P:** - **Neonates:** asymmetrical gluteal creases, clicking hip, difficult napkin applying, Ortolani, Barlow tests.
  - **Infant & child:** Trendelenburg (unilateral) or waddling gait (bilateral).
  - **Adolescent:** discomfort after exercise.
  - **Adult:** pain (osteoarthritis).
- **Invest.:** U/S, X-ray.
- **TTT:** - **New born:** -up to 3ws: spont. Healing.
  - after 3ws: VonRosen splint for (3-6months).
- **6m. → 6y.:** -reduction in cast for 6ws → splint.
  - failed reduction → surgery.
- **>6y.:** -unilat. → op. reduction+ correct. osteotomy.
  - bilat. → avoid surgery if unnoticed waddling.

### Genu Valgum vs. Varum

- **Genu Valgum:**
  - Usually idiopathic.
  - **C/P:** appears with standing, disappear with knee flexion, the pt. walks with partial knee flexion, (idiopathic: appear at 2-3y. recover at 6y., other deformities may coexist).
  - **TTT:** -No ttt, only reassurance.
    - at 3y. if intermalleolar distance >3 inches → corrective Osteotomy.
- **Genu Varum:**
  - Usually physiological.
  - **C/P:** involve the tibia alone or the femur also, the patient looks short and stunted.
  - **TTT:** usually recover spont. Or operation (cosmetic, to prevent osteoarthritis).

### Flat Foot (Pes Planus)

- **Congenital:** congenital vertical talus.
- **Infantile:** physiological.
- **Spasmodic:**
  - Uncommon painful condition, everted foot, tendons of peroneal and long toes are seen in continuous contraction.
  - **TTT:** Triple arthrodesis.
- **Idiopathic adult flat foot:**
  - Commonest of symptomatic flat foot in adults.
  - **Etio.:** repeated episodes of foot strain.
  - **C/P:** medial longitudinal arch collapse, aching pain in foot after long continued standing, Pain is provoked by dorsiflexion, later (rigid flat foot).
  - **TTT:** in symptomatic: pain relieved by rest, after total collapse → no ttt, change to sedentary job.
- **Traumatic:** Caused by fractures which abolish the longitudinal arch.



# CHAPTER 2

## Neuro-surgery

- Head injuries
- Brain tumors
- Brain abscess
- Hydrocephalus
- Cavernous sinus thrombosis
- Peripheral nerve injuries
- Diseases of the spinal cord

EDH

abscess

hydroceph.

Disc prol

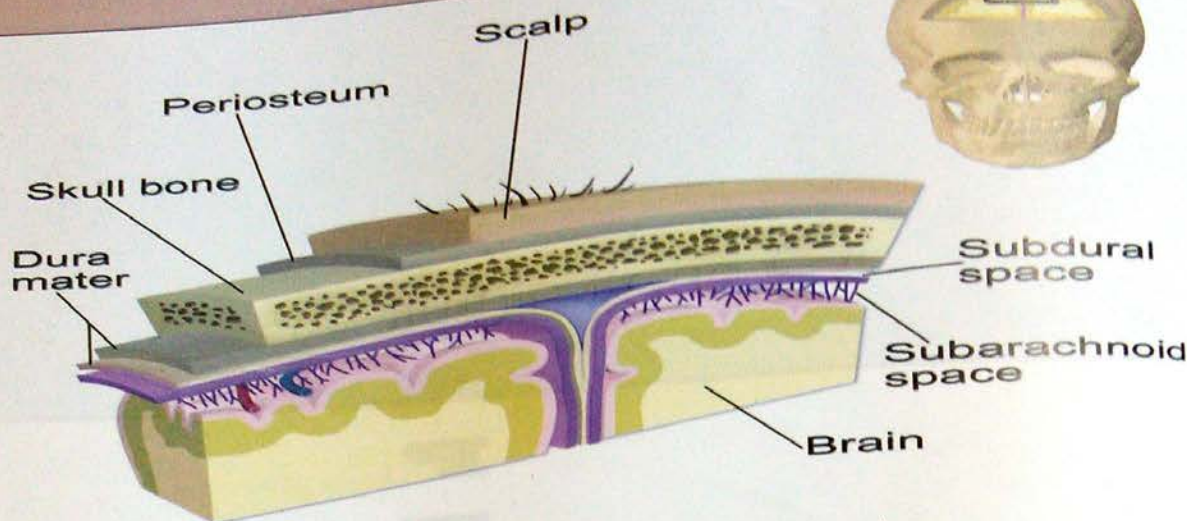


1241 \* Extradural Hge, Acute subdura, localized dep. frac.  
 frac. base, hematoma scalp.

## SPECIAL SURGERY

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# 1-Head Injuries



Layers covering the Brain

## A- Scalp Injuries

- These may be contusions, hematomas, lacerations or incised wounds.
  - ▣ They are caused by sharp or blunt instruments or falls on the head.
  - ▣ Bleeding is very excessive up to causing shock.
  - ▣ Healing is rapid.
  - ▣ If infection occurs in the area of loose areolar tissues, extensive cellulitis may occur.

### Management

#### Management of polytraumatized patient

- Prehospital management: ABCD (see before)
- 1<sup>ry</sup> survey: ABCD
- 2<sup>ry</sup> survey: see before

#### General

- ⇒ Profuse bleeding: very vascular, f.T prevent regail
  - Cannula & IV saline.
  - Blood in severe cases with shock.



#### Local

- I. If there is a possibility of a skull fracture, plain skull X-ray is performed.

#### II. Repair the wound:

- a- Trim the edges.
- b- Local infiltration anesthesia.
- c- Close in 2 layers:
  - Galea to galea → by absorbable sutures.
  - Skin to skin → by non absorbable sutures.

#### III. Treatment of complications & other associated injuries



- If there is liability to infection → closure is done of one layer with loose sutures  
 - When there is scalp defect, a rotational flap is performed.

## Hematoma

	Subcutaneous	Subgaleal (subaponeurotic)	Cephalhematoma
Site	Under the skin (Confined to dense subcutaneous layer) Localized to the site of trauma.	Under galea aponeurotica in loose areolar tissue.	Under the periosteum
Trauma	Direct trauma	Scalp trauma	Birth injury
Source of bleeding	Scalp	Scalp or fractured underlying bone	Fractured underlying bone
Characters	Small, painful	Diffuse soft, fluctuating extending as far as the attachment of the galea, reaching anteriorly to the supra-orbital ridges, Posteriorly to superior nuchal line & laterally to temporal crest	It is limited by suture line of affected bone as the periosteum is attached at the suture lines (usually the parietal bone)
Scalp	Moves with the scalp over the skull	The scalp floats over the swelling <i>* Dangerous → Cont. sinus thromb.</i>	The scalp moves over the swelling but the swelling can not be moved over the skull
DD		Subgaleal collections: CSF (meningocele), empyema	Depressed skull fracture. <i>* Caput succidum on periphery and cystic in center</i>

### Complications

- Infection.
- Associated fracture.
- Cephalhematoma → jaundice and anemia may occur. or shock in baby blood volume small.

### Investigations

Plain X-ray skull to exclude associated fracture.

### Treatment

- 1- Cold fomentation: immediately after trauma, to be replaced by hot fomentation later on.
- 2- Antibiotic: prophylaxis against secondary infection.
- 3- In case of subaponeurotic & subpericranial Hematoma: Aspiration and a pressure bandage.
- 4- A subcutaneous hematoma will resolve spontaneously.



## More details of scalp

### ✿ INFECTIONS OF THE SCALP

- ❑ Usually secondary to wounds.
- ❑ An abscess may occur in the subcutaneous, subgaleal or subperiosteal layers.
- ❑ Intracranial extension of infection from the subgaleal area may occur via the emissary veins.
- ❑ An infected sebaceous cyst is commonly seen in the scalp.
- ❑ **Treatment:** - Antibiotics according to culture studies.  
- An abscess should be drained.

### ✿ TUMORS OF THE SCALP

- a) **Benign:**
  - Lipoma- Papilloma- Plexiform neurofibroma- haemangioma- Cirroid aneurysm,
- b) **Locally malignant:**
  - Basal cell carcinoma.
- c) **Malignant:**
  - Epithelioma-Melanoma-Fibrosarcoma-Sebaceous adenocarcinoma-Metastases,

### ✿ ANATOMICAL FACTS OF SURGICAL IMPORTANCE:

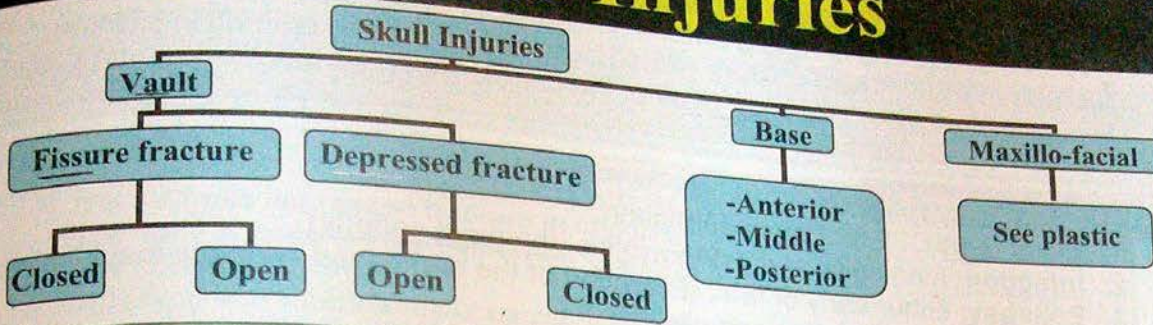
1. The scalp is very rich in blood supply, thus wounds of the scalp even if lacerated heals rapidly without infection.
2. The arteries present in the subcutaneous layer are adherent to the fibrous tissue of this layer.  
When a vessel is injured, the muscular coat of the divided artery cannot retract readily and so bleeding is very profuse.
3. The skin, subcutaneous tissue and epicranial aponeurosis are firmly attached to each other, but they are loosely connected to the pericranium by a layer of loose areolar tissue.
4. The layer of loose areolar tissue allows accumulation of large amounts of blood or inflammatory exudate.
5. Complete avulsion of the scalp can occur.

### ✿ HOW TO STOP BLEEDING FROM A SCALP WOUND?

1. **Direct pressure:** A depressed fracture should be excluded before applying direct pressure.
2. Applying multiple Allis forceps to the edge of the wound and bending them.
3. Applying multiple artery forceps to the galea aponeurotica and allowing them to fall back over the skin edge.
4. All these measures are temporary before suture of the wound.



# B- Skull Injuries



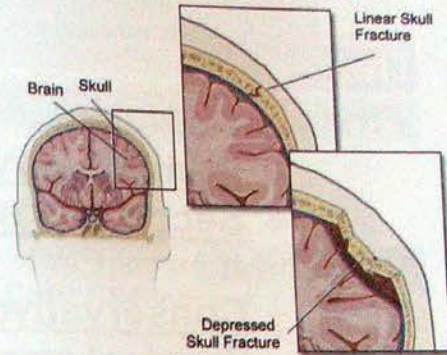
## I-Fracture Vault

### Etiology

1. Local indentation of the skull by direct blows → closed or compound depressed fractures.
2. General deformation of the skull due to compression by a hard flat surface → fissure (linear) fracture, often associated with brain injury.
3. Missile injuries.

### Clinical Picture

- Fractures of the vault may be fissure or depressed and any of them may be closed or open.



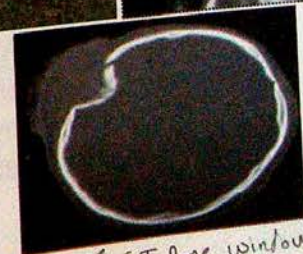
Fissure fracture	Closed depressed fractures	Compound depressed fractures
<ul style="list-style-type: none"> <li>Presents with the clinical picture of the associated cerebral damage.</li> </ul> <p><i>Simple or Compound.</i></p>	<ul style="list-style-type: none"> <li>Rare in adults.</li> <li>There is usually an overlying hematoma which may obscure the fracture.</li> <li>The depressed segment rarely causes cerebral compression.</li> </ul> <p><i>Simple or Compound</i></p>	<ul style="list-style-type: none"> <li>There may be:                             <ol style="list-style-type: none"> <li>a- Profuse bleeding.</li> <li>b- Leakage of CSF.</li> <li>c- Prolapse of a portion of the brain.</li> </ol> </li> <li>Concussion is surprisingly slight and there is usually no compression.</li> <li>The main hazard here is the liability to infection.</li> </ul>

### Investigations

#### A. Plain x-ray:

- In fissure fracture: will reveal the fracture, which may simulate a suture line of the skull but the latter exists at certain sites and it has a serrated edge.
- In depressed fracture: will visualize the depressed segment.

#### B. CT scan: to detect any associated lesions as extradural hemorrhage.



CT Bone window



- fissure fracture should be differentiated from suture line by:

- The anatomical site of suture line. *x-ray*
- The suture line is zigzag & does not bleed. *clinical*
- Diastatic Fracture: linear fracture extending to suture (more common in children).
- In depressed fracture: The inner plate of the skull is fractured before the outer plate. *أكثر طبقات الجمجمة تتضرر*

## Complications

1. Dural tear: CSF and brain herniation.
2. Infection: meningitis and osteomyelitis (the most serious).
3. Epilepsy: either early or late, (Elevation of the depressed segment may diminish, but does not abolish this complication).
4. Cosmetic deformity.
5. Severe bleeding from one of venous sinuses

Although any complication may occur, concussion & compression are rare.

## Treatment

### First aid Treatment (ABCD)

- ⇒ Primary survey: As Usual. *Life save*
- ⇒ Secondary survey: As Usual. *detect Cause*

### At hospital

- ⇒ Conservative treatment: see extradural hemorrhage.
- ⇒ Surgical treatment:

#### A- Fissure fracture:

- Treatment of the associated cerebral damage follows the usual lines.
- The site of a fissure fracture, e.g. overlying the course of middle meningeal vessels should alert the surgeon to the possibility of an extradural hematoma.
- If the fracture is compound → the scalp wound is treated as usual.

#### B- Closed depressed: or Pond Fract.

- Treated essentially by conservative measures.
- Indications of surgery:

- Large depressed segment > 1 inch.
- If the depressed segment compresses an important area as the motor area or speech centre.
- Associated brain damage or dural tear.
- If the depressed segment is causing a cosmetic deformity, e.g. in the frontal bone.
- If the fracture is overlying an air sinus.

#### C- Compound depressed:

- Technique (operative theater + complete aseptic conditions + general anesthesia)
  - 1- Foreign bodies are removed.
  - 2- The depressed segment is gently elevated to avoid tearing of the dura.
  - 3- Any prolapsed or necrotic brain tissues is sucked and hemostasis is performed.
  - 4- Any dural tear is repaired.
  - 5- Removed bone segments may be cleaned & replaced.



- 6- If the depressed bone is comminuted, cranioplasty may be performed.
- 7- The pericranium & the scalp sutured.
- 8- Prophylactic antibiotics are administered.
- 9- Any Intracranial lesion MUST be managed.

The most important cover to the brain is **DURA** and every attempt should be made to preserve it and close it.

### Pond fracture

- It is a simple depressed fracture in children.
- The bone is usually indented rather than fractured.
- The dura usually intact.
- This type of fracture usually corrects itself by time with growth of the skull.

*Handwritten note:* Surgery if large

### Comparison of simple & compound depressed fractures

	Simple depressed	Compound depressed
<b>Cause</b>	Blunt rounded object.	Localized sharp object or severe blunt object.
<b>Age</b>	Common in infants & children (ping-pong).	Common in adults (stronger skull).
<b>Associated lesions &amp; complications</b>	<u>Less common:</u> <ul style="list-style-type: none"> <li>- Mostly overlying hematoma.</li> </ul>	<u>More common:</u> <ul style="list-style-type: none"> <li>- Scalp → profuse bleeding.</li> <li>- Dura: CSF leakage, brain herniation &amp; infection.</li> <li>- Cerebral cortex: contusion &amp; epilepsy</li> <li>- Venous sinus: intracranial hemorrhage.</li> </ul>
<b>Treatment</b>	<ul style="list-style-type: none"> <li>- Conservative.</li> <li>- Elevation when indicated.</li> </ul>	<ul style="list-style-type: none"> <li>- <u>Surgical</u> interference</li> <li>- Cranioplasty: (in depressed comminuted fracture).</li> </ul>

### Comparison of fissure fracture & depressed fracture

	Fissure(linear) fracture	Depressed fracture
<b>Instrument e.g.</b>	- Head trauma to the wall	- Head trauma with a hammer
<b>Contact surface area</b>	- Wide	- Small
<b>Site</b>	- Starts at site of impact & runs away from it	- Localized under site of impact
<b>Complications</b>	- Less common	- Common
<b>Treatment</b>	<ul style="list-style-type: none"> <li>- <u>Conservative</u></li> <li>- Treatment of <u>associated lesions</u> if present</li> </ul>	<ul style="list-style-type: none"> <li>- <u>Elevation</u> if indicated + of associated <u>lesions</u> if present.</li> <li>- Cranioplasty if there is comminution of bone</li> </ul>



## 2- Fracture Base of the Skull

### Etiology

#### I. Indirect trauma: (the most common)

1. **Trauma to the spine:** fall on the hells or buttocks pushes the spine against posterior cranial fossa.
2. **Trauma to the chin:** the mandibular condyle transmits trauma to the glenoid cavity (middle cranial fossa).
3. **Trauma to the vault:** produces fracture in the base by extending to the bone.  
→ As the vault is elastic, it escapes while the base being rigid and weakened by multiple foramina, breaks.

#### II. Direct trauma: (rare)

3h01 3h02 - Due to penetrating sharp objects or bullet through the orbit, nose, mouth, pharynx, occiput.

### Pathology

- ✱ **Sites:** fracture base may occur in the anterior, middle or posterior cranial fossae.
- ✱ **Shape:** the fracture is usually a fissure, which runs through the weak points.

### Types

#### A. Closed: rare. intact dura

- There are 3 groups of associated lesions: i.e. 3x2
- **2 In** : infection, air enter the dura (Pneumocephalus)
  - **2 Out** : blood & CSF.
  - **2 Injured**: brain injury, cranial nerve injury except 12<sup>th</sup> CN.

#### B. Open:

- It is more common (why?)
  - o Because the dura is firmly adherent to the skull base than to the skull vault.
- Anterior cranial fossa is mainly related to the nose.
- Middle fossa is mainly related to the ear.
- Herniation of cranial contents.
- Injury to cranial nerves.
- Signs of brain injuries.

### Clinical Picture

- The manifestations of a fracture base are any or a combination of the 3 groups of signs in each cranial fossa.

#### 1- Anterior Cranial Fossa

##### ex 1- Blood:

- o Subconjunctival hemorrhage (panda bear or Raccoon sign).



- o Epistaxis: if affects cribriform plate of ethmoid.

CSF  
Blood  
Cr.N



	Subconjunctival hemorrhage due to local trauma	Subconjunctival hemorrhage due to fracture base
1. History - Trauma - Conscious. - Onset	- To the eye. - Not affected. - Immediate.	- To the head. - Loss of consciousness. - Delayed (effusion starts in lower lid then upper).
2. Shape	- Triangular, base to cornea.	- Triangular apex to cornea. - The eye may be pushed forward (proptosis)
3. Post limit	- Definite.	- Cannot be seen.
4. Color	- Bright red.	- Dark red.
5. movement	-----	Limitation of movement of eyeball

## 2- CSF:

- o Traumatic rhinorrhoea. If the dura is torn, may persist for weeks & patient complains of persistent salty taste due to the high chloride content of the fluid.
- o Air may enter the cranial cavity when the patient blows his nose (pneumocephalus).

## 3- cranial nerve injury: affected cranial nerves may be: 1- 6

- o I, III, IV & Ophthalmic branch of V cranial nerves.
- o The olfactory nerve is frequently torn, but unless its fellow is also damaged, the partial anosmia may pass unrecognized.

## 4- In severe injuries: brain matter may escape into the nose or pharynx.

## 5- Concussion is usually severe, but the intracranial damage tends to be less severe than in the case of other fossae.

- Optic nerve usually escapes as it is protected by the bony canal (Optic canal).
- CN III injury causing dilated pupil in conscious patient

12th  
hypoglossal  
also ↓  
sternum  
foramen

## 2- Middle Cranial Fossa

- Escape of blood and CSF from the ear is the most common and characteristic sign.

### 1- Blood

- Discoloration over mastoid process (battle's sign).
- There may be surgical emphysema.
- Epistaxis occurs if the fracture involves the nasal sinuses.
- The sphenoidal region is often involved and the cavernous sinus or internal carotid artery may be injured.
- D.D.: bleeding from ruptured drum → it clots rapidly.



### 2- CSF

- Escape of CSF and blood from the <sup>external</sup> ear is common (drips for days without clotting)

### 3- Cranial nerve injury

- Mandibular and maxillary divisions of the 5<sup>th</sup>, 6<sup>th</sup>, 7<sup>th</sup> or the 8<sup>th</sup> nerve may be injured.

#### - The facial nerve:

- commonly injured at the time of the accident, torn with permanent paralysis
- Occasionally, the paralysis appears after a few days from compression by extradural haemorrhage → recovery often follows.
- If the paralysis develops some weeks after injury → produced by pressure from fibrous tissue or callus → the condition will be permanent.



- 4- Surgical emphysema may occur around and behind the ear if the fracture involves the mastoid antrum.
- 5- Concussion is always present, often with signs of severe intracranial damage.

### 3- Posterior Cranial Fossa

#### 1- Blood:

- May occur in the suboccipital region producing a boggy swelling or discoloration at the nape.
- External haemorrhage does not occur because the fracture is rarely compound.

#### 2-CSF:

- CSF may escape from the mouth. *ororhea*

#### 3-Cranial nerve injury:

9<sup>th</sup>, 10<sup>th</sup> and 11<sup>th</sup>

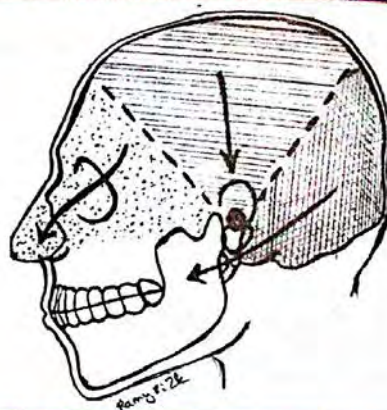
may be injured in jugular foramen.

4- patient usually is deeply unconscious due to injury of pons & medulla

5- Subtentorial hemorrhage may lead to death due to severe bulbar compression

6- The upper cervical nerves are sometimes irritated by blood producing retraction of the head and stiffness of the cervical muscles

12<sup>th</sup> nerve in the condyloid foramen is protected by the condylar process.



### Complications of fracture base

- Extradural hemorrhage

Sites of Hemorrhage & escape of CSF

### Investigations

- Plain x-ray.
- CT Scan:
  - Fractures in the base.
  - Any associated intracranial injuries (of an important value in head injuries).





**First aid Treatment (ABCD)**

- ⇒ **Primary survey:** As Usual.
- ⇒ **Secondary survey:** As Usual.

**At hospital**

- ⇒ **Conservative treatment:** <sup>كحل التماسك</sup> as extradural hemorrhage.
- ⇒ **Definitive treatment**

1. **Prevention of infection**

- Prophylactic antibiotics: should be started at once & continued for one week after cessation of bleeding or CSF leakage.
- Avoid mouth washes or to syringe the ear, as this increases the risk of infection.

2. **Control of CSF leakage**

- Cerebrospinal rhinorrhoea → semi-sitting position & avoid blowing.
- Cerebrospinal otorrhoea → lie on the opposite side & clean dry dress is applied on (not inside) the ear.
- Usually the leakage stops spontaneously in 85% of cases of rhinorrhoea and in 95% of cases of otorrhoea.
- If leakage from the nose persists for more than 10 days, the torn dura is grafted by fascia lata to avoid infection.
- Bed rest for at least 3 weeks and no work resumption before at least 2 months.

3. **Treatment of the associated brain injury (follows the usual lines).**

	Fracture Vault	Fracture Base of the Skull
<b>Compressing hematoma(EDH)</b>	Common	Rare
<b>Types</b>	Closed or open	Open>closed
<b>Infection, Pneumocephalus</b>	Less common	Common
<b>Bleeding/ nose, ear</b>	Less common	Common
<b>Associated nerve injury</b>	Rare	Common
<b>Associated brain injury</b>	Close to or near fracture. Opposite side in contre-coup	May be away from fracture. Site in indirect fracture base
<b>Treatment</b>	Elevation of depressed TTT of associated injury (dural tear, EDH....)	Aiming to control: CSF leak, Infection. TTT of associated injuries (brain & cranial ns)

MRI is superior to CT in demonstration of anatomical details and addition of sagittal cuts, while CT is superior in bone visualization.

**More details of the skull****TUMORS OF THE SKULL:**1. **Benign:**

- These are rare.
- An ivory Osteoma occasionally arises in the region of the frontal sinus.

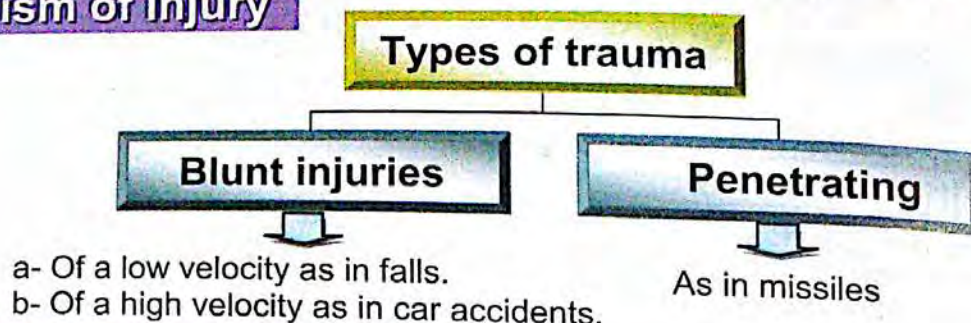
2. **Malignant:**

- Primary as: Osteosarcoma, Fibrosarcoma, Giant cell tumor and Multiple Myeloma,
- Metastases from the breast, thyroid, adrenal, kidney and prostate.



# C- Intracranial Injuries

## Mechanism of Injury



## Factors that affect the severity of cerebral injury

- 1- Displacement and distortion of the brain → damage to neurons, nerve fibers, glial tissue and blood vessels.
  - a) Posterior displacement → distortion at the region of the hypothalamus and brain stem → affects the reticular formation leading to temporary or persisting loss of consciousness.
  - b) Anterior displacement → distortion of the corpus callosum.
- 2- Mobility of the brain in relation to skull and meninges (Acceleration or deceleration injuries).
- 3- Configuration of the interior of the skull. Smooth areas will produce less damage than rough areas.
- 4- Age of the patient. A young patient has better chance of recovery than an elderly one, as the functional reserve of the brain is higher.

## Pathological sequelae of head trauma

### i. Primary Pathological Sequelae

(Primary lesions, which occur at the time of impact)

1. Diffuse neuronal damage (Concussion → physiological block).
2. Cerebral Contusion (microscopic injury of the brain) & laceration (macroscopic injury of the brain).

### ii. Secondary Pathological Sequelae

(Secondary lesions, which develop later)

- |                                     |                               |
|-------------------------------------|-------------------------------|
| 1. <u>Intracranial hemorrhage</u> . | 5. <u>Brain stem lesion</u> . |
| 2. <u>Brain edema</u> .             | 6. <u>Infection</u> .         |
| 3. <u>Vascular changes</u> .        | 7. <u>CSF rhinorrhoea</u> .   |
| 4. <u>Coning</u> .                  |                               |

## Extracranial factors that affect the cerebral injury

- 1- **Respiration:** respiratory inadequacy ( $\downarrow O_2$ ,  $\uparrow PCO_2$ ) can aggravate the brain edema and venous congestion leading to irreversible changes.
- 2- **Blood volume & blood pressure:**  $\downarrow$  cardiac output due to hypovolemia may lead to irreversible cerebral ischemic damage.
- 3- **Fluids:** patients with cerebral injury have disturbances in the BBB and  $\downarrow ADH$ . IV infusion of hypotonic fluids will decrease plasma osmolarity leading to increased brain edema
- 4- **Temperature:**  $\uparrow$  body temperature will cause a further deterioration in neurological state due to increased metabolic demands and accumulation of metabolites.



## Factors that raise the ICT in patients with head injury

- 1- Brain edema.
- 2- Intracranial hematoma: extradural, subdural or intra-cerebral.
- 3- Cerebral swelling due to local vasodilatation and loss of auto-regulation.
- 4- Rise of arterial PCO<sub>2</sub>.

## i. Primary Pathological Sequelae

### Early Complications of Head Injuries

#### 1- Cerebral Concussion

##### Definition

- It is a transient loss of consciousness, which starts with the trauma and lasts for a limited period followed by complete recovery if no other injury has occurred.
- The duration of the period of concussion depends on the severity of neuronal injury commonly few minutes. In severe head injuries, loss of consciousness may persist for several hours.

##### Mechanism

- Sudden change in velocity → vibratory wave, which affects reticular formation responsible for consciousness.

##### Clinical picture

- See extradural hemorrhage

##### Fate

- Complete recovery (common).
- Incomplete recovery (post-concussion \$).
  - (Amnesia – Headache – Drowsiness – Irritability).
  - Concussion passing to compression with Lucid interval.

#### Investigations to exclude intracranial hemorrhage

- Plain x-ray.
- CT (of choice to exclude intracranial hemorrhage).

##### Treatment

- Rest & observation for at least 48 hours.

#### 2- Cerebral Contusions

##### Definition

- Areas of bruising, swellings with intact pia and arachnoid, localized or generalized oedema and haemorrhage due to tearing of blood vessels.

##### Clinical picture

- Prolonged unconsciousness.
- Signs of focal neurological damage.

##### Fate

- On recovery patient complains of headache and confusion.
- Contusions are irritative to cerebral cortex so may cause epilepsy.



## 3- Cerebral laceration

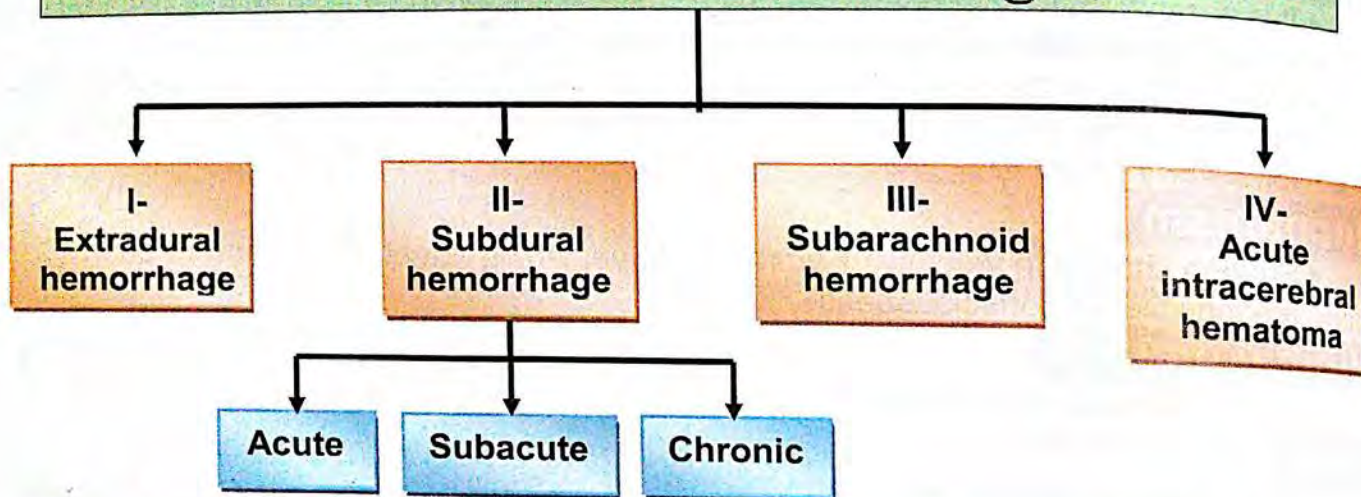
- The pia and arachnoid are torn, with bloody effusion in the CSF.

## ii. Secondary Pathological Sequelae

Before doing lumbar puncture we have to exclude ↑ICT for fear of development of Herniation syndrome.

## Clinical presentations of the various pathological sequelae

### Intracranial hemorrhage



## I- Extradural Hemorrhage

### Applied anatomy

#### Middle meningeal artery:

- ECA → Max. art → MMA  
→ sup. of Temporal

- It is a branch of the maxillary artery, entering the skull through the foramen spinosum to the floor of middle cranial fossa. There it divides into:
  - Anterior branch: It passes up & forwards, lying in a bony canal at the pterion. It overlies the motor cortex (artery of extradural hemorrhage).
  - Posterior branch: It passes backwards to the occipital bone.

### Definition

- It is hemorrhage, which occurs between skull and dura matter, commonly in temporal or parietal regions.

### Etiology

- Usually due to trauma to the side of head either:
  - With fracture of temporal or parietal bone. Common
  - Without fracture especially in children as they have elastic skull.

### Pathology

- Source of bleeding:
  - Middle meningeal artery, especially the anterior branch (most common).
  - Venous sinuses: profuse hemorrhage (serious). No recoil → No lucid interval
  - Diploic hemorrhage: minimal (clinically insignificant).



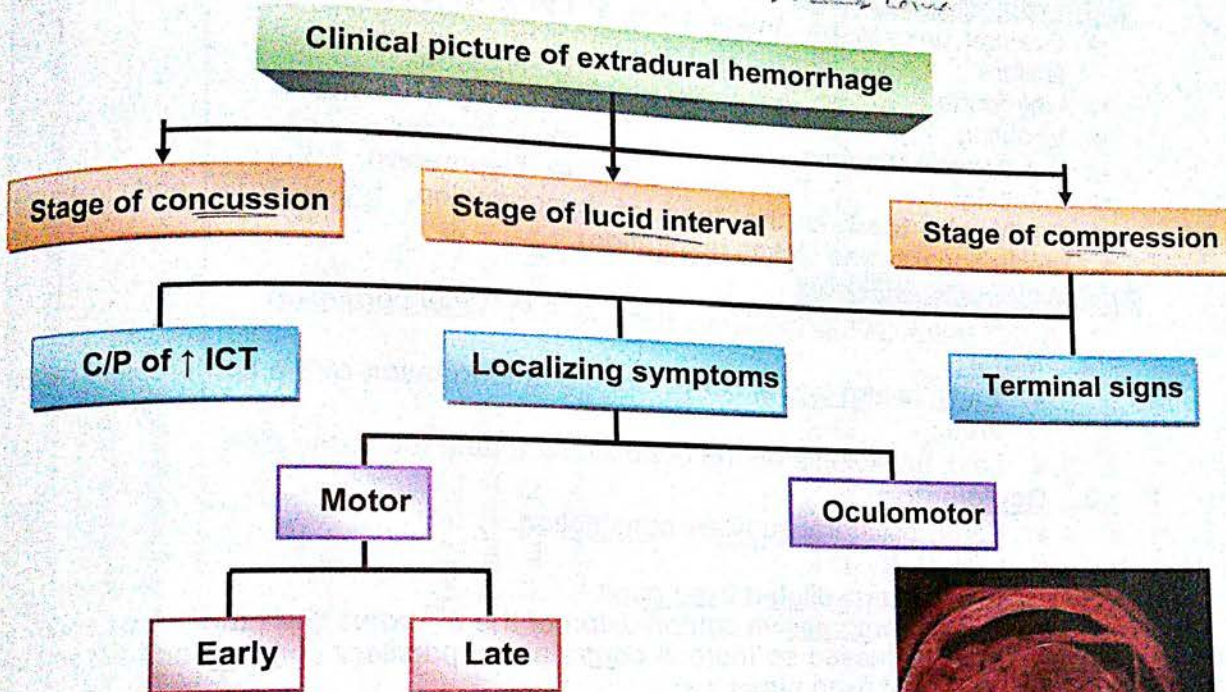


- In anterior branch bleeding, blood escapes from the injured artery in 3 directions:
- ليرت الإحسنة Outwards: to form a hematoma deep to the temporalis muscle.
  - لوقت Downwards: to the middle cranial fossa
  - لوقت الإحسنة Upwards: over the parietal region (the precentral motor cortex) causing convulsions followed by paralysis.

In posterior branch bleeding, the hematoma collects away from the motor cortex; convulsions do not occur.

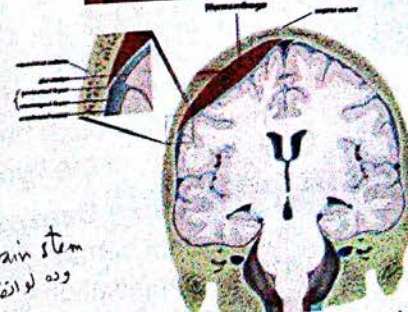
## Clinical picture

Trauma → Coma → aroused → Coma



## A. Stage of concussion

- a. Immediate loss of consciousness after trauma to the head.
- b. The patient falls flaccid as one block & loses his consciousness. *د.ت RAS damage*
- c. Vital signs:
  - i. Pulse: weak & rapid.
  - ii. ABP: ↓.
  - iii. Temp.: subnormal.
  - iv. Respiration: shallow, slow.
- d. Limbs:
  - i. Skin: cold.
  - ii. Muscles: relaxed.
  - iii. Reflexes: lost.
- e. Eyes:
  - i. Closed.
  - ii. Equal, reactive pupils, *with center in brain stem*
- f. Sphincters: May relax.
- g. On recovery, pulse, temperature, blood pressure, reflexes become normal & consciousness is regained after few minutes.





## B. Stage of lucid interval

- Period of recovery from coma of concussion followed by coma of compression.
- During this period blood is accumulating gradually in the extradural space.

- Lucid interval may be brief and missed
- May be longer if venous bleeding

## C. Stage of compression

### 1. C/P of increased ICT

- ⇒ Gradual progressive deterioration of the level of consciousness is the main feature.
- ⇒ Headache.
- ⇒ Vomiting.
- ⇒ Behavioural changes.
- ⇒ Irritability.
- ⇒ Cushing's triad is the triad of hypertension, bradycardia and irregular respiration (Cheyne Stokes respiration).
- ⇒ Nausea.
- ⇒ Blurring of vision.
- ⇒ Drowsiness.
- ⇒ Depression.

### 2. Localizing symptoms

- ⇒ Occurs due to compression by blood and tentorial herniation.

#### i. Motor:

- Early: contra-lateral convulsions due to irritation of the compressed motor area.
- Late: hemiplegia on the opposite side then the same side.

#### ii. Oculomotor:

- Early: ipsilateral pupillary constriction..
- Late:
  - Ipsilateral dilated fixed pupil.
  - With progressive compression of the 3<sup>rd</sup> nerve the other side becomes compressed so there is contralateral pupillary constriction followed by dilated fixed pupil.

### 3. Terminal Compression

As the coma deepens the blood pressure rises and the pulse and respiration slow down (Cushing's triad).

- Finally hyperpyrexia, decerebrate rigidity and bilateral dilated fixed pupils occur, and constitute clinical evidence of bad prognosis

It should be stressed that this classic picture is only found in a minority of patients.

## DD

- Acute subdural hemorrhage (see later)

## Causes of Death

### Immediate Deaths

Causes: due to severe injuries, for example:

- Primary brain stem hemorrhage and contusions
- Lacerations of the hypothalamus

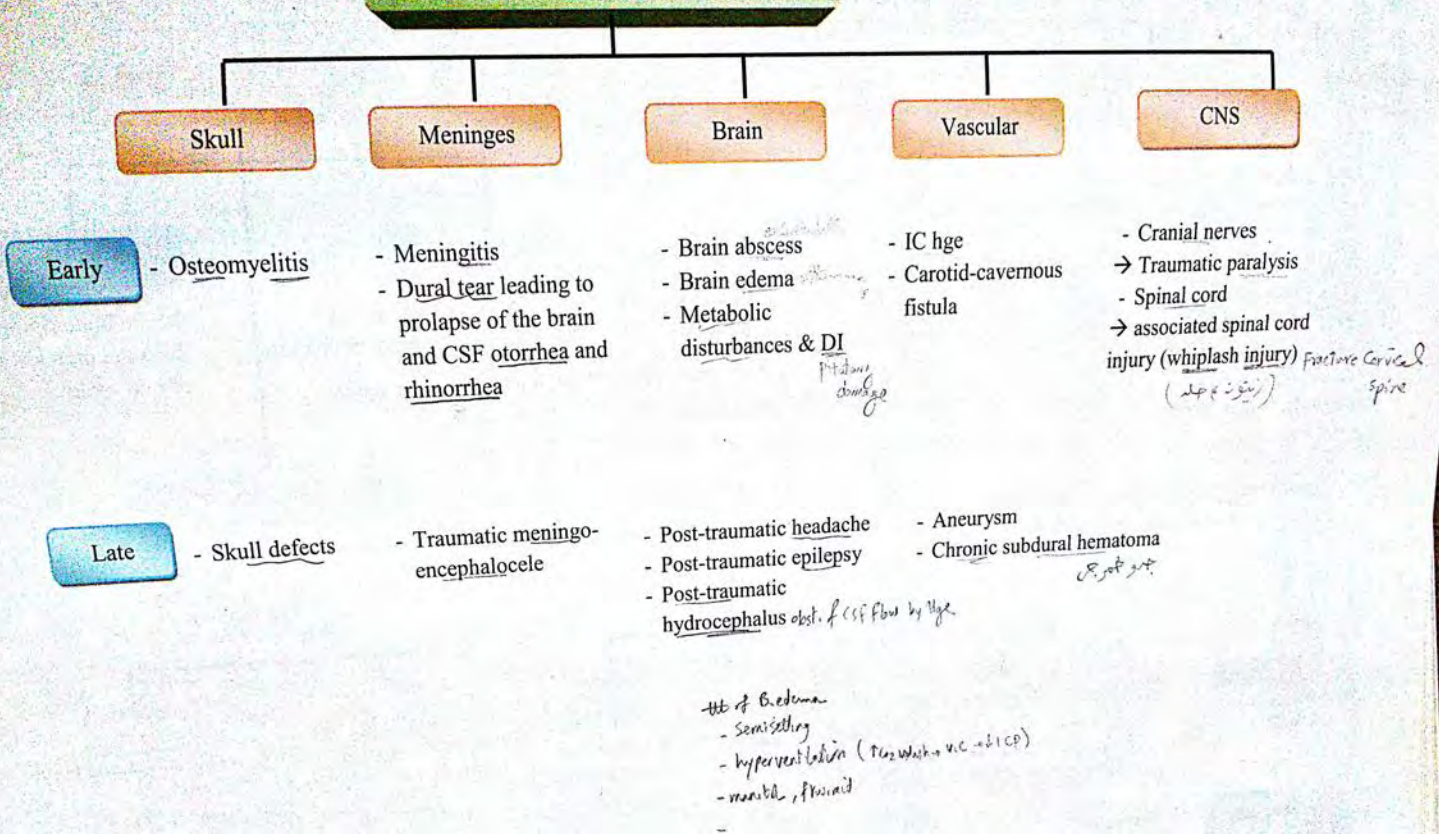
### Delayed Deaths

Causes: due to:

- Intracranial hematoma, which have escaped diagnosis.
- Chest complications.
- Meningitis & brain abscess.
- Metabolic disorders & diabetes insipidus.
- Multiple injuries.

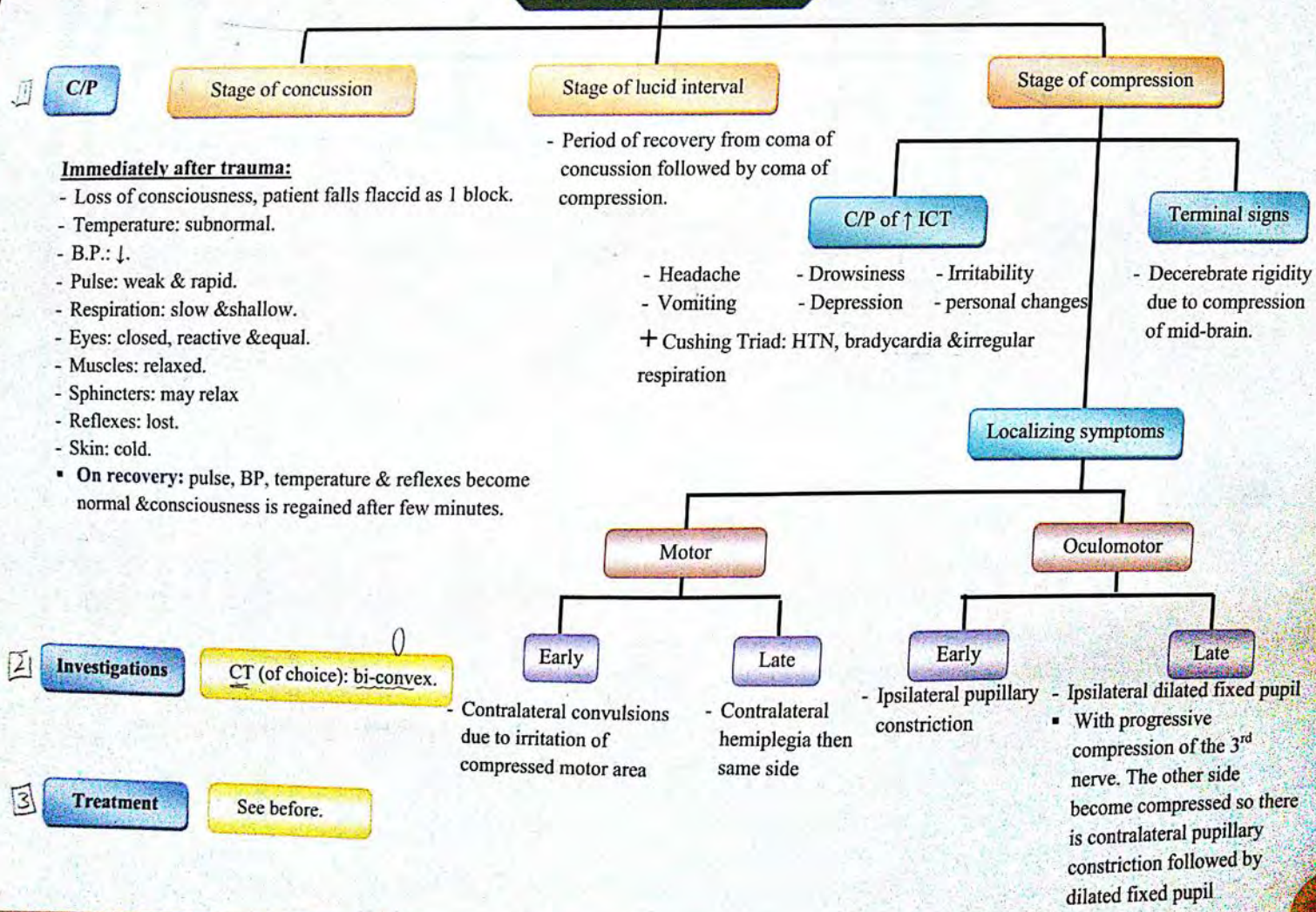


**Complications of any head trauma**





Management of Extra-dural Hge





## II- Acute Subdural Hemorrhage

### Etiology

- Usually due to severe trauma, less commonly with cerebral laceration.

### Incidence

- It is the least common of traumatic intra-cranial hematomas.

### Pathology

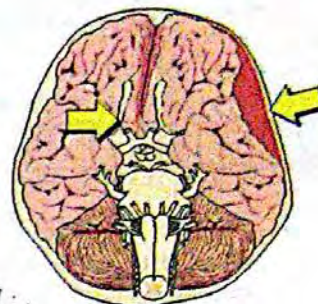
### Source

- Usually from rupture of a large cortical vein as it crosses the subdural space to reach the fixed subdural venous sinuses.

### Site

- Commonly bilateral & extensive.

### Clinical Picture



	Acute extradural hematoma	Acute subdural hematoma
<b>Etiology</b>	- Usually mild trauma.	- Severe trauma.
<b>Clinical picture</b>	- Usually mild brain damage.	- Severe brain damage & laceration.
	- Lucid interval may be present.	- Persistent loss of consciousness, no lucid interval.
	- The hematoma is usually unilateral.	- Commonly bilateral and extensive (coup & contre-coup).
<b>Investigations</b>	- CT → <u>biconvex</u> .	- C.T → <u>crescentic</u> (concavo-convex)
<b>Treatment</b>	- Early surgery is successful.	- The patient has serious brain damage and edema in addition to the hematoma, and so results of surgery are not very successful. Mortality rate is up to 50%.
<b>Prognosis</b>	- Better prognosis	- Worse prognosis

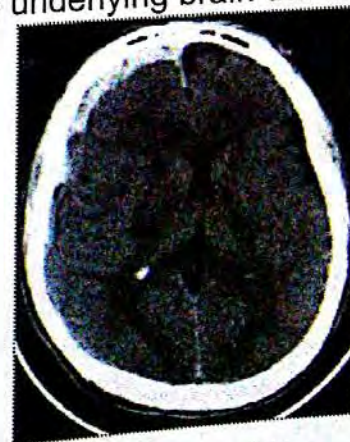
- Signs can be misleading because of the extent of the underlying brain damage.

### Complications

- As extradural hemorrhage.

### Investigations

- CT scan.





## III- Subarachnoid Hemorrhage

### Causes

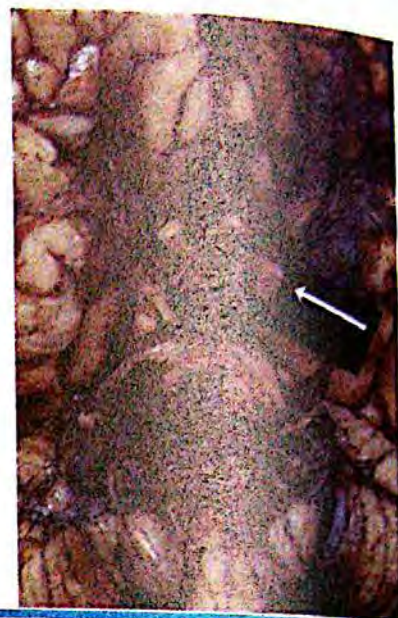
- **Traumatic** (most common cause)
- **spontaneous**
  - Rupture <sup>Berry</sup> aneurysm (50%). ✓
  - Hypertensive disorders.
  - Bleeding tendencies.
  - Malignant tumors.
  - A-V malformations.

### Clinical Picture

- Headache: sudden severe splitting, agonising headache accentuated by flexion of neck followed by sudden loss of consciousness with no recovery or may recover → then deteriorate (arterial spasm).
- Symptoms & signs of meningeal irritation e.g. photophobia, neck stiffness & Kernig's sign.
- General symptoms: nausea, vomiting, vertigo and fever.
- Focal defects.
- Sudden death within (6) wks of hemorrhage (= 2nd fatal attack).

### Investigations

- **CT-scan:** is the 1<sup>st</sup> investigation to be done, if blood is detected diagnosis is settled and lumbar puncture is not needed.
- **Angiography:** (performed within few days after hemorrhage) to diagnose bleeding vessel or AVM.
- **Lumbar puncture:** high pressure, bloody CSF + Xanthochromia.



The white arrow on the black card marks the site of a ruptured **berry aneurysm in the circle of Willis**. This is a major cause for **subarachnoid hemorrhage**.

### Treatment

- **Conservative.**
- Of the cause → Surgical (microscope): evacuate hematoma, obliterate aneurysm.
- Of complications e.g. hydrocephalus: VPS (ventriculo-peritoneal shunt).

## IV- Acute Intra-Cerebral Haematoma

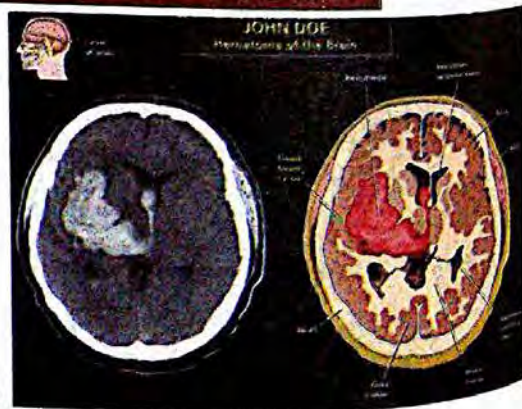
- This is the least common of traumatic intracranial haematomas.
- Usually accompanied by brain contusions, laceration, edema and necrosis.
- All these factors → poor general condition of the patient.

### Investigations

- **CT scan:** should be performed.

### Treatment

- Decision of surgery depends on the judgment of the surgeon but the results are unpredictable.





# V-Chronic Subdural Haematoma

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## Incidence

- More common in old age (due to brain atrophy) / alcoholics. *كبر السن / شرب*
- Bilateral in 50% of cases.

## Etiology

- Slight blow to the head, which may pass unnoticed in elderly alcoholics.

## Pathology

- It results usually from rupture of the *Chronic* superior cerebral veins as a result of sudden displacement of the brain within the skull. *صغير براسه*
- Cause:** Minor trauma to the front or back of the head, not enough to produce a fracture or even concussion.

## Clinical picture

- The interval between the trauma and the symptoms varies between weeks to months.
- The symptoms are vague and consist of chronic headache, mental apathy, slowing of cerebation and the patient may even develop stupor.
- Physical signs may be absent or at most there may be unilateral or bilateral extensor plantar response. Pupillary changes are late and denote impending conization. *hemiplegia*
- The symptoms and signs wax and wane. The condition may be diagnosed as psychosis or cerebrovascular accident.

## DD

- Other causes of increase intracranial tension. *tumor*

## Investigations

- CT is the investigation of choice (hematoma will appear as hypodense area).
- Fundus examination → Papilloedema is not common.

## Treatment

- Evacuation through burr holes.



## Management of intra-cranial injuries

### A- Dealing with life-saving priorities (primary survey):

- ABCDE.
- It is also to be stressed that the patients with a head injury are more likely to die from airway obstruction than from any remediable intracranial lesions.
- The presence of shock in a patient with a head injury is most likely due to internal haemorrhage in the thorax or abdomen.

### B- Secondary survey:

#### 1- Exposure:

- Of the patient to detect any soft tissue, vascular or orthopedic injury.
- This phase aims at resuscitation & monitoring of polytraumatized patient.

#### 2- Head to toe examination of undressed and stable patient:

- Vital signs → confirm that the patient is stable.
- Head examination.
  - Scalp → For any scalp wound or hematoma.
  - Skull → for any fracture



- Pupils → if dilated initially → direct injury to orbit or oculomotor nerve.  
→ if constricted initially → later dilates → lateralization due to a supra-tentorial haematoma.
- Neurological: Glasgow coma scale.
  - ⇒ The total points are added. The higher the score, the better is the prognosis.
    - Mild → (13-15)
    - Moderate → (9-12)
    - Severe → with a score of 8 or less.
- Neck: neck collar for fixation.
- Chest: pneumothorax, hemothorax, fracture ribs, cardiac tamponade.
- Abdomen → for internal haemorrhage or peritonitis.
- Back → For the possibility of fractures or dislocations.
- Limbs: for fractures and neurovascular bundle.

### **C- Indications for admission to the hospital:**

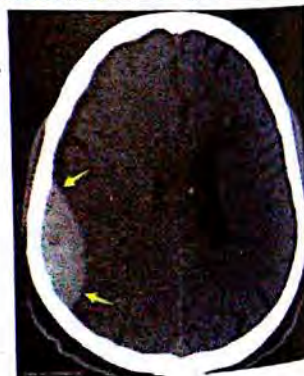
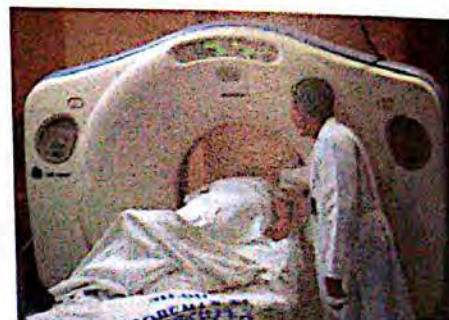
- a. Any depression of level of consciousness.
- b. Skull fracture.
- c. Focal neurological signs.
- d. Persistent headache or vomiting.
- e. Absence of responsible relatives who can observe the patient for the first 24 hours.
- f. Difficulty in assessing the patient: alcoholic, young or epilepsy.

- The level of consciousness is the most important sign of patient's progress.
- CT scan should be performed before surgery to evaluate the size of the hematoma and the degree of brain damage and oedema.

### **D- Investigations:**

#### **a. CT scan (of choice):**

- **Highly recommended for:**
  - a. Depressed or compound fractures.
  - b. Impaired level of consciousness or focal neurological signs.
  - c. Basal skull fractures.
  - d. Deteriorating level of consciousness.
- **It detects:**
  - a- brain edema, brain contusion or laceration.
  - b- The site, size and progress of the intracranial hematoma.
    - Acute extradural or subdural hematomas are hyperdense compared to the brain, and there will be shift of mid line structures.



#### **b. Plain X-ray:**

- 1- **Skull:**  
shows the site and type of the fracture → a clue to the severity and the site of an extradural hematoma.
- 2- **Chest & cervical spine.**

#### **c. Laboratory investigations:** especially renal functions to assess patient's general condition.

If the patient, on clinical grounds, is in urgent need for evacuation of an intra-cranial hematoma, no time should be lost in doing investigations, and surgery should be done immediately.



## E- Continuing care and observation:

### ♦ Aim:

- ♦ To give the patient the maximum care until spontaneous recovery occurs.
- ♦ To detect, at the earliest possible moment, the development of complications that may need surgical interference.

### 1- Attention to the airway :

- ♦ If spontaneous respiration is inadequate to keep the normal levels of PO<sub>2</sub> and PCO<sub>2</sub>, an endotracheal tube is inserted and controlled ventilation started.
- ♦ An endotracheal tube needs full sedation or even muscle relaxants. It can be left for a period up to 7 days.
- ♦ If ventilation is needed for a longer , a tracheostomy is performed.

2- A foley's catheter is inserted to facilitate the nursing care and to estimate the urine output.

3- Frequent change of posture to avoid bed sores.

4- Physiotherapy to the joints and massage to the muscles.

5- A nasogastric tube is inserted for feeding.

6- Osmotic diuretics : raise the osmolarity of the plasma → reduce the brain oedema.  
a- 250ml of 20% mannitol are given over a period of 20 minutes and may be repeated every 8 hours.

b- Before mannitol is administered, it is essential to exclude an intracranial haematoma and to check that the renal function is satisfactory.

c- Mannitol should not be used for more than 48 hours to prevent rebound oedema and electrolyte disturbances.

7- Furosemide: 40-80 mg IM is an alternative to mannitol.

8- Corticosteroids. These are empirically prescribed but there is no clear evidence that they reduce the cerebral oedema nor improve the outcome in patients with severe head injury.

### ♦ Repeated observations for the following :

- 10 Level of consciousness using Glasgow coma scale.
- 20 Pulse, B.P., and temperature. → for Cushing's Δ
- 30 Respiration.
- 30 Pupils.
- 40 Reflexes.

### ♦ Causes of deterioration of the patient :

- 1- Brain edema → leading to increased intracranial tension.
- 2- Airway obstruction and/or hypoventilation → brain swelling and increased intracranial tension, (Respiratory insufficiency can be confirmed by estimating PO<sub>2</sub> and PCO<sub>2</sub>).
- 3- Intracranial hematoma → confirmed by CT scan.
- 4- Fever due to respiratory infection or meningitis.
- 5- Overtransfusion by hypotonic fluids or dehydration.
- 6- Epilepsy → If not accompanied by convulsions → difficult to differentiate it from an intracranial haematoma.

### ♦ A rising ICT produces the following manifestations:

1. Deterioration in the level of consciousness.
2. Slowing pulse rate.
3. Rising blood pressure.
4. Slowing respiration.

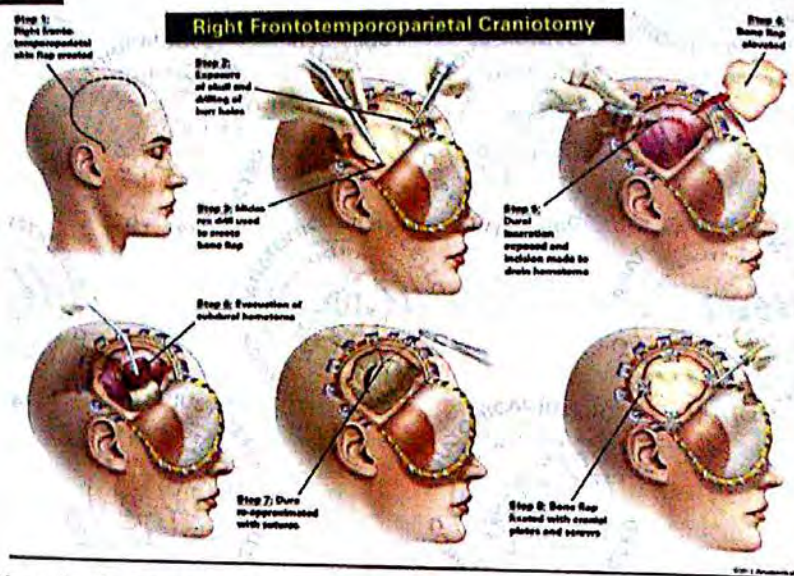
} Cushing Triad



## F- Surgery to evaluate an acute intracranial haematoma

- Deterioration of the patient's condition → high possibility of an intracranial haematoma → surgical interference at this stage can save the patient.
- Otherwise, progressive deterioration and fatal herniation of the cerebellar tonsils and medulla through the foramen magnum will occur.

### ➤ Operation:



- 1- The operation is done under general anaesthesia with endotracheal intubation.
- 2- The Patient is placed supine with the sites of the haematoma uppermost, and the head is raised slightly to reduce venous bleeding.
- 3- A formal craniotomy by an osteoplastic flap is done. *Quest. mark incision*
- 4- Four or five burr holes are done and are connected by a saw.
- 5- Skin and temporalis are not dissected from bone. The whole osteoplastic flap is turned down, thus exposing the dura.
- 6- If an extradural haematoma is present, it can be removed by suction and the middle meningeal artery coagulated or under-run by a stitch.
- 7- Occasionally it may be necessary to follow the middle meningeal artery to the foramen spinosum which is packed with bone wax. *ex. 204*
- 8- If a subdural haematoma is found, the dura matter is opened in a cruciate fashion to allow rapid decompression of the brain.
- 9- A drain is placed and the flap is returned to its place and fixed by suturing temporalis fascia and skin. *scalp. 11 CS*
- 10- Prophylactic anticonvulsant drugs are prescribed for 6 weeks to guard against epileptic fits.



# Late Complications of Head Injuries

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## 1- Brain edema

- Intracellular and extracellular accumulation of fluid occurs.
- May be **localized** around the area of brain injury or it may **extend** to involve the **whole brain** leading to marked rise of intracranial pressure.
- Clinically, this **simulates the picture of brain compression** due to surface hematoma, yet without focal manifestations.

## 2- Vascular changes

- The rising intracranial pressure disturbs the cerebral blood flow, with resultant ischemic necrosis and subsequent brain edema.
- Cerebral infusion pressure = B.P – intracranial pressure

## 3- Herniation

- The rise of intracranial pressure will cause:

### 1. Herniation of the contents of the supratentorial compartment

- Through the tentorial hiatus → tentorial herniation "lateral herniation" → Leads to →

- a) Herniation of the medial part of the temporal lobe on the side of the supra-tentorial mass:  
Leads to → 1- Compression of oculomotor nerve → constriction then dilatation of the ipsilateral pupil.  
2- Compression of the midbrain.

BRAIN HERNIATION



- b) Compression of descending motor pathways from the opposite hemi-sphere → hemi-plegia on the same side of hematoma.

- ### 2. Herniation of the contents of the infratentorial compartment
- through the foramen magnum → foramen magnum herniation "central herniation" → compression of the vital centers in the medulla → ↓pulse, ↓RR, ↑BP (Cushing triad), severe headache and neck rigidity are present.

## 4-Brain stem injury

### Etiology

- Primary damage to the brain stem (medulla and pons)
- Secondary damage due to unrelieved supratentorial herniation.

### Diagnosis

- The patient is unconscious with spontaneous extension spasms of all four limbs. opisthotonus, tachycardia, small pupils, pyrexia and rapid shallow breathing.

### Treatment

- With intensive treatment, the patient may recover but there is often marked spasticity.



## 5-Infection

### Etiology

- This complication is liable to occur in patients with compound fractures or fractures of the base especially if there is CSF rhinorrhoea or otorrhoea.

### Complications

- The usual complication is meningitis which may develop 2-3 days after the injury and manifests by fever and neck stiffness. (Meningitis can be confused with subarachnoid hemorrhage)
- Brain abscess is a possible sequel of infection.

### Investigations

- Diagnostic lumbar puncture will establish the diagnosis.

## 6-CSF Rhinorrhoea

### Etiology

- This occurs secondary to a fracture involving the paranasal sinuses, frontal, ethmoid or sphenoid associated with a dural tear.

### Pathology

- A piece of brain tissue is forced into the dural tear and prevents its healing.
- Complications:
  - This complication is liable to be followed by meningitis.

### Treatment

- The patient is treated initially by antibiotics.
- Indications for surgical interference include :
  - Persistence of the rhinorrhoea more than 10 days
  - The presence of a fracture involving the frontal or ethmoid sinus
  - The occurrence of meningitis.

### ➤ EXTRACRANIAL FACTORS THAT AFFECT THE CEREBRAL INJURY:

- 1- Respiration.
- 2- Blood volume and blood pressure.
- 3- Fluids(Patients with cerebral injury have disturbances in the blood brain barrier and inappropriate secretion of ADH. Intravenous infusion of hypotonic fluids in these patients will lower the plasma osmolarity leading to increased brain oedema and swelling.)
- 4- Temperature.

## 7-Post-traumatic Headache

- Patients with serious head injury usually have some residual symptoms as headache, giddiness, impaired sleep and defective concentration.
- These patients need prolonged convalescence



## 8-Post-traumatic Epilepsy

➤ This may be either :

### A. Early:

- Within one week after the injury.
- Its incidence is increased in patients with depressed fracture or intracranial haematoma.
- These patients need prophylactic anticonvulsants for 6 weeks.

### B. Late epilepsy:

- The incidence of which is much higher in those who had early epilepsy.
- It occurs within 1-4 years after the injury.

➤ Treatment: long term anticonvulsant drugs.

## 9-Post-traumatic hydrocephalus

➤ This may need shunt operation.

## More details

### ➤ HOW TO DETERMINE THE SIDE OF TRAUMA? (SIGNS OF LATERALIZATION)

- 1- The side of external trauma (counter-coup is an exception)
- 2- The side of initial constriction and dilation of the pupil.
- 3- The contralateral side of convulsions.
- 4- The contralateral side of hemiparesis.
- 5- The side of skull fracture in the X-ray.
- 6- CT scan: **investigation of choice.**

### ➤ EXAMINATION OF HEAD INJURY:

- Glasgow coma score.
- Pupil size & response.
- Lateralizing signs.
- Signs of fracture base:
  - Bilateral periorbital edema.
  - Battle's sign.
  - CSF rhinorrhea or otorrhea.
  - Hemotympanum or bleeding per ear.
- Full neurological examination: tone, power, sensation & reflexes.



# Glasgow Coma Scale

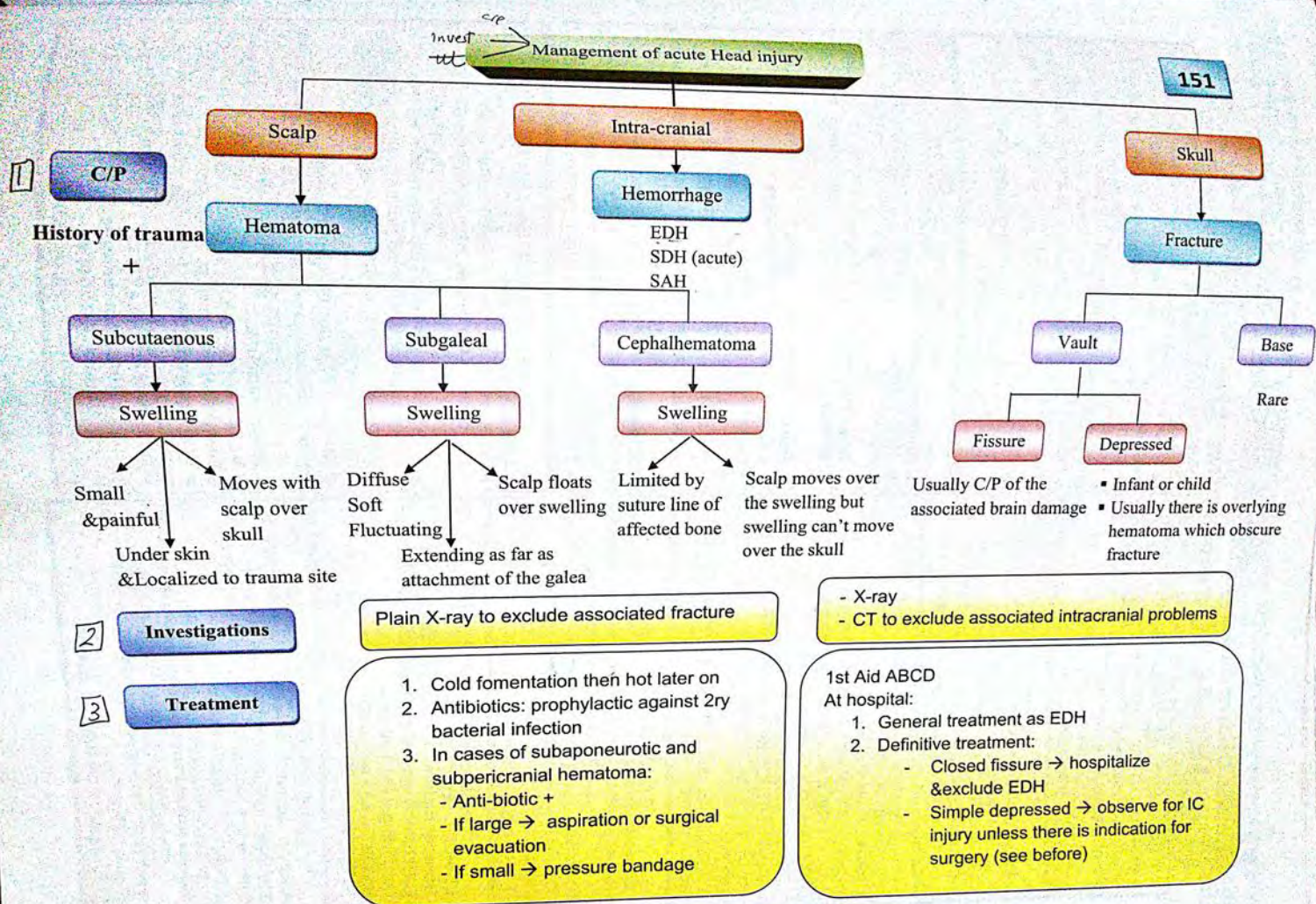
	1	2	3	4	5	6
Eyes	Does not open eyes	Opens eyes in response to painful stimuli	Opens eyes in response to voice	Opens eyes spontaneously	—	—
Verbal	Makes no sounds	Incomprehensible sounds	Utters inappropriate words	Confused, disoriented	Oriented, converses normally	—
Motor	Makes no movements	Extension to painful stimuli)	Abnormal flexion to painful stimuli)	Flexion / Withdrawal to painful stimuli	Localizes painful stimuli	Obeys commands

→ The scale comprises three tests: eye, verbal and motor responses. The three values separately as well as their sum are considered. The lowest possible GCS (the sum) is 3 (deep coma or death), while the highest is 15 (fully awake person).

→ **Generally, brain injury is classified as:**

- Severe, with GCS  $\leq 8$
- Moderate, GCS 9 - 12
- Minor, GCS  $\geq 13$ .







## Points to remember (head injuries)

### Scalp Injuries

- **Etiology:** blunt or sharp trauma, fall on head.
- **C/P:** pain, swelling, bleeding ± shock ± cellulitis.
- **Management:** as any trauma (ABCD) +
  - **General:** Control & Compensate for blood.
  - **Local:** Clean & repair the wound.

### Fracture Vault

- **Etiology:** direct blows, compression by a hard flat surface, missile injuries.
- **Fissure fracture:** C/P of cerebral damage.
- **Closed depressed:** overlying hematoma, rarely cause cerebral compression.
- **Compound depressed:** bleeding, CSF leakage, brain prolapse, main hazard is infection.
- **Invest.:** X-ray, CT scan.
- **Comp.:** Dural tear, Infection, Epilepsy, Cosmetic deformity, Severe bleeding.
- **TTT:** ABCD + Conservative (as EDH),  
**Surgical:** - **Fissure fr.:** ttt of cerebral damage.  
 - **Closed dep.:** raise the segment if (>1inch, over imp. area, over air sinus, brain or dural damage).  
 - **Compound dep.:** raise segment, repair dural tear, manage brain damage, antibiotics.

### Scalp Hematoma

- **Subcutaneous:** localized, moves over the skull.
- **Subgaleal:** diffuse, fluctuating, extends anteriorly to the supra-orbital ridges, posteriorly to superior nuchal line & laterally to temporal crest.
- **Cephalhematoma:** Under the periosteum, limited by suture line, cannot be moved over the skull.
- **Comp.:** as trauma, infection, associated fractures + cephalhematoma → jaundice, anemia.
- **Invest.:** as trauma esp. X-ray.
- **TTT:** cold foment, antibiotics, aspiration and pressure bandage.

### Fracture Base of the Skull

- **Etiology:** direct, indirect trauma (commonest).
- **C/P:**

<u>Blood</u>	<u>CSF</u>	<u>Cranial nerves</u>
↓	↓	↓
- <b>Ant.:</b> eye, nose	Nose	I*, III, IV, V (ophth.)
- <b>Middle:</b> Ear	Ear	5th (mand. & max.), 6th, 7th*, 8th 9th, 10th, 11th
- <b>Post.:</b> Nape	Mouth	
- **Comp.:** Extradural hemorrhage.
- **Invest.:** X-ray, CT scan.
- **TTT:** as trauma (ABCD) + prevent infection (antibiotics), control CSF leakage, ttt of brain inj.

### Extra-Dural Hemorrhage

- **Etiology:** trauma to the side of head.
- **Source:** MMA (commonest), venous sinuses (serious), Diploic hemorrhage.
- **C/P:** concussion → lucid interval → compression.
- **Comp.:** as any head trauma (early, late).
- **Invest.:** CT → unilateral biconvex.
- **TTT:** early surgery is successful.

### Subarachnoid Hemorrhage

- **Etiology:** traumatic\*, spontaneous.
- **C/P:** headache, mening. irritation, focal defects.
- **Invest.:** CT, angiography, lumbar puncture.
- **TTT:** conservative, surgical evacuation, of comp.

### Management of Intra-Cranial Injuries

- **Life saving priorities:** 1ry survey (ABCDE).
- **2ry survey:** exposure, head to toe exam.
- **Indications for admission to hospital.**
- **Invest.:** CT (of choice), X-ray, laboratory.
- **Continuing care and observation:** air way, Foley's catheter, change posture, physiotherapy, nasogastric tube, osmotic diuretics, frusemide, corticosteroids.
- **Surgery to evacuate hematoma.**

### Acute Subdural Hemorrhage

- **Etiology:** severe trauma.
- **Source:** rupture of a large cortical vein.
- **C/P:** bilat. & extensive. Loss of consciousness without lucid interval.
- **Invest.:** CT → crescentic.
- **TTT:** surgical with poor results (50%).

### Chronic Subdural Hemorrhage

- **Source:** rupture of the superior cerebral veins.
- **Etiology:** mild blow to the head in elderly.
- **C/P:** vague symptoms long time after trauma.
- **Invest.:** CT, fundus examination.
- **TTT:** evacuation through burr holes.

### Acute Intra-Cerebral Hemorrhage

- **Least common,** usually with brain damage.
- **Invest.:** CT scan.
- **TTT:** depends on surgeon opinion

### Late Complications of Head Injuries

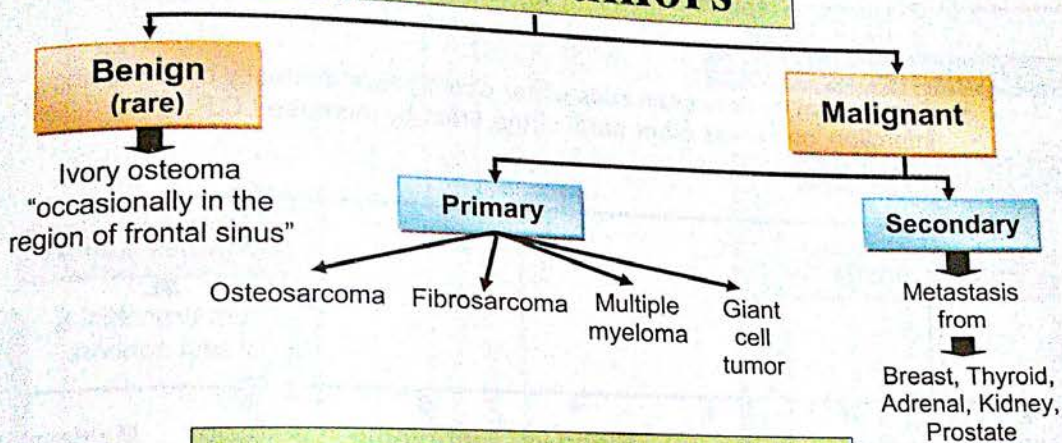
- **Brain oedema.**
- **Vascular change.**
- **Herniation.**
- **Brain stem injury.**
- **Infection.**
- **CSF rhinorrhoea.**
- **Post traumatic headache.**
- **Post traumatic epilepsy.**
- **Post traumatic hydrocephalus.**



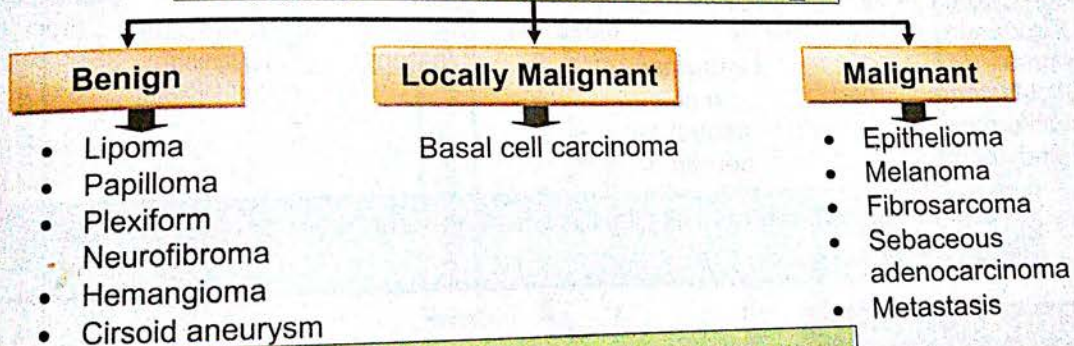
# Tumors

1. Skull tumors.
2. Tumors of the scalp.
3. Brain tumors.
4. Nerve tumors.

## 1- Skull tumors



## 2- Tumors of the scalp



## 3- Brain Tumors

### Definition

- Intracranial mass created by abnormal and/or uncontrolled cell division.
- The term intracranial tumor is used to refer to all neoplasms arising from the skull, meninges, blood vessels, pituitary & pineal glands, cranial Ns, brain tissue as well as metastatic tumors.

### Incidence

- In adults: 1.4 % of all cancers
- In children: 20-25 % of all cancers
- More than 50% of brain tumors are secondaries

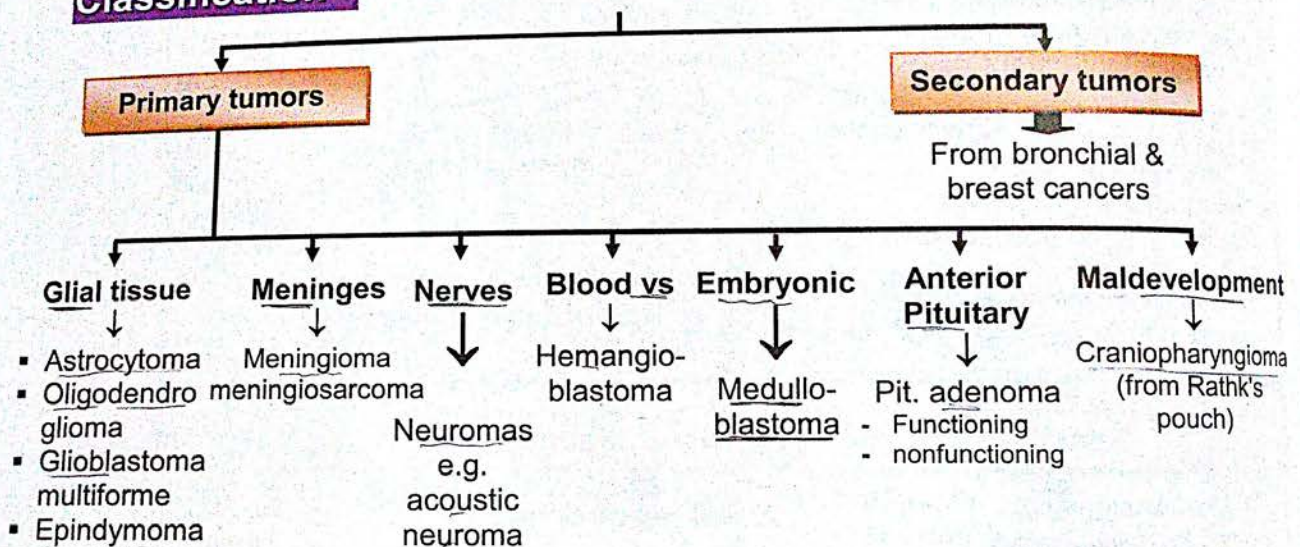


**Etiology**▪ **Unknown****Risk factors include:**

- 1- Exposure to radiation
- 2- Certain inherited disorders:
  - Li-Fraumeni syndrome
  - Neurofibromatosis
  - Turcot's syndrome
- 3- Hormone replacement therapy
- 4- Head injuries

**Pathological effects**

- Tumors can destroy brain cells either directly &/or indirectly by producing infarction, compress other parts of the brain by increase I.C.P.

**Classification**

The term "**glioma**" refers to all glial tumors in general but is also used instead of astrocytoma.

**Clinical picture**

- The most significant findings pointing to an intracranial tumour, on physical examination, are the presence of papilloedema and signs of focal damage to the nervous system.
- If a cerebral tumour is suspected lumbar puncture is contraindicated as it may precipitate a fatal conization of the brain stem through the foremen magnum.



# Clinical Picture of Brain Tumors

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May be asymptomatic

## Increased ICT

### **Headache**

In about 1/3 of patients  
Due to stretch of meninges  
Dull aching  
Peak in the morning  
↑ by cough, straining, sneezing

### **Vomiting**

Projectile  
More frequent in the morning  
Not related to meals  
Not preceded by nausea

### **Papilledema**

Blurring of vision

## False localizing signs (Due to increased ICT)

### Ventricular dilatation

Lateral V. → mental confusion  
3<sup>rd</sup> V. → bitemporal hemianopia  
4<sup>th</sup> V. → vomiting, ↑BP, ↓HR

### Cranial n. palsies (especially VI n.)

### Herniation

Tentorial (uncal) herniation  
Tonsillar herniation

## True localizing signs

### Cerebral hemispheres

Frontal    Parietal    Temporal    Occipital

### Cerebello-pontine angle tumors

- Ipsilateral cerebellar ataxia
- Ipsilateral affection of 5<sup>th</sup>, 7<sup>th</sup>, 8<sup>th</sup> N.
- Contralateral hemiparesis

### Pituitary tumors

- Hormonal manifestations
- Neurological manifestations
- Increased ICT

.e.g

- Hemiplegia in tumours of the motor area.
- Aphasia in tumours of the speech area.
- Hormonal disturbances in functioning pituitary tumours (Cushing's disease, acromegaly, and galactorrhea with prolactinomas).



## Investigations

### A- CT scan:(computerized tomography of the brain) It shows:

- Site, size&density of the tumor& any cystic degeneration or calcification.
- The size of the cerebral ventricles.
- Any midline shift.
- Better for bony & calcified pathologies
- Associated hydrocephalus

### B- MRI: (magnetic resonance imaging):(Investigation of choice)

- Better quality
- No bony artifacts
- Prominent anatomy.
- Show small metastasis
- More

### C- Plain x-ray: of the skull which might show: (general signs of ICT)

- Separation of the cranial sutures.
- Beaten-silver appearance or finger prints.
- Sellar changes:
  - Enlargement of the sella turcica.
  - Rarefaction and destruction of the dorsum sellae and the posterior clinoids.
  - Encroachment on the sphenoid air sinus
- Local changes in the plain skull X-ray may occur with specific tumors, e.g.:
  - Suprasellar calcification in craniopharyngiomas.
  - Hyperostosis and skull thickening in meningiomas.
  - Widening of the skull base foramina with skull base tumors.

### D- Cerebral angiography:This may show:

- General signs of increased intracranial tension e.g. stretching of all the cerebral vessels.
- Shift of the main cerebral vessels (anterior or middle) by the tumor.
- Appearance of abnormal vessels feeding the tumor

## Treatment

### a- Radical surgery:mainly for benign superficial tumors

- In patients shows signs of compression → urgent dehydration by 25% dextrose or mannitol + dexamethazone before surgery
- In patients have hydrocephalus(common with posterior fossa tumors)→ a ventriculoperitoneal shunt before surgery

- Many of the skull base tumors that were considered difficult to reach are now easily accessible by removing as much as possible of the bones of the skull base, face, and ear in order to minimize brain retraction.
- CT or MRI guided stereotactic surgery is done for biopsy or excision if the tumor is deeply seated in the brain.

### b- Palliative treatment: includes

- Cerebral dehydrating measures
- Debulking surgery
- Chemotherapy
- Radiotherapy
- Symptomatic treatment (for pain, vomiting, secondaries)

#### ✓ Indications for palliative treatment:

- Deep tumors
- Malignant infiltrative tumors
- Residual& recurrent tumors

### Points to remember (Brain tumors)

- ▶ C/P: ↑ ICT, false & true localizing signs
- ▶ Invest.: CT, MRI
- ▶ TTT: - Radical: if benign & superficial
- Palliative: dehydrating measures, radio, chemo



## → SPECIAL TYPES OF BRAIN TUMORS

### I. Meningioma

- They commonly occurs in 4th – 6th decades.
- The second most common primary tumor in CNS.
- They have slight female predominance.
- They are thought to arise from arachnoid villi.
- It is round, encapsulated, compress the underlying brain tissue without invasion.
- It has whorly appearance with central hyaline material which eventually calcify & form psammoma bodies.
- They are usually benign with long clinical course.
- Signs and symptoms are related to those of ↑ ICT.
- Complete surgical removal is usually curative, however recurrence may occur.

### II. Glioma

- Commonest 1ry CNS neoplasm.
- Arises from the supporting tissues of the C.N.S. & therefore is an infiltrating tumor.
- a) **Astrocytoma (the commonest brain tumor)**.
- b) **Glioblastoma multiformis**:
  - is the most common and most aggressive type of primary brain tumor in humans
  - Highly malignant and rapidly growing and is fatal within few months.

### III. Medullo-blastoma

- Highly malignant, occurring in children with early S. and S. of increased I.C.T. and archicerebellar manifestations.

### IV. Neurofibroma

- Arises from the Schwann cells of the nerve sheaths.
- It is benign and its commonest site is the 8<sup>th</sup> nerve in the cerebello-pontine angle (acoustic neuroma).

### V. Craniopharyngioma

- Arises from the cell-crests of Rathk's pouch, commonly before the age of 15 years.
- It is liable to calcification and cystic degeneration.
- It presents by endocrinal manifestations (due to pressure on the pituitary) & by visual disturbances (due to pressure on the optic chiasma, nerve or tract).

### VI. Metastatic tumors

- 1- Multiple brain tumors → brain irradiation.
- 2- Solitary brain metastasis:
  - a) Disseminated disease or life expectancy < 2 months → brain radiotherapy.
  - b) Limited systemic disease or life expectancy > 2 months:
    - i. Accessible → surgical excision + radiotherapy.
    - ii. Inaccessible → radiotherapy is the only treatment.

### VII. Neuroblastoma

- A highly malignant tumour which arises from the sympathetic chain or adrenal medulla.
- It is composed of small round cells with hyperchromatic nuclei arranged diffusely or in rosettes. Ganglion cells and nerve fibrils are often present.
- The tumour forms a reddish purple soft swelling liable to haemorrhage & degeneration.
- It grows rapidly, reaches a large size & metastasizes widely by blood & lymph vessels.
- It is usually occurs in early childhood & is most common in the abdomen & neck.
- It forms a large retroperitoneal mass and soon gives rise to metastases.
- The tumour is **highly radiosensitive** but metastases are so early and widespread that the prognosis is **not favourable**.



## Pituitary tumors

### Non-functioning adenomas

- 30 %
- 4<sup>th</sup>, 5<sup>th</sup> decades (Null cell tumors).
- C/P: optic chiasma.
- TTT: Microscopic trans- sphenoidal excision

### Functioning adenomas

- 70 %
- Prolactinomas 40%.
- TTT:
  - a) Medical:
    - Bromocriptin.
  - b) Surgical:
    - Trans-sphenoidal root, sublabial or trans-nasal → excision of pituitary adenomas

## Hydrocephalus

### Anatomical consideration

CSF Secretion by choroid plexus → Lateral ventricles → through foramen of Monro → third ventricle → through aqueduct of sylvius → fourth ventricle → exits through the foramina of Luschka and Magendie → the subarachnoid space → absorption through the arachnoid granulations into the venous system.

### Definition

- A disturbance of formation, flow, or absorption of cerebrospinal fluid (CSF) that leads to an increase in volume of ventricular system. It means "Water head".

### Anatomical types

#### a- Communicating hydrocephalus:

- ↑ CSF pressure inspite of full communication between the ventricles and subarachnoid space.
- Causes:
  1. Defective absorption of CSF (**most often**).
  2. Impaired venous drainage (**occasionally**).
  3. Overproduction of CSF (**rare**)

#### b- Non-communicating hydrocephalus:

- ↑ CSF pressure due to CSF flow obstruction within the ventricular system or in its outlets to the arachnoid space, resulting in impairment of the CSF from the ventricular to the subarachnoid space. The most common form is **obstructive**.

### Incidence

- As an isolated congenital disorder is 1 per 1,000 live births.
- In association with spina bifida is 1 per 1,000 live births in USA.

### Pathophysiology

- ↑ intracranial pressure → dilatation of the ventricle → pressure on brain tissue (Mantle brain)



## Etiology

### A. Congenital causes in infants and children:

- **Brainstem malformation causing stenosis of the aqueduct of Sylvius:**  
This is responsible for 10% of all cases of hydrocephalus in newborns.
- **Dandy-Walker malformation:** A cystic dilatation of the fourth ventricle obstructs CSF flow.
- mening. cyst ▪ **Arnold-Chiari malformation:** Hydrocephalus + myelomeningocele. *stabbing of cerebellum*  
The fourth ventricle is displaced caudally below the foramen magnum → impedes CSF flow to the subarachnoid space.
- **Agensis of the foramen of Monro.**
- **Congenital toxoplasmosis.**

### B. Acquired causes in infants and children:

- **Mass lesions:** tumors (e.g. medulloblastoma, astrocytoma), cysts, abscesses, or hematoma
- **Hemorrhage:** Intraventricular hemorrhage can be related to prematurity head injury, or rupture of a vascular malformation.
- **Infections:** Meningitis (especially bacterial)
- **Idiopathic**

### C. Causes of hydrocephalus in adults:

- Subarachnoid hemorrhage.
- Idiopathic hydrocephalus represents one third of cases of adult hydrocephalus.
- Head injury.
- Tumors can cause blockage anywhere along the CSF pathways.
- Meningitis.

## Clinical picture

### SYMPTOMS

#### ➤ In infants:

- Head enlargement
- Poor feeding
- Irritability
- Reduced activity
- Vomiting
- Delayed motor and mental milestones.

#### ➤ In children:

- Slowing of mental capacity
- Headaches (awaking him from sleep) that are more significant than in infants because of skull rigidity
- Neck pain
- Vomiting, more significant in the morning
- Blurred vision: This is a consequence of papilledema and later of optic atrophy
- Double vision: This is related to unilateral or bilateral sixth nerve palsy.
- Difficulty in walking secondary to spasticity

#### ➤ In elderly:

- **Gait disturbance** is usually the first symptom and may precede other symptoms by months or years. Magnetic gait is used to emphasize the tendency of the feet to remain "stuck to the floor" despite patients' best efforts to move them.
- **Dementia**
- **Urinary incontinence** may present as urgency, frequency, or a diminished awareness of the need to urinate.





**SIGNS**➤ **Infants or newborn:**

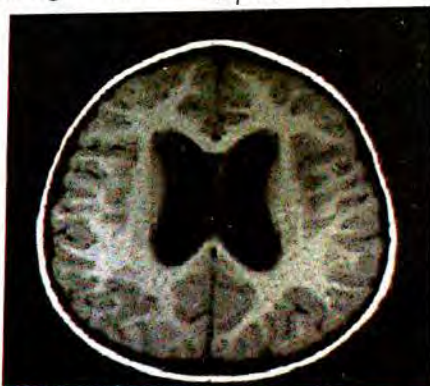
- Macrocephaly: Head circumference is at or above the 98<sup>th</sup> percentile for age.
- Dysjunction of sutures: This can be seen or palpated.
- Dilated scalp veins: The scalp is thin and shiny with easily visible veins.
- Tense fontanelle:
- McEwen's sign: resonant note on percussion of skull.
- Eye → Sun setting appearance with failure of upward gaze
- Associated congenital anomalies ;(meningocele, Arnold Chiari,...)

➤ **Adults :**

- Papilledema: If raised ICP is not treated, it leads to optic atrophy.
- Unsteady gait
- Unilateral or bilateral sixth nerve palsy (diplopia due to lateral rectus muscle paralysis) is secondary to increased ICP.

**Investigations**

- **CT and MRI (of choice)** can assess the site of obstruction & the causative pathology. MRI can evaluate for Chiari malformation or tumors.
- Ultrasonography: through the anterior fontanelle in infants is useful in follow up.
- Skull X-ray: Separation of cranial sutures in infants, silver beaten appearance in younger child.    ■ PET Scan (positron emission tomography)



Non-communicating  
obstructive hydrocephalus



Communicating hydrocephalus  
with surrounding atrophy

**Treatment****Medical Care**

- Medical treatment in hydrocephalus is used to delay surgical intervention.
- It may be tried in premature infants
- Decreasing CSF secretion by the choroid plexus → Acetazolamide and frusemide.

**Anticonvulsants****Treatment of the cause**

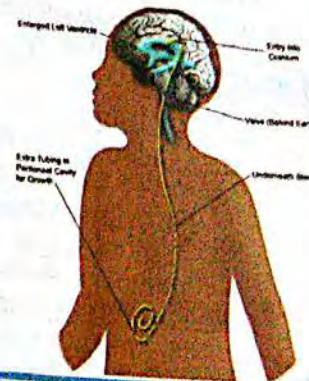


**Surgical treatment**

- It is the preferred therapeutic option → shunts, or endoscopic 3rd ventriculostomy
- The principle of shunting is to establish a communication between the CSF (ventricular or lumbar) and a drainage cavity (peritoneum, right atrium, pleura)
- A ventriculoperitoneal (VP) shunt:**
  - It is used most commonly.
  - The frontal horn of the lateral ventricle is the usual proximal location.
  - The peritoneal tube is inserted in the epigastric midline below the xiphoid process.
  - The need to lengthen the catheter with growth may be obviated by using a long peritoneal catheter.

**→ Complications :**

- Obstruction** (ttt → revising the shunt and replacing the malfunctioning component).
- Infection** (ttt → shunt is removed + IV Abs "2 weeks" + external ventricular drain + another shunt is inserted)
- Undershunting.
- Overshunting, subdural hge or low-pressure state.
- Related to hardware: kinking, separation and dislodgment, shortening by age.
- Focal glomerulonephritis.
- Acute shunt failure.



Ventriculo-peritoneal shunt

**Follow-up****Further Inpatient Care**

- Patients with shunt-dependent hydrocephalus should be admitted for consideration of shunt revision if shunt malfunction or infection is suspected.
- In children, shunt revisions are scheduled according to growth rate.

**Prognosis**

- Long-term outcome is related directly to the cause of hydrocephalus.
- Up to 50% of patients with large intraventricular hemorrhage develop permanent hydrocephalus requiring shunt.
- Satisfactory control was reported for medical treatment in 50% of hydrocephalic patients younger than 1 year who had stable vital signs, normal renal function, and no symptoms of elevated ICP.

N.B. in arnold-chiari <sup>1</sup> the hydroceph. first of mening. cele first

-if infant & meningo cele only and you tte it surgied → follow up the head (ICP) for fear of hydroceph. may develop



# Brain Abscess

## Definition

- Mass of immune cells, pus & other materials due to a bacterial or fungal infection.

## Etiology

### Organism

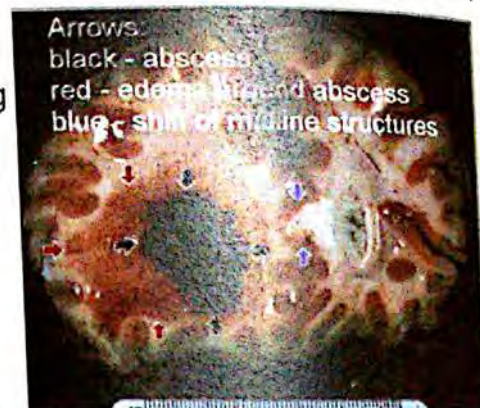
- Gram +ve bacteria: e.g. Staph.
- Gram -ve bacteria: due to nosocomial infections.
- Mycobacterium tuberculosis.
- Anaerobic organisms: due to improvements in techniques for bacterial isolation.
- Fungi, parasites, or other opportunistic organisms in immunocompromised.

### Route

- Direct spread:
  - (The majority) from a contagious suppurative focus e.g. paranasal sinusitis, otitis media, or mastoid infection.
  - Dural opening: whether traumatic or surgical.
  - Skull defects: which are acquired (e.g. cholesteatoma of the middle ear), post-traumatic or after previous craniotomy or congenital.
- Hematogenous: dissemination from a primary site (e.g. from dental or tonsillar abscess). Hematogenous abscesses are usually multiple.

### Predisposing factors

- Immunocompromised patients: (e.g. those receiving immunosuppressive therapy for transplantation, or victims of AIDS) are more prone to affection.
- Open head injuries (e.g. depressed fracture).
- Otitis.
- Sinusitis.
- Congenital heart disease e.g. right to left shunt



### Pathology

- The single most important response that limits the spread of infection → the formation of the collagen capsule in a developing abscess.

### Clinical Picture

→ Infection causing mass in the brain

#### 1- Infection:

- FAHM (low grade fever in half of the cases).
- The commonest symptom is progressively severe headache that is resistant to analgesics.
- Tachycardia – rigors.

#### 2- Mass (↑ ICP):

- Headache.
- Stiff neck, shoulders or back.
- Vomiting.
- Blurring of vision.
- Disturbed conscious level in about 50% of the cases:
  - Inattention
  - Confusion
  - Drowsiness
  - Coma

ICerebritis: - early: 1-3d, small necrotic focus surround by inflammatory cells  
late: 4-9d; necrotic center enlarge & pus formation & no capsule

II capsule: early: 10-13 : capsule of reticular fibers  
late: >14d.



**3- Brain (focal lesion):****a. Irritation:**

- Sensory: tingling – numbness
- Motor : muscle twitches, convulsions.

**b. Destruction:**

- Sensory: General: hypohesia, loss of sensation.  
Special: blindness - deafness
- Motor : paresis up to paralysis

**Complications**

1. Meningitis, severe & life threatening.
2. Epilepsy
3. Permanent neurological losses (vision, speech, movement).
4. Recurrence of infection.
5. Abscess rupture into the ventricle & subarachnoid space.
6. Herniation secondary to mass effect.

**Investigations****Laboratory**

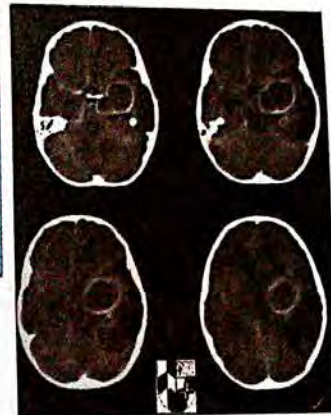
They are nonspecific & of little help in the diagnosis:

1. ↑WBC, ↑ESR.
2. Lumbar puncture is contraindicated to avoid a fatal conization.

**Radiological**

- CT± contrast or MRI with gadolinium enhancement is **the investigation of choice**.

- CT shows a smooth, thin, regular contrast medium enhanced wall with a central region of hypodensity. It is often difficult to differentiate this appearance from that of other CNS processes, including primary and metastatic tumors, infarction, hematomas, and radiation necrosis.
- MRI with gadolinium enhancement more readily detects cerebritis stage.



▪ CT sinuses

**Investigations for the source**

- CXR
- ECHO

**Treatment**

*This is indicated for an abscess < 1.5 cm.*

**1- Non-surgical treatment** *in Cerebritis & early capsule***A. Antibiotics:**

- Appropriate antibiotic selection is based on culture and sensitivity results.
- However, while waiting for these results broad spectrum, high dose antibiotics are initially administered.
- The chosen drugs should have the ability to cross the blood-brain barrier.
- The usual regimen is a combination of penicillin G, trimethoprim-sulphamethoxazole, and an aminoglycoside.
- The majority of the responsible organisms are obligate anaerobes with 50% of them resistant to penicillin.



**B. Corticosteroids:**

- These are in common use to help reduce cerebral oedema, despite their potential adverse effect on the infection.

**2- Surgical treatment**

*late Capsula*

- Aspiration versus excision.
- The mortality rate resulting from aspiration alone, aspiration followed by excision and primary excision alone, are almost similar.
- However, certain factors favour aspiration while others favour excision.

**A) Factors that favour aspiration :**

1. Multiple abscesses.
2. A deeply seated abscess.
3. A critical location (e.g. motor or speech area).
4. Poor general condition of the patient.
5. Aspiration is done by using a blunt-tipped needle by way of burr hole in the skull.

**B) Factors that favour excision:**

- 1- Multilocular abscess, as it is sometimes difficult to aspirate all the locules
- 2- A superficial abscess.
- 3- The presence of a foreign body.
- 4- Fungal abscesses, as they are known to have poor response to antifungal therapy.

**Prognosis**

- If untreated, a brain abscess is almost always deadly.
- Within treatment, the death rate is about 10%.
- The earlier the treatment is received, the better.
- Some patients may have long-term neurological problems after surgery.

**Points to remember**

- ▶ **Etiology:** Gram +ve, direct or blood spread
- ▶ **C/P:** as abscess, ↑ ICT, focal symptoms
- ▶ **Comp.:** as abscess, neurological, herniation
- ▶ **Invest.:** as abscess, CT, MRI with gadolinium
- ▶ **TTT:** surgical, medical (antibiotics, steroids)



# Cavernous Sinus

## Anatomy of the cavernous sinus

- (1) **Nature:** the cavernous sinuses are 2 venous channels formed by splitting of dura matter.
- (2) **Site:** on each side of the pituitary body and the body of sphenoid.
- (3) **Contents:**

### A) In the sinus:

- 1- Internal carotid artery.
- 2- Abducent nerve.

### B) In the lateral wall of the sinus:

From above down are the 3<sup>rd</sup>, 4<sup>th</sup> and 1<sup>st</sup> and 2<sup>nd</sup> divisions of 5<sup>th</sup> cranial nerves.

## Cavernous Sinus Thrombosis

### Definition

- It is inflammation with thrombosis (thrombophlebitis) of the cavernous sinus.

### Etiology

### Organism

- Pyogenic organisms (staphylococci, streptococci, ... etc).

### Route

#### ➤ Hematogenous:

- Along the communicating veins from the orbit, face, middle ear, side of the head, mouth and paranasal sinuses.  
(Anterior facial V. → deep facial V. → pterygoid plexus of veins → emissary veins → cavernous sinus)

#### ➤ Endogenous infection: Rare.

### Predisposing factors

- Depressed immunity

### Clinical Picture

- a) As the clinical picture of infection: FAHM but more severe.
- b) In addition: usually bilateral due to spreading infection to the other cavernous sinus through the intercavernous plexus:
  - 1) Severe supraorbital pain: due to involvement of the branches of the ophthalmic division of 5<sup>th</sup> cranial nerve
  - 2) Edema: behind the ear (over the mastoid bone): due to thrombosis of the mastoid emissary vein.
  - 3) Proptosis: rapidly progressive and becomes bilateral usually.
  - 4) Pupil dilatation with total ophthalmoplegia: due to paralysis of the ocular motor nerves 3<sup>rd</sup>, 4<sup>th</sup> and 6<sup>th</sup> cranial nerve.
  - 5) Fundus changes:
    - Engorgement of retinal veins.
    - Papilledema.



**Complication**

⇒ Death usually occurs due to complications:

- (1) Meningitis and brain abscess.
- (2) Pulmonary complications as pulmonary embolism or infection.

**Treatment****A. Hospitalization in ICU:**

⇒ The disease is fatal if the treatment is not given early:

- a. Rest in bed, tonics and analgesics.
- b. Systemic antibiotics in massive doses.
- c. Anticoagulants.
- d. Corneal protection from exposure keratitis (by antibiotic eye ointment, eye pad and bandage).

**B. Treatment of complications**

عوارض  
سابقه



# Peripheral Nerve Injury

## Etiology

- **Open injury** : gunshot – stab wound.
- **Closed injury**:
  - Sudden direct violence e.g. motor car accident.
  - Ischemia.
  - fractures and dislocations.
  - Compression by tourniquets, splints, crutches or edema.
  - Traction e.g. brachial plexus injury during delivery of the fetus.
  - accidental injection of irritant substances e.g. sciatic nerve.

## Pathology & Types

Neuropraxia	Axonotmesis	Neurotmesis
<p>Nerve concussion: physiological interruption of all its functions without any organic damage. <i>as facial palsy</i></p> <p><b>(functional paralysis)</b></p> <p>Complete motor paralysis.</p> <p>Patchy sensory loss.</p> <p>No Wallerian degeneration.</p> <p><i>complete</i></p> <p>Recovery takes place spontaneously within <b>4-6 weeks</b></p> <p>It may be produced by minor traction or compression injuries or by the concussion and vibratory effect of a high velocity missile passing near the nerve.</p> <p>The electrical excitability of the paralysed muscles remains normal.</p>	<p>Rupture of nerve fibers but <u>outer sheath</u> is intact (<i>Intracanal rupture</i>)</p> <p>Complete motor paralysis.</p> <p>Complete sensory loss.</p> <p>Wallerian degeneration in distal part for 10 days followed by regeneration 1mm/day with further 3 weeks delay before complete activation.</p> <p>It may be produced by contusion and traction injuries or may complicate fractures and dislocations.</p> <p>Recovery is, however, <u>delayed</u> till the growing axons reach their appropriate endings, and occurs first in the muscle groups nearest to the site of injury and lastly in the peripheral skin areas. The length of time required for the recovery depends upon the level of the lesion.</p> <p>Recovery after such lesions is usually <u>complete</u> because the axons remain in their respective neurolemmal tubes.</p>	<p>Division of the nerve axon &amp; connective tissue (partial or complete).</p> <p>Complete motor paralysis.</p> <p>Complete sensory loss.</p> <p>Wallerian degeneration occurs but regeneration is impossible.</p> <p>After surgical repair recovery is <b>*Poorest: mixed nerves</b>(Ulnar &amp; median)</p> <p><b>*Poor: motor nerves</b> which supply a large number of small muscles</p> <p><b>*Best: purely motor nerves</b> (a few groups of large muscles) such as the radial nerve.</p> <p>Degenerative changes occur in the nerve, as in axonotmesis but the gap fills with a mass of fibrous tissue and regenerating axons known as <b>bulb neuroma</b>. Partial lesions produce a lateral or central neuroma. Complete division produces a terminal neuroma on the end of the proximal segment of the nerve, separated by an interval from the atrophied distal end. In the distal segment of the divided nerve Wallerian degeneration occurs.</p>



## Clinical Picture

### 1- Motor manifestations:

- Loss of voluntary movement.
- Muscle wasting & deformity.

- Loss of reflexes (superficial & deep).

### 2- Sensory manifestations:

- **Superficial sensory loss:** in area of skin supplied by the affected nerve in area less than anatomical nerve distribution due to dermatomal overlap.
- Deep sensory loss.
- Pain referred to the area of cutaneous distribution of an injured nerve is more common in partial than in complete lesions and is a favourable sign.
- **Causalgia:** severe burning pain due to partial injury of median, sciatic nerve.

### 3- Autonomic manifestations:

#### Vasomotor manifestations:

- \* **Early:** the denervated area becomes red & warm due to sympathetic paralysis.
- \* **Late:** the denervated area becomes pale & cold due to ↑ sensitivity of receptors to circulating catecholamines.

#### Pseudomotor manifestations:

- o Loss of sweating (anhidrosis) in the denervated area, usually over a larger area than the area of anaesthesia.
- **Trophic changes:** Due to disuse, sensory loss & vascular changes.
  - o Skin: thin, smooth, loss of hair, neurotrophic ulcer.
  - o Nails: brittle.
  - o Bones: progressive decalcification which is most marked in the proximal and distal extremities of the phalanges.
  - o Joints: Contracture and ankylosis develop more readily in painful than in painless lesions.



Palpable neuroma  
(Painful)

**4- Palpable neuroma:** May be detected along the course of the affected nerve.

**5- Tinel's sign:** Sure sign of Neurotmesis.

- Course of the nerve is lightly percussed from below upward gives tingling sensation (when the level of regeneration is reached). +ve Sign → Good Prognosis

## Investigation

**1- Nerve conduction velocity (normal: 50-70 m/sec):** No abnormality detected in neuropraxia. NCV progressively decreases and becomes 20-40% of normal after one month. It is most suitable for the diagnosis of compression neuropathy and is very useful in detecting regenerating axons as NCV will gradually increase.

**2- Electromyography:** Denervated muscles show spontaneous fibrillations after 2-4 weeks. These fibrillations remain so long as the muscle still viable, but if complete fibrosis occurs, no electrical activity is detected and the muscles is no longer suitable for reinnervation.

## Treatment

### 1- Conservative treatment:

- **Indications:**
  - Closed inj
  - Closed injury, as it is:
    - Usually Neuropraxia or axonotmesis.
    - Rarely Neurotmesis.
- **Methods:**
  - o **Splintage:** prevents over stretch of the paralyzed muscles.
  - o **Active & passive exercises & massage:** maintain nutrition of tissues.
  - o **Electrotherapy**

3- sweat test: Consixin powder → on area → give Caffeine & aspirin to pts → sweat + pink

4-X-ray → for fractures.



- Protection of the skin. The patient should be warned of the susceptibility of the anaesthetic skin to injury and heat.

## 2- Surgical treatments:

### Indications:

1. Neurotmesis.
2. Open injuries.
3. Closed injuries with:
  - a) Failure of recovery in the expected time.
  - b) No improvement guided by Tinel's sign
  - c) Palpable neuroma.

### Methods:

#### Primary suture:

- ⇒ Immediate suture.
- ⇒ Indication: Clean incised wounds.
- ⇒ Disadvantages:

The nerve sheath is very thin → difficult to hold sutures so it needs expert neurosurgeon but gives the best results.

#### Secondary suture: done in contaminated or lacerated wounds

- ⇒ Suture the nerve 3 - 4 weeks after injury due to end of wallerian degeneration & end of traumatic swelling & edema.
- ⇒ At the time of wound repair:

The 2 ends of the nerve is approximated with a black silk suture.

#### 3-4 weeks later:

- The 2 cut ends of the nerve are exposed carefully trimmed with a sharp knife until the healthy nerve bundles are exposed.
- Apposition is obtained by fine silk sutures picking up the nerve sheath only.
- Two methods of repair : epineurial repair, Interfascicular repair ( which is more accurate, using operating microscopy).

#### If gap is present:

- ⇒ Neurolysis: dissection of the nerve from the surrounding structures.
- ⇒ Division of unimportant branches.
- ⇒ Transposition of the nerve to shorten its course.
- ⇒ Nerve grafting:
  - Using a cutaneous nerve such as the saphenous nerve.
  - This nerve is divided into segments that match the size of the defect. This type of multiple nerve grafts (2-4) bridging the defect looks like a cable hence the name "cable grafting".
  - For successful take of the cable graft, a well vascularized bed should be available
- ⇒ The limb is fixed in plaster cast for 3 weeks in a position, which prevents tension on the sutured nerve.

## 3- Orthopedic measures:

- Indication: To improve function if recovery of the nerve is impossible.

### Methods:

- Arthrodesis. → fix joint in position of best function
- Tendon transplantation.
- Amputation: in severe multiple neuropathic ulcers

## Prognosis

- The result of nerve is better in pure motor nerve controlling the coarse movement e.g. radial & is worst in mixed nerve e.g. ulnar & median.



**Remember**

- ▶ **Etiology:** open, closed
- ▶ **C/P:** motor, sensory, autonomic, neuroma, Tinel's sign
- ▶ **Invest.:** nerve conduction velocity, EMG, sweating test
- ▶ **TTT:** conservative, surgical, orthopedic

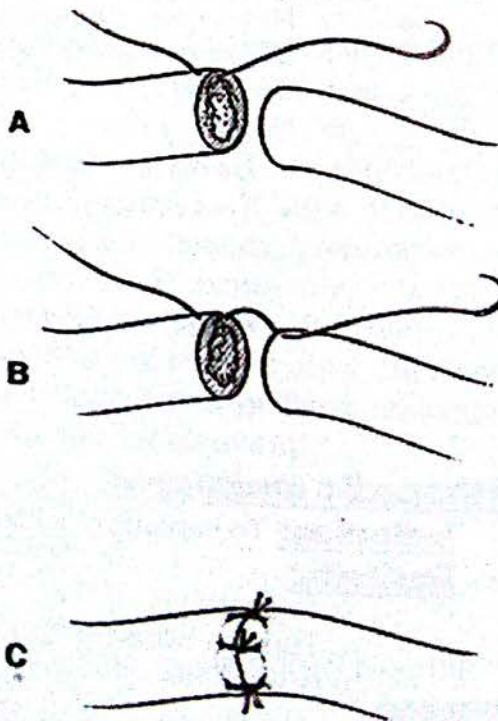
**Factors affecting success of surgery**

1. **The injured nerve:** The radial nerve is by far the most satisfactory because it contains a predominance of motor fibres and there is less chance of maldistribution of the fibers during regeneration.
2. **Level of suture:** With a high-level injury the length of time taken by the regenerating fibers to reach the more distal muscles reduces the chance of a satisfactory recovery.
3. **Time interval between injury and suture:**
  - The earlier the repair, the better is the results since a long period of denervation of a muscle allows more wasting and degeneration of the muscle fibers.
  - A muscle which has been deprived of its nerve supply for more than 2 years cannot be expected to show any degree of recovery owing to irreversible changes in the motor end plates.
4. **Extent of injury:** Large gaps between cut ends have a bad prognosis.
5. **Age and general condition of the patient:** The results of nerve suture are particularly good in children and adolescents.

Placement of epineural sutures for neurorrhaphy.

Caution should be exercised to ensure placement only through epineurium as in A & B.

Preplacement of all sutures prior to trying will ensure even suture line tension as in C.



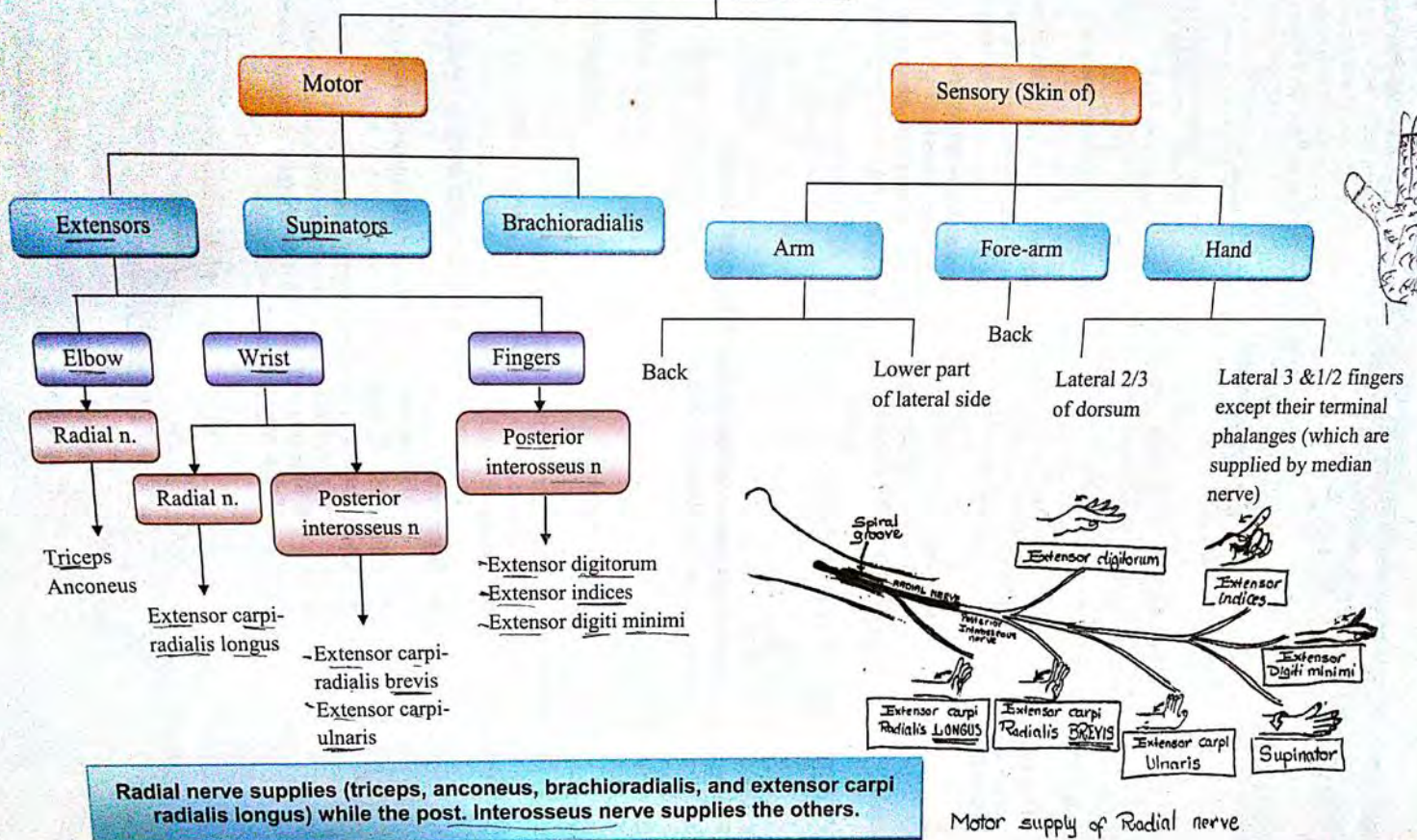


## Radial Nerve Injuries

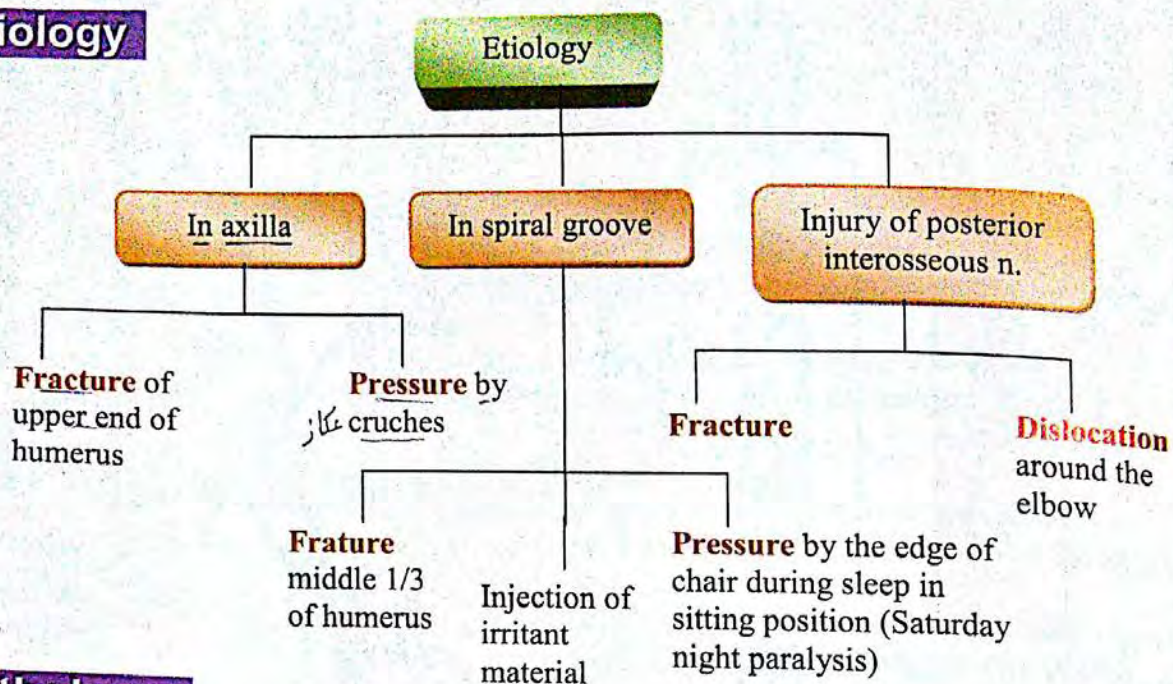
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### Anatomical considerations

#### Radial nerve supplies





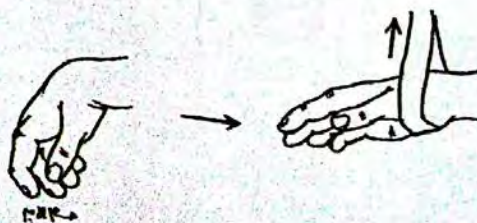
**Roots of origin** C<sub>5</sub>, 6, 7, 8 & T<sub>1</sub>**Etiology****Pathology**

- See general.

**Clinical Picture****A. In axilla: (flexed elbow + wrist drop + finger drop)**

- History of trauma (may be absent in Saturday night paralysis or fracture upper end humerus).
- Associated injuries.
- Motor manifestations:
  - Loss of voluntary movements.
  - Loss of reflexes.
  - Deformity (flexed elbow + wrist drop + finger drop) due to paralysis of the following muscles:

- Triceps** : **flexed elbow**.  
→ However can be extended only by its own weight.
- Supinators** : **pronated forearm**.  
→ However can be supinated by the biceps.
- Extensors of wrist** : **wrist drop**.
- Extensors of fingers & thumb** : **finger drop**.  
→ However, fingers can be extended by the lumbricals & interossei if the wrist & fingers are supported. (Trick movement).



كل ارمي  
بعضها  
لو كوار و ٣ حار ايفر  
در كل ما نزل من حار  
تنفر  
Extensor



4. Sensory manifestations:
  - Sensory loss is limited to a small area at the base of the thumb due to overlap of sensory supply by nearby nerves.
5. Autonomic manifestations (see general).
  - Vasomotor.
  - Pseudomotor.
  - Trophic changes.
6. Palpable neuroma.
7. Tinel's sign.
8. Others: scar, swelling (mal-united fracture or callus).

### B. In spiral groove: (wrist drop + finger drop)

- Causes: Injury in the spiral groove may be due to:
  - a. Fractures of the shaft of the humerus,
  - b. Falling asleep with the arm lying across the edge of a chair or table (**Saturday-night paralysis**).
  - c. Prolonged application of a tourniquet.
  - d. Operations in which the outstretched arm has rested on the edge of the table.
  - e. Intramuscular injections of irritant drugs.
- As before, but extension of the elbow is intact as long head of triceps receives its nerve supply high up in the axilla.

### C. Injury of the posterior interosseus nerve: (finger drop)

- Only finger drop because: Extensor carpi radialis longus is intact so extension of wrist is normal (nerve supply from radial nerve not posterior interosseus).

## Investigations

See general

## Treatment

### 1- Conservative treatment:

- **Indications:**
  - ▣ Closed injury.
- **Methods:**
  - o **Splintage:** prevent over stretch of the paralyzed muscles. The hand is hyperextended in a cock up splint to prevent stretching of the paralyzed muscles.
  - o Active & passive exercises & massage: maintain nutrition of tissues.

### 2- Surgical treatments:

- **Indications:**
  1. Neurotmesis.
  2. Open injuries.
  3. Closed injuries with:
    - a) Failure of recovery in the expected time.
    - b) No improvement guided by Tinel's sign.
    - c) Palpable neuroma.
- **Methods:**
  - o **Primary suture:**
    - ⇒ Immediate suture.
    - ⇒ **Indication:** Injuries occur during operation.
    - ⇒ **Disadvantages:** The nerve sheath is very thin → difficult to hold sutures so it needs expert neurosurgeon.
  - o **Secondary suture:** (see general principles)
  - o **If gap is present:** (see general principles)



### 3- Orthopedic measures: (see general principles)

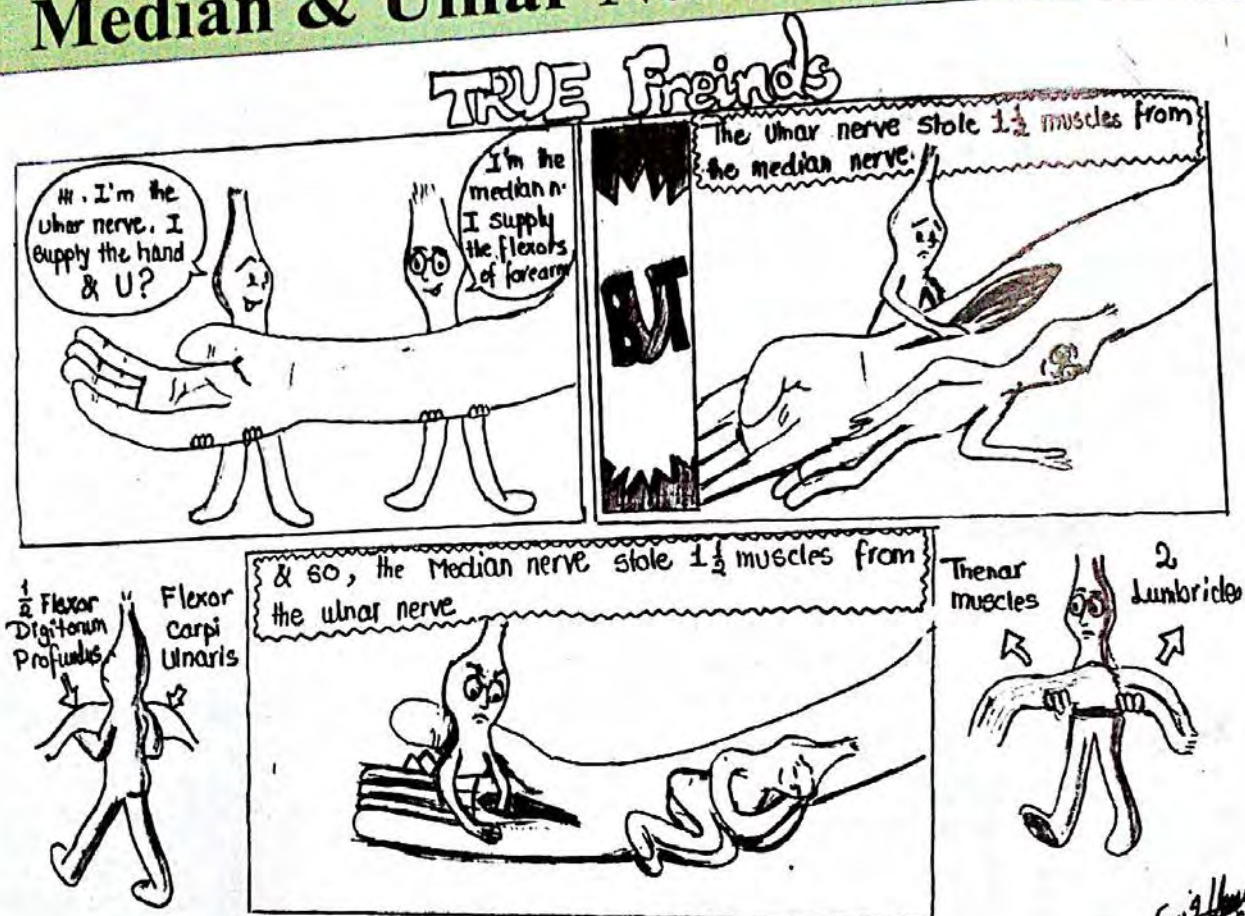
#### Prognosis

- Good (purely motor nerve controlling coarse movements).
- Recovery may be expected in 9-12 months.

#### Remember

- ▶ Etiology: fracture/dislocation, pressure, injection
- ▶ C/P: - **Axilla:** flexed elbow, wrist & finger drop
- **Spiral groove:** wrist & finger drop
- **Post. interosseous n.:** finger drop
- ▶ Invest.: as before
- ▶ TTT: as before + cock up splint

## Median & Ulnar Nerve Injuries



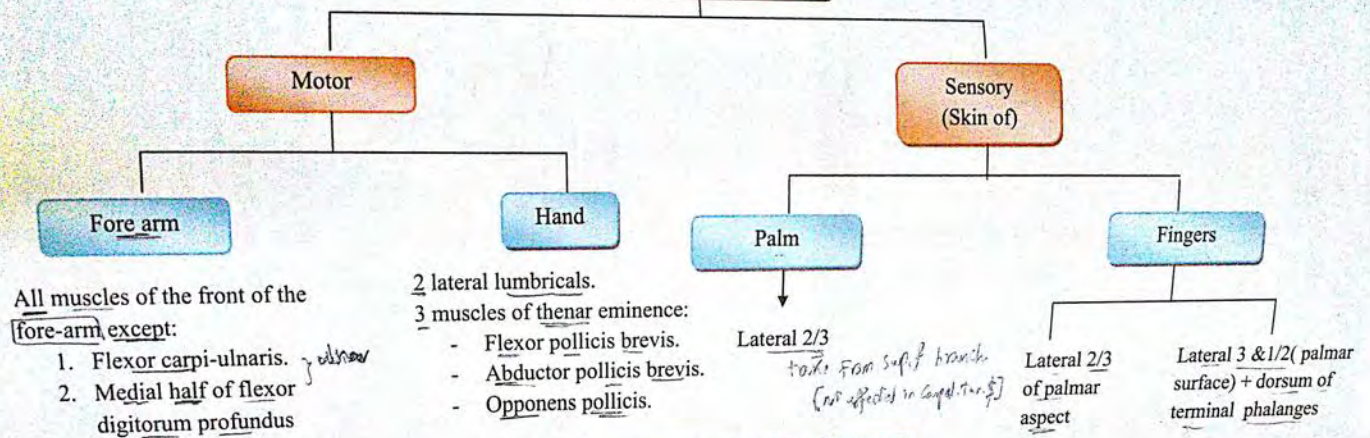
The 4 lumbricals and 8 interossei are attached to extensor expansion so paralysis of lumbricals alone or interossei alone do not produce clawing, but paralysis of both → weakness of extensor expansion → flexion deformity by flexor digitorum superficialis and profundus



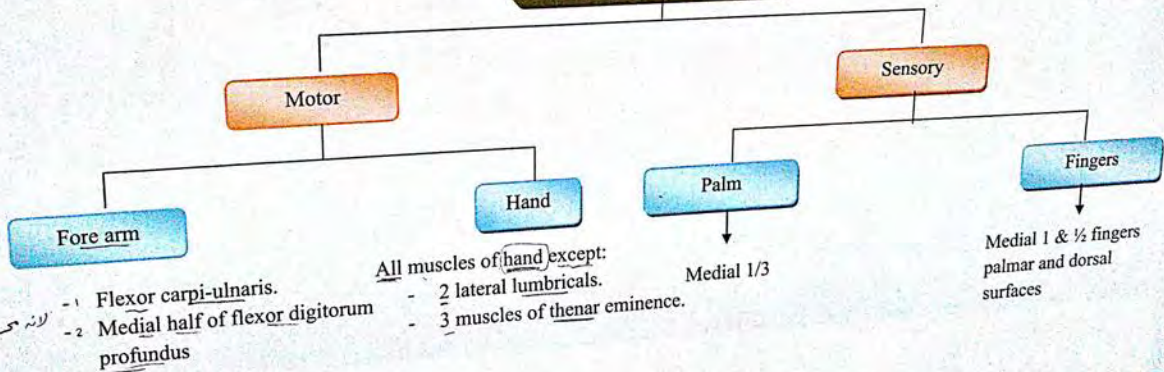
## Anatomical considerations

### Median nerve supplies

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### Ulnar nerve supplies





# SPECIAL SURGERY



	Median N. Injury	Ulnar N. Injury
<b>Roots</b>	C5, 6, 7, 8 & T1	C7, 8 & T1
<b>Etiology</b>	<ul style="list-style-type: none"> <li>- Cut wound. <i>open</i></li> <li>- Colle's fracture. <i>closed</i></li> <li>- Carpal tunnel S.</li> <li>- Uncommon, due to fractures &amp; dislocations around elbow.</li> <li>- May be injured above the elbow by tourniquet. <i>Injury.</i></li> </ul>	<ul style="list-style-type: none"> <li>- Cut wound.</li> <li>- Fracture lower end of ulna.</li> <li>- Immediate injury due to fractures &amp; dislocations around the elbow.</li> <li>- Fracture medial epicondyle of humerus.</li> <li>- Delayed ulnar neuritis (due to cubitus valgus deformity).</li> </ul>

## Pathology

See general

## Clinical Picture

<b>Symptoms:</b>	<ol style="list-style-type: none"> <li>1. History of trauma.</li> <li>2. Pain.</li> <li>3. Swelling.</li> <li>4. Deformity.</li> <li>5. Associated injuries.</li> <li>6. Causalgia.</li> </ol>
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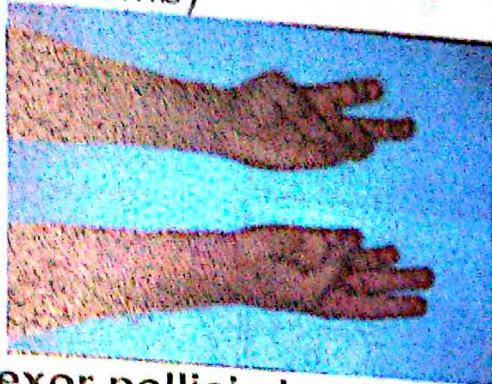
<b>Signs:</b>	<b>Injury at the wrist</b>	
<b>1. Motor</b>	<b>1. Injury of thenar muscles:</b> (wasting of thenar eminence)  <ol style="list-style-type: none"> <li><b>Opponens pollicis muscle:</b> <ul style="list-style-type: none"> <li>Result in → Ape hand deformity (Simian hand). (Thumb in same plane as other fingers adducted with loss of opposition due to paralysis of Thenar muscles except adductor pollicis).</li> </ul> </li> </ol>	<b>1- Injury of hypothenar muscles:</b> (wasting)  <ul style="list-style-type: none"> <li>Result in: loss of abduction of little finger.</li> </ul>
	<b>2- Injury of interossei:</b> <ul style="list-style-type: none"> <li>Result in guttering, No fanning, No adduction</li> </ul>	abd. digit minimi flex. ~ ~ opponens ~ ~



Median N. Injury



- Tested by: counting finger test "loss of opposition of the thumb)



b. Flexor pollicis brevis & abductor pollicis brevis:

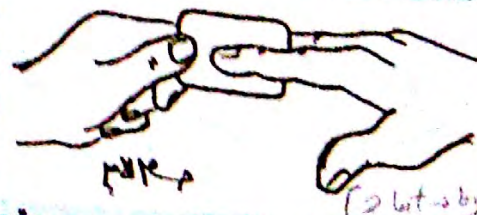
- Result in: weakness of abduction & flexion of the thumb.
- Tested by: pin touch test

## 2. Injury of 2 lateral lumbricals

## Ulnar N. Injury



- Tested by: card test
- Loss of abduction & adduction due to paralysis of interossei.



### 3-Injury of 2 medial lumbricals

- Result in: Partial claw hand ✓  
due to paralysis of the medial 2  
lumbricals with intact lateral 2  
lumbricals because they are  
supplied by median nerve  
(extension of MPJ and flexion  
of IPJ of medial 2 fingers).. ✗ Not ✓




4- Injury of adductor pollicis:

- Result in: loss of adduction of thumb.

ما كسبه في expansion. ما النخ يعوز يديه امر انك تقل extension الامر يوصل لدول الاول ويستقلو فيخلوا  
فعلها الى ما تعين الـ digitary. لا فاع به ايم ياخذو الـ up hand  
لكن لما يستقلو على الارض لumb  
inter ossei -  
ذلك الصباغ index middle  
لنموه الـ lumb بتوسع intact لانهم واضر

■ Tested by: **Froment's test**  
Weak adduction of the thumb  
due paralysis of adductor  
polices. grasp paper by flexion





## SPECIAL SURGERY

### Median N. Injury

#### 2. Sensory

- Sensory loss over:
  - Lateral 2/3 of palmar surface.
  - Lateral 3 & 1/2 fingers.
  - Dorsum of their terminal phalanges.



- 3. Autonomic
- 4. Palpable neuroma
- 5. Tinel's sign

See general

### Ulnar N. Injury

- Sensory loss over:
  - medial 1 & 1/2 fingers.
  - medial 1/3 of the palm.
- No affection of dorsal aspect of (due to sparing of dorsal cutaneous branch which passes backward 6 cm. above wrist).



last if in at elbow  
Not loss except if at elbow

### Injury at the elbow

As above +

#### 1. Motor

##### ■ Injury of:

- a) Flexor carpi radialis:  
Weak flexion of wrist & ulnar deviation. in flex. of wrist



- b) Lateral 1/2 of flexor digitorum profundus:  
+ve Ochsner's Clasping test  
(pointing index finger)



c) a + b

Wasting of the lateral aspect of the forearm

- d) Flexors of the forearm:  
Weak hand grip & weak flexion

- e) Flexor pollicis longus:  
The patient is unable to flex the terminal phalanx of the thumb.

- f) There is paralysis of the 2 pronators with loss of

##### ■ Injury of:

- a) Flexor carpi ulnaris: generally occurs when wrist is flexed  
- Loss of ulnar deviation or radial deviation of the flexed wrist.
- b) Medial 1/2 of flexor digitorum profundus:  
- loss of flexion of terminal phalanx of little & ring finger (ulnar paradox).

elbow deformity decrease  
extensor up hand  
digi

up hand  
flex. digi. Profundus only  
flex. digi. Profundus only

فلا قطبنا تاني 11 deformity قلت 11  
عكس المرفوف  
ulnar paradox

\*Sensory: a) above + dorsal  
Hema Adel



# Median N. Injury

# Ulnar N. Injury

## Injury in axilla & arm

- Ape hand
- Hypoesthesia of median distribution in hand
- Weakness of forearm flexion & pronation
- Weakness of wrist & finger flexion with ulnar deviation

- Partial claw hand
- Hypoesthesia in hand with ulnar distribution
- Weakness of intrinsic muscles of hand
- +ve Froment's sign
- +ve paper test

As above

See general

- Sensory
- Autonomic
- Palpable neuroma
- Tinel's sign

## Investigations & TTT

## DD (of claw hand)

1. Klumpke's palsy & costo-clavicular \$.
2. Combined ulnar & median n. injury.
3. Volkmann's ischemic contracture.
4. Dupuytren's contracture.
5. Post-burn scar contracture: palm



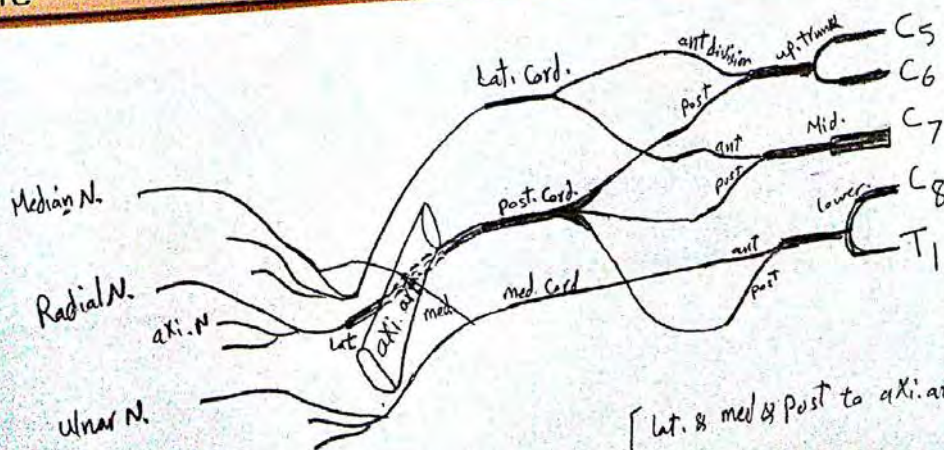
## Remember Median n. injury

- Etiology: at the wrist, in the forearm
- C/P: as before + at wrist → ape hand  
At elbow → +ve Ochsner's clasping test
- Invest.: as before
- TTT: as before

## Remember Ulnar n. injury

- Etiology: at the wrist, in the forearm
- C/P: as before + at wrist → partial claw hand + Froment's test  
At elbow → ulnar paradox
- Invest.: as before
- TTT: as before

Brachial Plex.



[Lat. & med & post to axi. art]



# Sciatic Nerve Injury

Drop foot

## Etiology

1. Penetrating wounds of gluteal region.
2. Post. hip dislocation.
3. Fracture pelvis.
4. IM injection.

## Pathology

See general

## Clinical picture

### 1- Motor:

- Paralysis of hamstrings → weak flexion of the knee (some degree of flexion is preserved by sartorius & gracilis.)
- Paralysis of all leg muscles → **foot drop**.
- Paralysis of intrinsic muscles of foot → clawing of toes.

### 2- Sensory:

- Anaesthesia below knee except on the medial side of leg, foot & big toe → supplied by saphenous n. (branch of femoral n.).
- Trophic changes are common on the sole of the foot & toes & if the nerve lesion is partial, severe (causalgia) may be experienced in the sole.

### 3- Autonomic manifestations.

### 4- Palpable neuroma.

### 5- Tinel's sign.

## Investigation

- See general

## Treatment

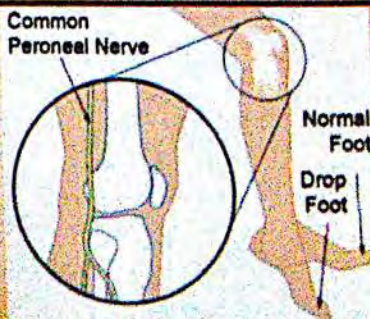
- See general but ....
- Conservative**
  - The deformity is controlled by wearing a suitable support to prevent foot drop
  - The nutrition of the muscles is maintained by massage and electrotherapy.

## Remember

- **Etiology:** post. hip dislocation, IM injection
- **C/P:** drop foot, clawing of toes, anesthesia below the knee except medial aspect

### ► Causes of foot drop:

- Sciatic nerve injury.
- Lumbar disc prolapse.
- Fracture neck fibula.
- Peripheral neuropathy.
- Parasagittal meningioma.





sciatic N. → lat. poplit.  
poplit.

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## Lateral Popliteal Nerve Injury

### Etiology

- Injury is common in its most superficial part, which present around the neck of fibula.
- Injury is usually due to **fracture neck of fibula**.
- Deep wounds of the thigh.
- Subcutaneous tenotomy of the biceps tendon.
- Pressure by strapping, bandages, splints and plasters.

= Common Peroneal N. inj.

"Tom has a Very Nice Dog"  
Tibialis ant. extensor hallucis longus  
exten. digitorum perianus tertius  
supinator

### Pathology

- See general principles.

### Clinical picture

#### 1- Motor

- Paralysis of the dorsiflexors → plantar flexion i.e. **foot drop** (early)
- Paralysis of the elevators of the foot → inversion. No eversion  
→ **Paralytic talipes equinovarus** (late)

Side { ant. Comp. mus. → dorsiflex.  
Perini mus → eversion  
Longus  
brevis

#### 2- Sensory:

- Anaesthesia over the lateral part of the dorsum of foot & part of the lateral side of the leg.

#### 3- Autonomic manifestations.

#### 4- Palpable neuroma.

#### 5- Tinel's sign.

### Investigation

- See general principles.

### Treatment

- See general principles.

### Prognosis

→ Good (mostly motor).

#### Remember

- Etiology: fracture neck fibula
- C/P: early: foot drop  
Late: paralytic talipes equinovarus
- Good prognosis, mainly motor

## Medial Popliteal Nerve Injury

#### 1- Motor:

- Paralysis of plantar flexors → dorsiflexion & **calcaneovalgus**
- Paralysis of muscles of the sole → clawing of the toes.

#### 2- Sensory:

→ anaesthesia of the sole.



# Brachial Plexus Injuries

## Etiology

### a. Open injuries

Gunshot, stabs in the lower part of the post. triangle (rare).

### b. Traction injuries

- Heavy weights fall on the shoulder → undue traction upon the roots of the plexus, especially of the fifth and sixth nerves.
- Hyperabduction of the arm.
- Birth injury → vertex or breech presentation. shoulder

### c. Pressure injuries

- Fractures of the clavicle and dislocations of the shoulder
- Attempts to reduce them may result in injury to the plexus, especially to the medial cord.

## Clinical Picture

### A. Complete brachial plexus injuries: damage of all roots.

- Motor changes: affecting all muscles of the upper limb except trapezius.
- Sensory changes: Anaesthesia of whole upper limb except:
  - o Medial side of arm (supplied by intercosto-brachial nerve (T2).
  - o Skin over upper part of deltoid muscle (supplied by supraclavicular nerve (C4).

-xx Horner's syndrome: due to sympathetic paralysis.

### B. Upper trunk injury: (C5 - C 6) Erb-Duchenne paralysis

- Motor changes: policeman's tip deformity. (waiter's tip position)

- If the sixth nerve escapes the arm will be internally rotated by the unopposed subscapularis

- Sensory changes: Anaesthesia over the deltoid muscle (except upper part).

- Sensory changes are absent if the fifth nerve only is involved

### C. Lower trunk injury: (C8 - T1) Klumpke's paralysis.

- Motor changes: complete claw hand.
- Sensory changes: anaesthesia along the medial aspect of the forearm & the medial 3 & 1/2 fingers.
- ✓ Horner's syndrome: due to sympathetic paralysis. (it indicates bad prognosis)

## Investigations

- ➡ See general principles.

## Treatment

### 1- Conservative treatment:

#### - Indications:

##### ▪ Closed injury:

- Usually Neuropraxia or axonotmesis.

- Rarely Neurotmesis.

#### - Methods:

- o Splintage: The arm is splinted in right-angled abduction to relax the deltoid and supra and infra spinatus, the forearm being flexed and supinated to relax the biceps, brachialis and supinators.





- Active & passive exercises & massage : maintain nutrition of tissues.
- Electrotherapy

## 2- Surgical treatments:

### - Indications:

1. Neurotmesis.
2. Open injuries.
3. Closed injuries with failure of recovery in the expected time. (2 months)

### - Methods:

- Primary suture: See general principles.
- Secondary suture: See general principles.

## 3- Orthopedic measures:

- See general principles.

## Prognosis

- The operation is difficult and the results are often disappointing.
- In closed injuries the lesion is usually a mixed one due to a combination of neuropraxia, axonotmesis and neurotmesis and so conservative treatment is often followed by progressive improvement.

### Remember

- **Etiology**: open, traction, pressure injuries
- **C/P**: - Complete: paralyzed UL except trapezius + anaesthetic UL except skin over deltoid & medial side of the arm + Horner's \$
- Upper trunk: policeman's tip deformity
- Lower trunk: klumpke's paralysis
- **Invest. & TTT**: as before

# Axillary nerve injury

## Etiology

- This nerve is occasionally injured where it winds around the neck of the humerus by:
  1. Gunshot wounds.
  2. Direct blows on the shoulder.
  3. Fractures of the surgical neck of the humerus.
  4. Dislocations of the shoulder.
  5. Crutch palsy.

- ▶ Injury at neck of humerus
- ▶ flat shoulder

post. cord of Br. plexus  
↓ give  
axillary N.

## Pathology

- See general principles.

## Clinical Picture

- History of trauma.
- Motor loss.
  - The deltoid muscle is paralyzed and wastes rapidly so that the shoulder is flattened. The patient is unable to raise the arm from the side loss of abduction from 30-90°
- Sensory loss.
  - there may be temporary anaesthesia over the posterior fold of the axilla.
- Trophic changes.

badger area

## Investigation

- See general principles.

## Treatment

- See general principles.



## Scheme for written questions of peripheral nerves

### Etiology

- Open injury
- Closed Injury

### Pathology

- Neuropraxia.
- Axonotmesis.
- Neurotmesis.

### Clinical picture

- History of trauma.
- Motor loss.
- Deformity.
- Sensory loss.
- Trophic changes.
- Special tests.
- Special types of pain e.g. causalgia.

### Investigations

- EMG.
- NCV.

### Treatment

- Closed nerve injury.
- Opened nerve injury.

In modern surgery the best response is immediate nerve repair using microsurgical repair provided that wound is not heavily contaminated or lacerated.

### Prognosis



# Cranial nerve injuries

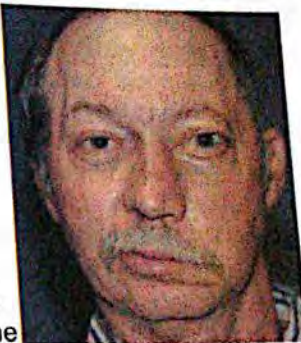
## 1) Facial nerve injury

### Etiology

#### a) Intracranial lesions:

(the nucleus of the nerve being in the floor of the 4<sup>th</sup> ventricle).

1. **Supranuclear lesions:** produce an UMNL of the lower half of the opposite side of the face only (since the occipitofrontalis and orbicularis oculi muscles enjoy a bilateral innervation).
2. **Nuclear lesions:** the whole face and the sixth nerve on the same side are affected with rapid atrophy of the facial muscles, together with crossed hemiplegia since the motor decussation takes place at a lower level.
3. **Infranuclear lesions:** occasionally results from pressure of a tumour in the cerebellopontine angle on the root of the nerve and gives rise to paralysis of the same side of the face together with deafness and cerebellar signs.



#### b) Cranial lesions:

- The nerve may be damaged in fractures of the base of the skull, middle ear disease or operations on the mastoid antrum. Any lesion which affects the nerve is liable also to involve the auditory nerve, the petrosal nerves or the chorda tympani.

#### c) Extracranial lesions (Bell's palsy):

- This is probably due to herpetic neuritis & may follow exposure to cold.
- Swelling within the sheath of the nerve extends into the stylomastoid foramen → nerve compression within its bony canal. Absorption of the exudate usually occurs before nerve is damaged permanently, but in about 10% of cases some degree of paralysis persists. The nerve trunk or branches may be damaged by injuries, operations or malignancy in the parotid region.



Upper Motor neuron lesion



Lower Motor neuron lesion

### Clinical picture

#### 1- Face:

- a. The affected side of the face is flat, motionless and expressionless.
- b. On looking upwards, the corrugations of the forehead are not apparent.
- c. On attempting to move the face, as in laughing or showing the teeth, the muscles on the non-paralysed side alone are contracted.
- d. Marked asymmetry results from the drawing over of the opposite side.

#### 2- Eye:

- a. The eye cannot be closed and on attempting to do so the eyeball rolls upwards and outwards.
- b. Epiphora results from drooping and relaxation of the lower eyelid and corneal ulceration may follow due to exposure.



**3- Mouth:**

- a. The lips can't be closed firmly & so whistling and blowing can't be performed.
- b. Food collects between the cheek and teeth from paralysis of the buccinator and the patient, after a meal, has to clean out the debris with his fingers.

**4- Tongue.**

- Loss of taste in the anterior 2/3 of the tongue indicates a lesion proximal to the entrance of the chorda tympani (about 6 mm above the stylomastoid foramen).

**Treatment****A. Conservative treatment for Bell's palsy:**

- Electrical treatment & massage → maintain health of the muscles and prevent atrophy.
- During recovery, active facial movements in front of a mirror should be practiced several times daily.
- Most cases of Bell's palsy begin to recover after **3-4 weeks** and recovery is complete in **3-6 months**.

**B. Operative treatment for injuries:**

- Nerve suture should be performed if the nerve is accidentally divided.
- If a nerve graft is needed to bridge a defect in the facial nerve, the easiest source is the great auricular nerve as it lies within the area of the parotidectomy operation which is a common cause of injury.
- If repair is impossible, hypoglossal anastomosis may be resorted to. The hypoglossal nerve is intentionally divided and its proximal end is anastomosed to the distal end of the injured facial nerve.
- In hopeless cases, asymmetry of the face may be improved by a plastic operation such as the insertion of fascial strips to sling up the corner of the mouth to the zygoma.

**2) Accessory nerve injury****Etiology**

1. Fractures of the posterior fossa involving the jugular foramen.
2. Damage during operations on the neck, particularly for removal of tuberculous or malignant LNs (more common).

**Clinical picture**

- Division of the nerve in the anterior triangle results only in partial paralysis of the sternomastoid and trapezius muscles (since they receive an additional nerve supply from the cervical plexus).
- If the nerve is injured in the posterior triangle the trapezius alone is affected.
- Paralysis of the trapezius causes drooping of the shoulder, tilting of the scapula and inability to abduct the arm above the right angle. Weakness of the whole arm results from imperfect fixation of the scapula.

**3) Hypoglossal nerve injury****Etiology**

1. This nerve may be injured during operations for removal of tuberculous LNs & may be involved by malignant diseases.
2. It usually escapes, however, in fractures of the base of the skull, since the anterior condyloid foramen is protected by a bony ridge which deflects the fracture towards the foramen magnum.



**Clinical picture**

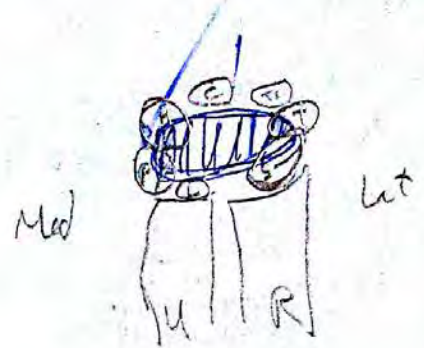
- Paralysis of the nerve is followed by hemiatrophy of the tongue which becomes directed towards the paralyzed side on protrusion.

**Carpal Tunnel Syndrome****Anatomical considerations** *of flexor retinaculum***Site**

- Thick band stretches distal to wrist joint (hand structure).

**Attachments**

- Medially** → attached to pisiform & hook of hamate bones
- Laterally** → tubercle of scaphoid & crest of trapezium

**Superficially**

From medial to lateral

1. Ulnar nerve
2. Ulnar vessels
3. Palmar cutaneous branch of ulnar nerve
4. Tendon of palmaris longus muscle
5. Palmar cutaneous branch of median nerve

*N.B: Radial artery does not pass superficial to flexor retinaculum*

**Deep to it****The carpal tunnel containing**

1. Flexor digitorum superficialis tendons
2. Flexor digitorum profundus tendons
3. Ulnar bursa enclosing flexor digitorum superficialis & profundus tendons (tendons of superficialis are arranged in two strata)
4. Flexor pollicis longus tendon
5. Radial bursa enclosing flexor pollicis longus tendon
6. Median nerve.
7. Flexor carpi radialis tendon & its synovial sheath (SPECIAL CANAL).

**Definition of carpal tunnel syndrome**

- It is compression of the median nerve inside the carpal tunnel under the flexor retinaculum.

**Etiology**

- Primary:** idiopathic.
- Secondary:** rheumatoid arthritis, myxedema, pregnancy, after Colle's fracture, fracture scaphoid, acromegaly.

*acute → fracture*  
*Chronic → tumor*



## Clinical picture of chronic primary carpal tunnel syndrome

### Symptoms

- **Early** <sup>sensory</sup> → pain in the hand along the lateral 3 fingers. *Radial side*
- **Late** <sup>motor</sup> → weakness, parathesia & numbness. *or full extension - "reversed Phalen"*

### Signs

**As median nerve injury at the wrist.**

- **Early** → there is tenderness on percussion on the course of the median nerve under the flexor retinaculum.
- **Late** → there is atrophy of thenar muscles & sensory loss along digital branches of lateral 3 ½ fingers.

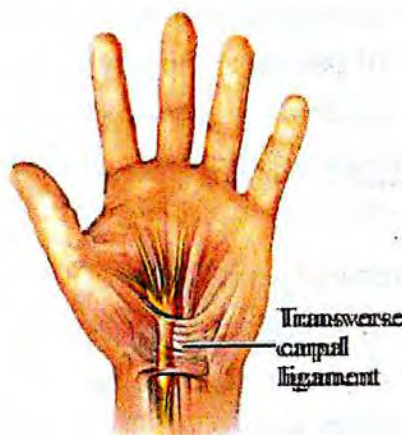
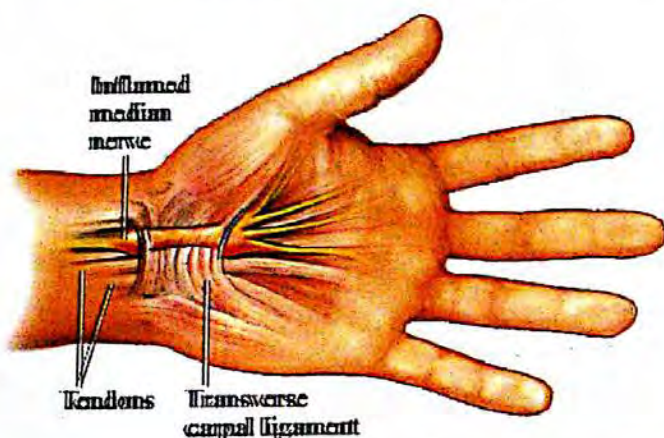
✓ No sensory loss over palm as palmar cutaneous branch of median nerve passes superficial to flexor retinaculum. → This occur in *early* only.

### Investigations

- Nerve conduction velocity: impaired *D.D Thoracic outlet*

### Treatment

- Division of the flexor retinaculum.

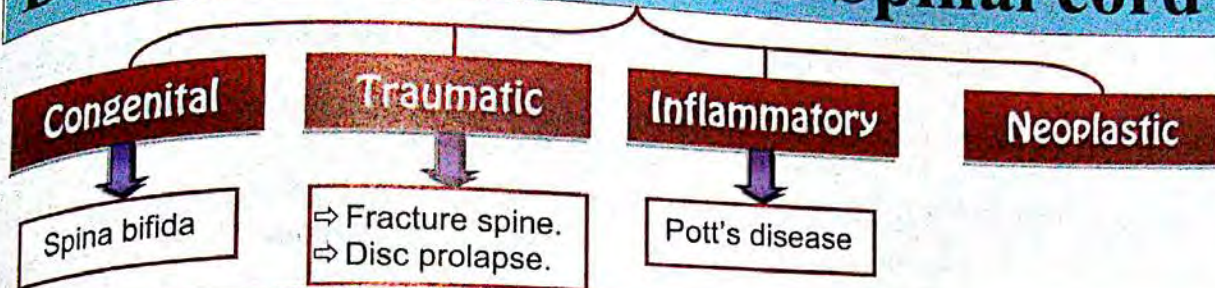


## Anaesthesia & nerve injuries

<b>Brachial plexus</b>	<ul style="list-style-type: none"> <li>▪ Arm suspended &gt; 50° to operating table with external rotation causing over-stretch of the roots</li> </ul>
<b>Ulnar nerve</b>	<ul style="list-style-type: none"> <li>▪ When arm pronated, compressed between hard edge of the table &amp; medial epicondyle</li> </ul>
<b>Radial nerve</b>	<ul style="list-style-type: none"> <li>▪ Compressed between the hard edge of the operating table &amp; humerus in spiral groove.</li> <li>▪ Tourniquet injury &amp; faulty intramuscular injections in the arm.</li> </ul>
<b>Sciatic nerve</b>	<ul style="list-style-type: none"> <li>▪ Compressed in lateral position of hip surgery or intramuscular injections.</li> </ul>
<b>Common peroneal nerve</b>	<ul style="list-style-type: none"> <li>▪ Compression between operating table &amp; fibula.</li> </ul>
<b>Tibial nerve</b>	<ul style="list-style-type: none"> <li>▪ Compressed in popliteal fossa by the knees supports in the lithotomy position</li> </ul>



# Diseases of the Spine & Spinal cord



## CONGENITAL ANOMALIES OF THE SPINE

- 1- **A congenitally wedged vertebrae ( hemivertebra ):**
  - Especially in cervical region → scoliosis or kyphoscoliosis.
- 2- **Sacralization of fifth lumbar vertebra:**
  - = Fusion of L5 to the sacrum
- 3- **Lumberization of the first segment of the sacrum:**
  - = Separated first sacral segment.
- 4- **Spondylolisthesis:**
  - = defect in articular process ( pars interarticularis) of L4, L5 or S1.
  - Early cases treated by physiotherapy, rest and spinal support.
  - Gross cases treated by spinal fusion.
- 5- **Spina bifida.**

\* meningoencephalocele

\* Subarachnoid cyst

\* Microcephalus

\*

### 1. Spina Bifida (Spinal dysraphism)

#### Definition

- Failure of the fetus spine to close properly during the first month of pregnancy.

#### Embryological background:

##### A- Spinal cord:

- Ectoderm → Neural groove → Neural canal.
- Neural canal is separated from skin to become spinal cord

##### B- Vertebrae:

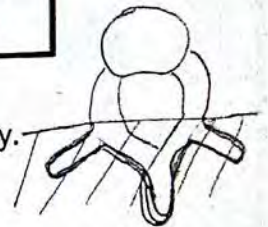
- 1- Notochord → center of vertebral body and intervertebral discs "nucleus pulposus"
- 2- Mesoderm around notochord → 2 mesodermal wings "neural arches" → Meet in

middle line to form spinous processes.

- Any arrest of any stage → one type of spina bifida
- May be isolated Anomaly or associated with other congenital anomalies e.g. VACTERL

#### Etiology

- The causes of spina bifida are not completely understood.
- Incriminated risk factors include:
  - 1- Folic acid deficiency.
  - 2- Positive family history
  - 3- Having a baby with a neural tube defect
  - 4- Poorly controlled diabetes
  - 5- Anticonvulsants intake





**Types****I. Spina bifida Occulta: ( 10% of population)****Pathophysiology:**

- The development is nearly complete except for a bifid spine covered by intact skin.
- The skin is connected to the meninges by a fibrous band (membrana reuniens)
- There may be no evidence of the presence of bifid spine or there may be:
  - Lipomatous tumor.
  - Skin dimple.
  - Tuft of hair.
  - Midline lumbar capillary hemangioma.

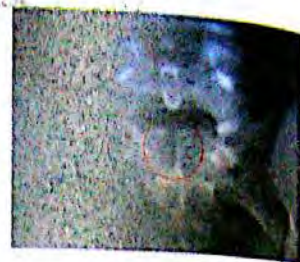
**C/P:**

- In most cases: asymptomatic till puberty.
- In minor cases: Urinary incontinence at puberty.
- At 1<sup>st</sup> nocturnal enuresis due to unequal growth of spinal cord & vertebral column or other nervous manifestations.

- **Plain X-ray of spine:** reveals deficient laminae.

**Treatment:**

- Usually not required
- In neurologic affection: cutting of the traction band or membrane.

**•Why symptoms arise at puberty?**

- It is a period of maximum elongation of vertebral column → max. traction on "membrana reuniens"

**•What is the cause of sphincteric disturbance?**

- The meninges are pulled from the back → traction on motor tracts → tracts of sphincteric control 1st to suffer as they are last fibers to be myelinated

**II. Spina bifida Overta****A. Meningocele:**

- **Pathophysiology:** contains CSF
  - Bulging of the meninges only through the spinal defect.
  - It does not contain nervous tissue.

**Sites:**

- Lumbosacral region.
- Back of neck (D.D. with lipoma).

**C/P:**

- Swelling which is:
  - Cystic.
  - Translucent.
  - Compressible.
  - Gives expansile impulse on cough.
- Mostly neurologically normal.

- **Associated anomalies:** rare.

**Treatment:**

- If there is a CSF leak urgent repair is required. Otherwise elective plan is planned for fear of Comp!
- Better to be during the first few months of life.



Spina bifida occulta

Meningocele

Myelomeningocele

for fear of Comp!  
rupture  
Hemorrhage  
meningitis



**B. Meningo- myelocele:**

It is the **commonest** type of manifest spina bifida.

**Pathophysiology:**

- Protrusion of spinal cord and roots through the bony defects within covering of meninges and / or skin. *not translucent*
- The meningeal covering may rupture and the spinal cord & roots lie exposed to air, CSF may leak from open lesions.

**C/P:**

- The protruding roots & cord are usually *باريظين مش هيرجعوا حتى بعد الجراحة* **functionless** → Paraplegia, wasting, or contractures, with sensory loss.
- A dilated bladder & a patulous anus might be present.
- Trophic changes are marked, particularly perforating ulcers of foot.

**Associated anomalies:**

- o Hydrocephalus.
- o Aqueduct Forking.
- o Arnold-Chiari malformation:  
= the cerebellar tonsils lie at a level below the foramen magnum  
→ obstruct the flow of CSF from the fourth ventricle → hydrocephalus.

**Treatment:**

- The lesion should be repaired as soon as *emergently* possible (within 24-48 hrs) due to neurological defect. *Due to N. defect*
- **Immediate** closure & replacement of the neural tissue into the spinal canal to prevent infection.
- ⊖ In Arnold-Chiari malformation: the same +  
a- Ventriculo-peritoneal (or atrial) shunt for hydrocephalus.  
b- If untreated 75 % of cases die within the first year of life.

**C. Myelocele (complete spina bifida)**

- No fusion of the neural tubes.
- So, the defect is occupied by open spinal plate appearing as red granular area with CSF coming from its center.
- The lesion is incompatible with life → **fatal** in 100 % of cases.

**D. Syringomyelocele:**

- A rare form where the central canal is dilated.

**Diagnosis****Prenatal Diagnosis:**

- o The most common screening methods used to look for spina bifida during pregnancy are second trimester maternal serum alpha fetoprotein (MSAFP) screening and fetal ultrasound.

**Postnatal Diagnosis:**

- o Mild cases: detected by X-ray during a routine examination.
- o More severe forms of spina bifida often have muscle weakness in their feet, hips, and legs: magnetic resonance imaging (MRI) or a computed tomography (CT) scan to get a clearer view of the spine and vertebrae.
- o If hydrocephalus is suspected: CT scan and/or X-ray of the skull

**Prevention**

- o Folate one month before conception and during 1st trimester can prevent up to 70% of cases.





## 2. Injuries of the Spine

### A- Fracture & Dislocation of the Spine

#### Definition

- Disturbance of the normal continuity of vertebrae.
- It may be isolated fracture or fracture dislocation.

#### Incidence

- More in males (more exposure to mechanism of injury)
- Most commonly affected spine at the junction of mobile and rigid parts at lower cervical and dorso-lumbar regions.

#### Etiology

##### I- TRAUMA.

##### a. Hyper-flexion trauma:

- This is the most frequent trauma, e.g., fall of a heavy object on the back of the trunk or head.

##### b. Hyper - flexion and rotation.

##### c. Vertical compression trauma:

1. Fall from height on the feet (fractures of the calcaneus is a common association or the buttocks).
2. Fall on the head, e.g. diving in shallow water.

##### d. Hyper-extension injuries: uncommon.

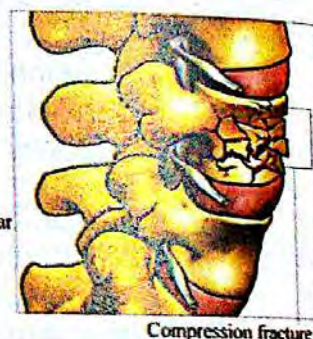
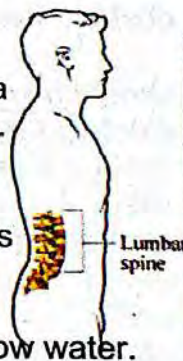
##### II-PATHOLOGICAL FRACTURES:

- a. Metastases.
- b. Osteoporosis.

#### Types

##### A. According to morphology:

1. **Wedge compression fracture:**
  - Hyper-flexion trauma crushes the vertebral body into the shape of a wedge.
2. **Fracture dislocation:**
  - If hyper-flexion is accompanied by rotation → fractures of articular processes.
  - The posterior ligaments are torn → forward dislocation of a vertebra.
  - Commonly there is damage to the spinal cord and nerve roots.
3. **Dislocation:**
  - Pure dislocation without fracture is common in cervical vertebrae because its articular processes are rather horizontal.
  - Same results of fracture dislocation.
4. **Comminuted (burst) fracture:**
  - This is an uncommon injury due to vertical compression of the straight spine.
  - Ligaments are not ruptured → the fracture is stable.
  - However, Cord or root damage may occur by the fragments of the vertebral body.
5. **Avulsion fractures of transverse and spinous processes:**
  - Not accompanied by neurological injury and require no special treatment.





6. **Dislocations and fracture dislocations of the atlas and axis vertebrae:**
- Serious as they may be fatal because of trans section of the cord above the level of innervation of respiratory muscles.
  - Atlas dislocation can occur with or without fracture of odontoid process (hangman's fracture).

### B. According to stability:

- Stability of the spine fractures depends on the integrity of the posterior ligaments; the interspinous, supraspinous and ligamentum flavum
- **Stable fractures:** Have intact posterior ligaments, e.g., wedge compression, comminuted and avulsion fracture of the transverse and spinous processes.
- **Unstable fractures:** Have torn posterior ligaments and are liable to injure the cord and nerve roots, these include fracture dislocation and pure dislocation.

## Neurological injury

- Paraplegia or quadriplegia is the result of injury of the spinal cord or nerve roots or both.
- It is important to diagnose the level of the lesion as well as its nature to whether recovery is expected or not.

### a. Level of lesion:

- The spinal cord ends at the lower border of the first lumbar vertebra.

Site of trauma	Spinal cord damage	Nerve root damage	Neurological deficit
Below L1	No	Root lesions of the Cauda equina.	According to the affected roots.
lumbo-dorsal junction (T12-L1)	First sacral cord segment	Roots of D12 and L1	<ul style="list-style-type: none"> <li>■ Isolates the sacral cord (this is irrecoverable).</li> <li>■ Paralysis of the muscles controlling the hip (root damage).</li> </ul>
Tenth dorsal vertebra (T10)	First lumbar cord segment	Roots of T10	<ul style="list-style-type: none"> <li>■ Isolates the entire lumbar and sacral cord with permanent paralysis of the lower limbs and viscera.</li> </ul>
Between the tenth and the twelfth dorsal (T10-T12)	Cord lesion at any level in the lumbo-sacral cord.	T10 - T12.	According to cord and root injury.
Cervical spine	Corresponds to the level of bone injury	One or two roots Correspond to damaged vertebrae.	<ul style="list-style-type: none"> <li>- According to cord and root injury.</li> <li>- High cervical cord transection is fatal because all respiratory muscles are paralyzed.</li> </ul>



### **b-Nature of lesion**

#### **1. Spinal cord concussion:**

- Like cerebral concussion and nerve concussion, recovery is the rule.

#### **2. Spinal cord damage by contusion or laceration (transection):**

- These do not recover.
- Types of spinal cord transection are:
  - i. Complete transection.
  - ii. Hemisection (Brown-Sequard syndrome).

#### **3. Cauda equine injury:**

### **Clinical Picture**

- a. Spine injury is suspected after major trauma or if the patient is unconscious after the +injury.
- b. Other injuries of the skull, chest, abdomen, limbs should be searched for.
- c. Local signs
  - Slight kyphosis may be felt or visible.
  - There is local tenderness over the spinous processes. No gap is felt between the spinous processes in a stable fracture and vice versa in unstable fractures.
  - No attempt should be made to test for back movements as this may induce paraplegia.
- d. Neurological assessment
  - Motor power.
  - Sensations.
  - Reflexes.

### **Complications**

- 1- Spinal cord and/or root injury including roots of cauda spina
- 2- Shock may be:
  - a- Spinal shock
    - Sympathetic affection leading to loss of vascular tone & bradycardia
    - loss of muscle tone → venous pooling & hypovolemia
  - b- Hemorrhage lead to true hypovolemia

### **Investigations**

- A- For diagnosis: plain X-ray spine, AP and lateral
  - Cervical spine films should show all seven cervical vertebrae and T1.
  - a special view through the open mouth is needed to show the atlas vertebra.
- B- For complications: CT and MRI → assess spinal cord damage.
- C- For detection of cause of pathological fracture

### **Treatment**

#### **A. Initial management**

- When fracture of the spine is suspected, movements of the spine must be prevented.
- A cervical collar is applied and the head is immobilized during transport and during examination.
- The trauma victim is moved on to the stretcher all in one piece; he should never be lifted by the shoulders and the thighs.
- In the hospital, the patient is nursed on a bed with fracture boards. Shock must be treated. Associated injuries may require urgent treatment.



**B. Stable fractures****1) Wedge compression fracture:**

- The fracture is disregarded. The patient is put in bed and is taught extension exercises for the back muscles. Within a month, he is allowed up
- He can resume work in 3 months.
- A painless, mobile, and powerful back is achieved in spite of the fact that the compressed vertebra remains wedge shaped.

**2) Comminuted fracture:**

- Pain is usually severe and healing is delayed. A plaster jacket is applied in the neutral position (straight spine; not hyperextended) for 3 months.
- The patient can walk with the plaster on.
- Spinal exercises must be practiced regularly as soon as the plaster jacket has been applied.

**3) Avulsion fractures of the transverse or spinous processes:**

- Rest and analgesics.

**C. Unstable fractures****1) No neurological deficit:**

- Reduction and immobilization are required to prevent spinal cord injury.
- This is later followed by physiotherapy for rehabilitation.

**a- Cervical spine:**

- Traction using tongs for 6 weeks is followed by a cervical collar for one month. Open reduction and internal fixation by plates may be needed.

**b- Thoraco-dorsal spine:**

- Reduction by gentle extension is followed by fixation in a plaster cast in mild extension.
- If closed reduction is not possible, open reduction and internal fixation is the alternative.

**2) Evident cord transection****3) Care of paraplegic patient.****D. Principles of Management****1- Postural reduction and 2 hourly turning:**

- Position of extension is maintained by pillows Not plaster cast (cause pressure sores).

**2- Medication:**

- a- Corticosteroid in first 48 hrs : ↓ edema
- b- DVT & stress ulcer prophylaxis

**3- Skin care:** Kept clean and dry, washed, dried, powdered.

- If established bedsore → remove sloughs & daily dressings till grafting.

**4- Bladder care:**

- a) Indwelling catheter in initial shock stage
- b) Stroking the side of thigh initiate bladder contraction when reflex return (automatic bladder empty by contraction of detrusor muscle)
- c) Cauda equine : bladder remain paralyzed ( emptying by abdominal straining, intermittent catheter every 12 hrs or indwelling catheter)
- d) UTI is prevented by (aseptic catheterization, urine exam and bacteriology, Antibiotics)



- e) If there is high residual urine: need special investigations (cystography and cystometry).

**5- Bowel training:**

- Enema every third day, mild laxative, train patient to strain and evacuate bowel.

**6- Muscle and Joints:**

- Contractures are Prevented by passive movement and corrected by Tenotomy.

**7- Rehabilitation of permanent paraplegic:**

- a- Trunk and shoulder muscles are well developed helping the patient to sit up.
- b- A wheel chair may be used for life.

## B- Spinal Cord Transection

### Clinical features

- **Early stage (spinal shock):** lasts for a few days.
  - A. complete flaccid paralysis below the line of cord section,
  - B. loss of tendon reflexes.
  - C. an atonic distended bladder.
- **Then,** the cord below the level of transection recovers reflex function, which results in spastic paralysis and a reflexly emptying bladder.

### Diagnosis

In spinal shock phase it is suspected with the following findings:

1. Complete loss of all forms of sensation below the level of the lesion.
  - In concussion, sense of joint position which ascends in the posterior column is preserved.
2. If the sensory loss and paralysis rise after injury indicating ascending edema.
3. A damaged cord, which has not recovered in 48 hours, will never recover.
  - A very sure sign of cord transection: is the appearance of the mass reflex (at 3-6 weeks) and the presence of anal and penile reflexes in the absence of sensation in the legs.

### Treatment

- 1) Paraplegics are better treated in special centers by well trained personnel.
- 2) The patient is transported with care to avoid further damage to the cord.
- 3) In most centers treatment is usually conservative.
- 4) Decompression and internal fixation are done if :
  - a- paralysis is incomplete and particularly if it is increasing.
  - b- CT scanning shows fragments of bone encroaching upon the spinal canal.

In some centers: decompression is done routinely to facilitate nursing and rehabilitation of the patients, but this is controversial.



# C- Disc Prolapse

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## Definition

- A condition results from rupture of annulus fibrosus with herniation of nucleus pulposus causing compression on nerve roots or spinal cord.
- There are 2 Classes according to onset → acute & chronic.



## Etiology

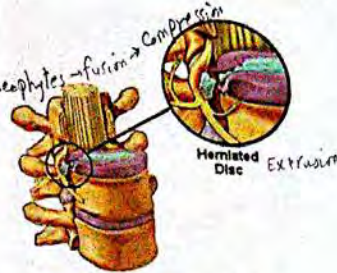
- Sudden strain with the spine in an unguarded position (80%).
- Degeneration of the annulus (20%).
- old age (Degeneration) [Hard]
- Young age (trauma) [Soft]

## Incidence

- 80% (L4/L5 - L5/S1) → "lumbar disc prolapse".
- 20% (C5/C6 - C6/C7) → "cervical disc prolapse".

## Pathology

- According to direction of prolapsed
  - Postero-Lateral → compression of nerve roots.
  - Posterior → compression of spinal cord.
  - Into the vertebral body (Schmorl's node) is rare.
- Osteoarthritis of intervertebral joints may follow degeneration and prolapse of the disc.



## Clinical picture

### I- Lumbar disc prolapse:

#### Clinical features

- Low back pain while lifting a heavy object or stooping → spinal muscles go into painful spasm → the patient locked in agony → unable to straighten up.
- Root pain: radiates down the back of the lower limb and is increased by coughing.
- The patient shows a scoliotic position with a limping gait to reduce pressure on the nerve root.
- Straight leg raising or flexion of the spine increases the pain due to compression of the nerves against the protrusion.



#### Motor and Sensory:

Prolapsed disc	Roots affected	Pain & Sensory loss	Motor
L4/5 disc	5 <sup>th</sup> lumbar root	Over the back of the thigh, lateral aspect of the leg and dorsum of the foot.	Weakness of ankle dorsiflexion.
L5/S1 disc	first sacral root	the back of the leg and sole of the foot	weak planter flexion of the ankle and absent ankle jerk.

#### Autonomic

- Sphincteric disturbances (S<sub>2,3,4</sub>).
- Vasomotor changes.

Post → cauda eq.

Post. lat → sciatia



## Cauda equina syndrome

Due to compression from massive ruptured disc mostly L4 - L5

### Clinical picture:

1. Motor weakness (may progress to paraplegia)
2. Saddle anesthesia (perineum, genitalia & buttocks)
3. Bilateral sciatica
4. Urinary retention or incontinence
5. Fecal incontinence

## II- Cervical disc prolapse:

### a. Lateral prolapse: Post-lat Radiculopathy

- 1- Compression of half of the spinal cord leads to Brown Sequard syndrome.
- 2- Compression on nerve roots depends on the affected disc level:

Prolapsed Disc	Roots affected	Pain & Sensory loss	Motor
C5/6 disc	6 <sup>th</sup> cervical root	The outer border of the arm and dorsum of forearm	Weakness of the biceps & diminished biceps & supinator jerks.
C6/7 disc	7 <sup>th</sup> cervical root	Back of upper arm and forearm.	Weakness of the extensors of the fingers and diminished triceps jerk.

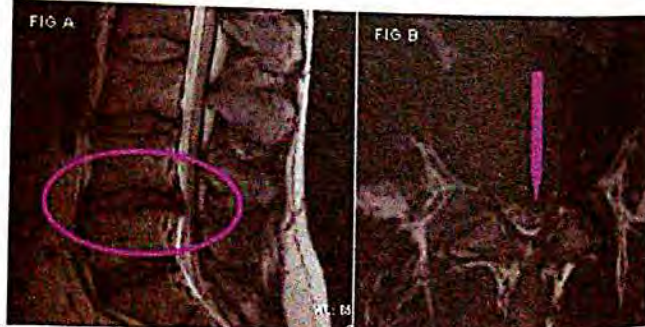
→ Movements of the spine aggravate the pain while rest or traction of the spine relieve it.

### b. Posterior (central, midline) prolapse: Myelopathy

- 1- Compression of the anterior part of the cord may lead to quadriplegia.
- 2- Compression of the anterior spinal artery may affect:
  - a- The pyramidal tract → UMN below level of compression.
  - b- The spinothalamic tract → superficial sensory loss below the level of compression.

## Investigations

- Plain X-ray of spine (PA and lateral views):
  - a. To exclude bone diseases that cause similar manifestations.
  - b. Later → show narrowing of the disc space.
  - c. In chronic cases → show osteophytes at the margins of the vertebrae.
- C.T. scan & MRI (the investigation of choice):
  - accurately localize the site of disc prolapse or spinal cord compression.
- Myelography was previously used and now replaced by CT and MRI.



## Treatment

### 1- Lumbar disc prolapse

#### a) Conservative treatment:

- Rest in a bed (for 2-4 weeks):
  - on boards placed under the mattress to give a rigid support relieves the pain in the majority of cases.
- Analgesics: usually an anti-inflammatory agent.
- Weight reduction.
- Avoidance of sudden flexion strains on the spine.
- Physiotherapy after recovery from the acute attack.



**b) Surgical treatment:**

► **Indications:**

1. Persistent symptoms. failure of conservative from start
2. Recurrent attacks of severe pain.
3. Evidence of motor or sensory affection or sphincteric disturbances. "Myelopathy" 4- progressive motor weakness

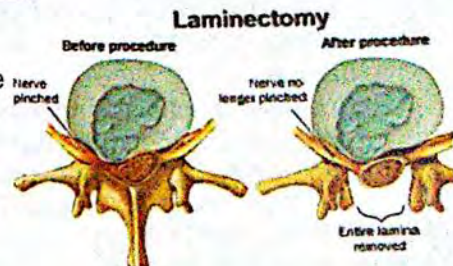
► **Aim:**

- Removal of the prolapsed nucleus pulposus.

► **Approach to the prolapsed disc is either by:**

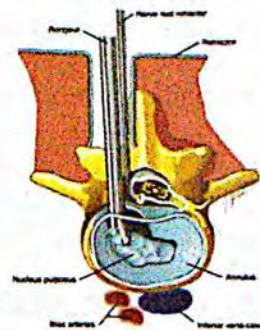
I. **Laminectomy:**

- 1- A vertical midline incision in the back.
- 2- The laminae of corresponding vertebrae are removed → access to the dura.
- 3- Dura is retracted medially to expose and remove the prolapsed material.



II. **Microdiscectomy:** - Ant. approach

- 1- Here no bone is removed.
- 2- Access is gained by incising the tissues between adjacent laminae.
- 3- The operation can be conducted by endoscopic surgery.



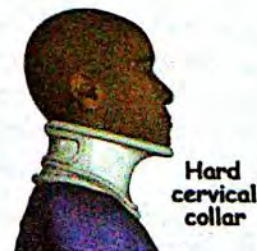
► **Causes of recurrence of pain after surgery:**

- Removal of a disc from a wrong level.
- Presence of another undiagnosed disc prolapse.
- Presence of interstitial neuritis of the nerve roots due to prolonged compression.
- Osteoarthritis of the intervertebral joints, in this case, spinal fusion should be performed during the operation for removal of the disc.

**2- Cervical disc prolapse**

Conservative

- A. Neck collar to limit movement of the neck.
- B. Analgesics.
- C. In severe cases with nerve root compression: → traction by the physiotherapist for about 20 minutes every day.
- D. In very severe cases: → traction of the neck is maintained for as long as the patient can stand it by a head halter.



Surgical

Indication

Method

- E. In cord compression with developing quadriplegia and urinary incontinence: → urgent decompression by discectomy or Laminectomy may be needed, followed by spinal fusion: - if hard type (old)



**Most frequent sites:**

- Spondylolisthesis → L5, S1
- Spina bifida → Lumbar
- Fracture → Dorso-lumbar & cervical.
- Pott's disease → Dorso-lumbar.
- Disc prolapse → Lumbar (L4,5 & L5, S1) & cervical (C5,6,7).



## D- Spondylosis

### Pathology

- Spondylosis of the spine is a degenerative condition.
- It is often a part of generalized osteoarthritis.
- More localized spondylosis may follow old forgotten trauma.
- The **Cervical** and **Lumbar** vertebrae are particularly affected.

### Clinical Picture

- Pain, usually in a nerve-root distribution
- Limitation of movement
- Stiffness.
  - An element of disc prolapse is a common feature of spondylosis → many of the S/S of spondylosis are the same as in disc prolapse.
  - But in spondylosis widespread affection of the vertebrae than in disc prolapse, detected clinically and radiologically.

### Investigations

- ▶ **Plain X-ray:**
  - Osteophytic lipping of the edges of the vertebrae, especially in the lateral view.
  - Osteophytes are commonly form around the vertebral foramina through which nerve roots pass.
  - Disc degeneration is seen as narrowing of the space between adjacent vertebrae.

### Treatment

→ The treatment for spondylosis is much similar to prolapsed intervertebral disc.

#### A. Conservative:

- Analgesics: as anti-inflammatory agents to relieve pain.
- In mild cases: physiotherapy and exercises to strengthen spinal extensor muscles.
- Traction for varying periods.
- Spine support:
  - Lumbar spine: Abdominal corset to limit movements of the lumbar spine.
  - Cervical spine: Cervical collar.
  - In severe cases with severe pain: immobilization in a plaster jacket.

#### B. Surgery:

##### ▶ Indications:

- 1- Severe persistent symptoms.
- 2- Evidence of advancing nerve pressure.

##### ▶ Procedures:

- Laminectomy → for decompression of neural elements followed by spine fusion with bone grafts.

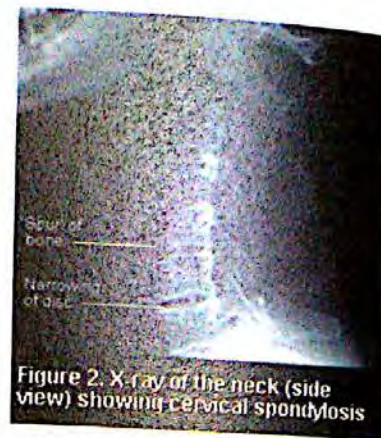
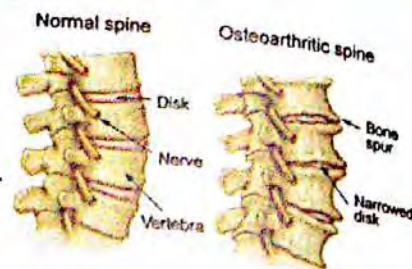


Figure 2. X-ray of the neck (side view) showing cervical spondylosis



### 3. SPINAL CORD TUMORS

#### Site

#### Extra-dural

- The commonest are secondary deposits, usually from breast, lung or prostate cancer
- Sarcoma & neurofibroma are also found.

#### Intra-dural

#### Extra-medullary

Irritation of nerve roots

#### Intra-medullary

Pressure on the cord

#### Clinical picture

- ▶ Intra-dural extra-medullary tumors → Meningiomas & Neuromas.
- ▶ Intra-medullary tumors → Gliomas or Ependymomas.
- ▶ Extra-dural → S/S of irritation of nerve roots, Then, the signs of pressure on the cord.
- ▶ A neurofibroma may be "dumb-bell" in shape, the smaller part lies within the neural canal while the larger part projects through an intervertebral foramen.

#### Investigations

- 1- Plain X-ray of the spine (antero-posterior, lateral & oblique views)
  - Erosion of bone or bone abnormalities are seen in 50% of patients.
- 2- CT scan & MRI.
- 3- Myelography:
  - Has been largely replaced by CT scan & MRI.

#### Treatment

##### ⇒ Laminectomy:

- If possible, the tumor is removed.
- Removal of tumor & laminectomy helps in decompression of the cord.



## Points to remember (spine)

### Spina Bifida (Spinal Dysraphism)

- ▶ **Etiology:** Folate def., +ve F.H., uncontrolled DM, Anticonvulsants intake.
- ▶ **Spina Bifida Occulta:**
  - Development is nearly complete except for a bifid spine covered by intact skin.
  - **C/P:** asymptomatic, Urinary incontinence at puberty (1<sup>st</sup> nocturnal enuresis).
  - X-ray, TTT usually not needed, in neurological affection → cut the traction band.

### ▶ **Spina Bifida Overta:**

#### Meningocele:

- Bulging of the meninges only.
- **Sites:** Lumbo-sacral, back of neck.
- **C/P:** swelling (cystic, translucent, impulse on cough, compressible), neurologically free.
- **TTT:** if CSF leak → urgent repair.

#### Meningo-myelocele:

- Commonest type of manifest spina bifida.
- Protrusion of meninges+ spinal cord and roots
- **C/P:** motor (paraplegia, wasting), sensory, bladder affection, trophic changes.
- may + hydrocephalus (Arnold Chiari).
- repair as soon as possible (within 24-48 hrs).
- In Arnold Chiari: + VP shunt.

### Spondylosis

- ▶ Degenerative, part of generalized osteoarthritis.
- ▶ Commonest in Cervical and Lumbar vertebrae.
- ▶ **C/P:** pain (in root distribution), Limitation of movement, Stiffness. (similar to prolapse but more widespread affection).
- ▶ **Invest.:** X-ray: (lipping of edges, Osteophytes, narrow disc space).
- ▶ **TTT:** (similar to prolapse)
  - Conservative: analgesics, physiotherapy, spine support, traction.
  - Surgical: (severe persistent symptoms, advanced nerve pressure) → Laminectomy.

### Fracture & Dislocation of the Spine

- ▶ **Etiology:** trauma, pathological fracture.
- ▶ **Types:** Acc. to morphology & stability.
- ▶ **C/P:** as trauma + slight kyphosis, local tenderness, neurological assessment.
- ▶ **Neuro. lesion:** level, nature (concussion, contusion, Cauda equine injury).
- ▶ **Comp.:** Spinal cord injury, Shock.
- ▶ **Invest.:** X-ray, for comp.(CT, MRI), for cause.
- ▶ **TTT:** - Initially: (immobilization, cervical collar, transport to hospital).
  - Acc. to type: (stable, unstable).
  - Principles of management.

### Disc Prolapse

- ▶ **Etiology:** Sudden strain 80%, Degeneration.
- ▶ **C/P:** - Lumbar: Pain (low back, LL, with leg raising), motor, sensory, autonomic.
  - Cervical: Lateral: roots → motor, sensory. Central: UMN.
- ▶ **Invest.:** CT, MRI (of choice), X-ray.
- ▶ **TTT:** - Lumbar: Conservative: (rest, analgesics, wt. reduction, physiotherapy)
  - Surgical: Laminectomy, Microdiscectomy.
- Cervical: neck collar, analgesics, in severe cases → traction, in cord compression → decompression.

### Spinal Cord Tumors

- ▶ **Extra-Dural:** usually secondaries.
  - Irritation of roots, then, pressure of cord.
  - Neurofibroma may be "dumb-bell" in shape.
- ▶ **Intra-Dural:**
  - Extra-medullary: (irritation of roots)
    - Meningiomas & Neuromas.
  - Intra-medullary: (pressure on the cord)
    - Gliomas or Ependymomas.
- ▶ **Invest.:** plain X-ray, CT, MRI.
- ▶ **TTT:** Removal of tumor & Laminectomy.



# CHAPTER 3

## Plastic surgery

- Burn
- Skin graft and flap
- Skin neoplasm
- Aesthetic surgery & bed sores
- Skin & subcutaneous tissue
- Muscles, Tendons & Fascia
- Hands & Feet.
- Face, Lips & Palate
- Mouth, Cheek & Tongue
- Teeth, Gums & Jaw

- Wound & Healing (General)

G. { - Lymphatic & Nervous: anatomy, lymphedema, autonomic nervous system, tumor

- infection

General, CR.N, Brach. plex, ul. Limb, sciatic

ectomy  
sympath. , auton



# Burn

## Definition

- Necrosis of tissues by physical or chemical agents.

(Mechanical  $\xrightarrow{\text{dry}}$  Wound)

## Etiology

### A-Physical Burns

#### i. Thermal (75% of all burns):

- Scalds are caused by boiled liquids; they often affect children. *wet burn*
- Flame burns can affect any age & is the most common burn industrial accident. *dry burn*
- Contact burns due to direct contact with hot objects (e.g. irons).
- Steam burns: also steam inhalation can cause thermal injuries to the airway.

#### ii. Electrical burns:

- High voltage  $>1000$  volt  $\rightarrow$  *deep burn* marked tissue damage
- Low voltage  $<1000$  volt  $\rightarrow$  minimal tissue damage

#### iii. Radiation burns (irradiation therapy - sun rays)

*disturb electricity of heart*

The blood and bones are good conductors, thus eventually every organ in the body may be affected.

### B- Chemical burns

Due to alkalis or acids.

## Classification (Assessment) of burns

### ➤ According to the extent (in relation to total body surface area "TBSA"):

#### A major burn

- More than 30 % of the body surface area.

#### An intermediate burn

- 15 - 30 % in adults.
- 10 - 30 % in children.

#### A minor burn

- Less than 15 % in adults.
- Less than 10 % in children.

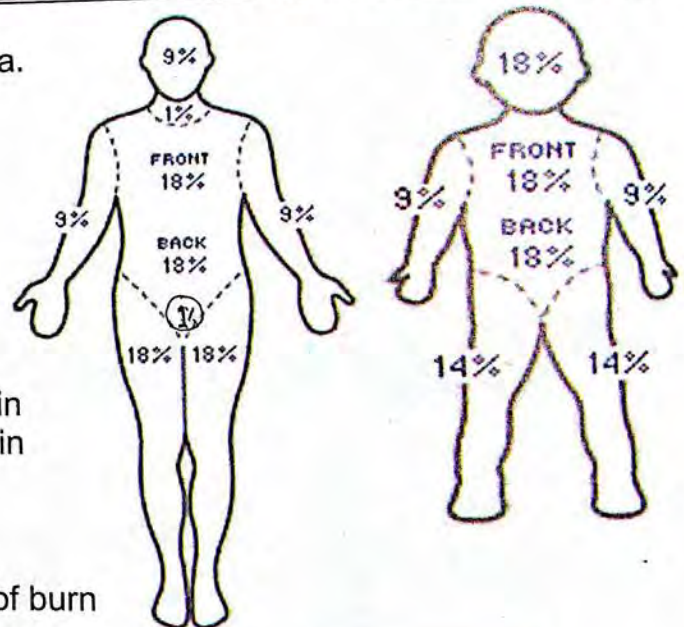
#### ▪ This is estimated by:

##### a- Rule of 9:

- This method is easy but not accurate in children due to large size of the head in relation to the rest of the body.

##### b- Lund and Browder charts:

- More accurate in all age groups
- Correlation between age, area, depth of burn



1<sup>st</sup> degree



2<sup>nd</sup> degree



3<sup>rd</sup> degree





## According to the depth:

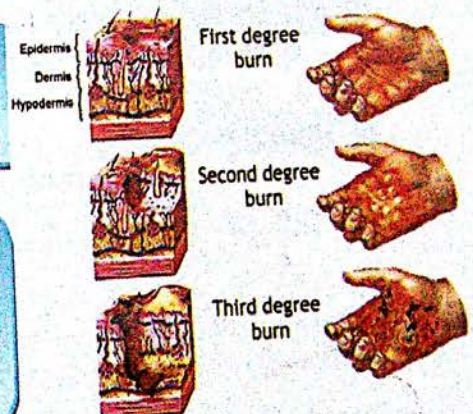
	1 <sup>st</sup> degree	2 <sup>nd</sup> Degree	3 <sup>rd</sup> degree
Damage	<ul style="list-style-type: none"> <li>Only the epidermis → erythema of skin usual example is sunburn.</li> </ul>	<ul style="list-style-type: none"> <li>Epidermis + portion of dermis.</li> </ul>	<ul style="list-style-type: none"> <li>Complete destruction of epidermis and dermis.</li> </ul>
Healing	<ul style="list-style-type: none"> <li>Heal rapidly</li> </ul>	<ul style="list-style-type: none"> <li>Epidermal regeneration can occur from remnants of hair follicles and sweat glands in dermis provided that no infection.</li> <li>If infection → destruction of epithelial remnants → 3<sup>rd</sup> degree.</li> </ul>	<ul style="list-style-type: none"> <li>No healing only migration of epithelium from edges of burnt area</li> <li>separation of eschar by 3<sup>rd</sup> week</li> <li>Skin graft is needed</li> </ul>
Appearance	<ul style="list-style-type: none"> <li>Forms blisters surrounded by erythema</li> <li>Their surface is moist due to exudation of plasma</li> </ul>		<ul style="list-style-type: none"> <li>White or black eschar</li> <li>The area is dry</li> <li>Possible visible thrombosed S.C vessels</li> </ul>
Presence of pain	<ul style="list-style-type: none"> <li>Painful</li> <li>Sensitive to air (can be elicited by pinprick test)</li> </ul>		<ul style="list-style-type: none"> <li>Painless (due to loss of terminal nerve endings)</li> </ul>

For simplification, the burns can be classified into:

- Superficial → 1st and 2nd degree.
- Deep → 3rd degree.

2<sup>nd</sup> degree of burn is further subdivided into:

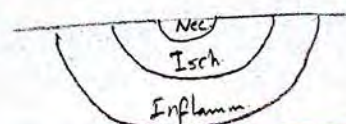
- 1- Superficial: heals with epithelization in 10-14 days.
- 2- Deep: heals more slowly (25 - 35 days)





**Pathology****A. Injury**1. **immediate direct cellular injury**

Consist of 3 zones :



	<b>Etiology</b>	<b>Fate</b>
1-Central zone of coagulation	ماتت Necrosis	Eschar formation → separation after 3 weeks → leave ulcer
2-Intermediate zone of stasis (degeneration)	الحقون Ischemia	Viable tissue which may: - Die after 48 hours - Or remain viable
3-Outer zone of hyperemia (inflammation)	التهاب Inflammatory reaction	- Recover within 7-10 days - OR become infected

2. **Delayed Ischemic injury** as a result of progressive dermal ischemia.**B. Healing**1. **Partial thickness burns**

Healing by epithelialization within 3 weeks

1st degree → 3 days 2nd → 2-4 wks

2. **Full thickness burns**

Separation of eschar leaving granulation tissue after 3 wks (at about 4wks) → fibrosis &amp; scarring

Degree of tissue destruction depends on temp. + duration of exposure to heat  
 Rate of tissue healing depends on remaining hair follicles & sweat glands

**Pathophysiology**I. **Cellular**: Release of Inflammatory mediators as CIL, TNF & Burn toxins → MOFII. **Vascular**: intra venous1. ↓ I.V. volume due to ;a) Evaporation (each 1L evaporation of water → the body loses 580 KCal).b) ↑ Capillary permeability (maximum in the first 8hrs & continue for 48hrs) → severe hypovolemic shock (especially with deep burn).2. ↑ blood viscosity leading to thrombosis & embolismIII. **Metabolic response** burn is a stress → so release of stress hor. as [adrenaline, cortisol, T<sub>3</sub>, glucagon, renin, aldosterone, ADH]1. It results in hypercatabolic state2. protein breakdown (-ve nitrogen balance)IV. **Immunological** burn is a stress → stress ↓ immunity due to ↑ Cortisone → suppresses B.MImmunosuppression due to defective humoral & cell mediated immunityCatabolic hor.  
of fat & proteins

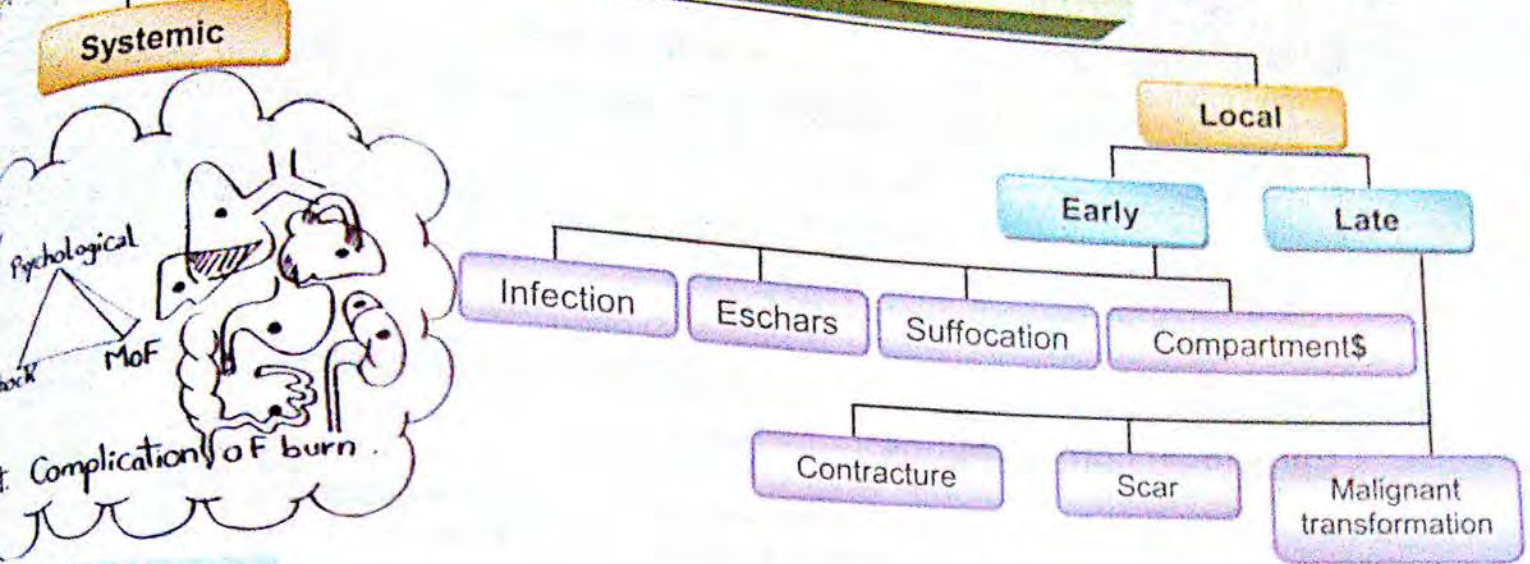


# Complications

## VOLUME -II

The 1<sup>ry</sup> cause of death is INFECTION

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### I. Systemic:

#### 1- Shock

Immediate	Early	Late
<b>Neurogenic</b> from severity of pain	<b>Hypovolemic</b> due to under correction of lost fluid	<b>Septic</b> after 1 week from infection

#### 2- Pulmonary complications:

Immediate	Early	Late
<b>Asphyxia</b> Due to inhalation of heat or noxious gases → bronchospasm.	<b>Pneumothorax</b> <b>Pneumonia</b> <b>Pulmonary embolism</b>	<b>Respiratory failure type II</b> Hypoxia, hypercapnia (ARDS) v.d. of Pul. Cp.

#### 3- Cardiovascular complications:

- Acute left ventricular failure. ischemic
- Congestive heart failure. from fluids
- Arrhythmia (especially in electrical burn).
- Myocardial infarction (either due to stress or hypovolemia & ↑ viscosity).

#### 4- Renal complications: → reversible

- Acute tubular necrosis (acute cortical necrosis) due to release of cytokines & ILs. → irreversible
- Myoglobinuria & hemoglobinuria (especially with electrical burn).
- ARF (due to hypovolemic shock) → leading to water & electrolyte imbalance.

#### 5- Gastro-intestinal complications:

- Adynamic ileus = Acute gastric dilatation due to severe sympathetic stimulation & release of cytokines & ILs. Usually occurs early (may necessitate the insertion of a nasogastric tube).
- Curling's Ulcer (Acute ulceration of the stomach & duodenum): due to stress → Symp. adren. → splanchnic vasoconstriction → Ischemia → destruction of mucosa. It is avoided by prophylactic use of antacids & H<sub>2</sub> receptor blockers.
- Liver dysfunction: due to ischemia & toxins. (antacid يدرمها فنرى HCL ناد)



d. Acute ulceration of the colon (may be deep reaching the serosa) may occur and it is suggested to be due to fungal infection. as immunity is ↓

**6- Multiorgan failure:**

Often follows pulmonary insufficiency or sepsis → death.

**7- Psychological complications:**

anxiety then depression

**8- Septic complications:**

في وقت الحرق

بعد الحرق  
النشوة

- UTI from catheter.

↓ d.t immunity

- Septic thrombophlebitis from canula.

- Pneumonia from endotrach. tube

**9- Endocrinal complications:**

stress

- ↑ Catecholamines from stress.

- ↑ Cortisol and ADH → Na & H<sub>2</sub>O retention.

**II. Local**

**I. Early local complications:**

**1. Infection:**

→ not early

- The primary cause of death due to immunosuppression.
- It occurs usually between 4-7 days post-burn.
- It may be bacterial, viral or fungal & it may be either exogenous or endogenous sources.   
 Convert burn from 2<sup>nd</sup> degree to 3<sup>rd</sup>
- Infection may lead to the development of septicemia and septic shock.
- Treatment by proper local burn wound care (discuss).
- The value of systemic antibiotics in the prevention of infection is doubtful.

**2. Constricting eschars:**

- In deep circumferential burns of the limbs & chest → ischemia & dyspnea due to restriction of chest expansion.   
 pressure
- It should be treated by urgent escharotomy (not painful as nerves are damaged).

**3. Suffocation:**

- Due to edema in burns of the face and neck and may need urgent tracheostomy.

**4. Compartment syndrome:**

- Due to edema of the subcutaneous tissue.

by mus.



Escharotomy

**II. Delayed (late) local complications:**

1. Contractures: across joints.

2. Scar formation: (hypertrophic or keloid)

3. Malignant transformation: (Marjolin's ulcer) in long-standing unstable scars is rare.

4. Pigmentation

good prognosis d.t fibrosis delay spread



# Treatment of Burn



## A-Definitive treatment of minor burn

Can be treated as out patients by:

- **Clean** with antiseptics solution as Savlon® or Betadine®.
- **Dressing** by local chemotherapeutic as Silver Sulphadiazine Oint. + Vaseline gauze.
- **Give** analgesic and prophylactic systemic antibiotic.
- **Repeat** the dressing for 2 weeks till healing.

## B-Definitive treatment of major burn

### I. First aid

**Move** the patient from the source of burn (stop, drop & roll).

- **Airway:** maintained
- **Breathing:** maintained.
- **Circulation:** maintained.
- **Drugs:** Strong IV analgesics (as 50mg pethidine), antitetanic immunoglobulins.  
*Intramuscular injections are avoided as absorption is poor.*
- **Exposure:** remove any clothes.
- **Fluid (run) water:** at room temperature. Saline or tap water can be poured over the burnt area for 15 minutes to limit the depth of burn, decrease edema, relieve pain and decrease micro-vascular damage.

Ice cold is contraindicated → ↑ tissue damage

### II. Admission & Resuscitation

- **Admission to burn unit of hospital.** → Look at surface area of burn if >15% → admission
- **Resuscitation:**
  - Wide bore IV cannula is inserted rapidly before the veins get collapsed to give IV fluids & IV antibiotics.
  - A Foley's urethral catheter is introduced to check urine output.
  - Ryle tube suction and NPO in the first 48 hours then oral feeding should be started after that.
- **Monitoring:**
  - **Vital signs:** Urine output, CVP, Consciousness level.
  - **Lab tests:** CBC, ABG, S. electrolytes, LFTs, KFTs.
- **Medications:**
  - Analgesics:** IV morphine to avoid neurogenic shock. except if head inj or chest inj
  - Antibiotics:** better to use broad spectrum antibiotics.
  - Antitetanic** Igs or vaccine.
  - Anti-ulcer** measures in the form of antacids & H2 receptor blockers. & Anti Coagulant.

Calculate total burn size and estimate the depth of the burn wound.



## SPECIAL SURGERY

(commonly used)

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### III. Fluid Therapy

According to **Parkland formula**

1- **Amount:** 4 ml / kg / 1% surface area

1<sup>st</sup> day:

1st 8 hrs 1/2 total amount	
2nd 8 hrs 1/4 amount	3rd 8 hrs 1/4 amount

16 hr. → the rest.

f. burn

2<sup>nd</sup> day:

give half the dose of the 1<sup>st</sup> day

+  
(0.5 cc colloid / kg / % burn area)

2- **Rate:**

50 - 70 cc/hr

3- **Types of fluids**

- 1- Crystalloids : saline or **ringer lactate**
- 2- colloids : 1/2 crystalloids + 1/2 colloids especially in deep burns.

4- **Route:**

- a- In burns < 20% TBSA (or < 10% TBSA (children)) → oral route.
- b- In burns > 20% TBSA → IV route (NOT oral route to avoid GIT complications especially in the first 48hrs).

5- **Monitoring:**

1. Vital signs.
2. Urine output should be 0.5-1 ml/kg/hour.
3. C.V.P. in critical cases. (for fear of R. side heart)

- In all formulae, the daily caloric needs should be provided by administration of 2000 ml of glucose 5%.
- In all formulae, the maximum percentage of burn calculated is 50% to avoid serious over infusion.
- Administration of blood usually needed in major deep burns. It can be started after 48 hours guided by hematocrit value. (HT < 30%, give blood)
- IV antibiotics: Prophylactic systemic antibiotics (3rd generation cephalosporins + aminoglycosides + Metronidazole).
- Crystalloids better to be avoided in full thickness burn where capillary membrane is damaged → saline infusion → extravascular space → ↓ IV value → aggravate hypovolemic shock so give Colloid
- Oral intake is avoided during the first 48 hours to avoid gastrointestinal complications and is started gradually after that. so we give glucose
- The greatest fluid loss occurs during the first 8 hrs postburn & continues more slowly over the next 16 hrs.

### Nutrition

\* NPO For 48hr But give glucose 5% in 1,2 day (2L)

- It shouldn't be neglected.
- Patients with extensive burns are liable to serious catabolic state.
- IV hyperalimentation corrects this problem and supports the patient.

### IV. Local treatment of major burn

The aim is to avoid infection

- 1- **Escharotomy:** The circumferential burns in limbs and chest, the constricting eschars (adherent necrotic tissue) have to be released immediately.
- 2- **Fasciotomy:** in deeper burns may be limb salvage.
- 3- **Cleaning and removing loose skin** and initial conservative debridement.
- 4- **Topical antimicrobial agents:**
  - The ideal should be in water soluble base, not painful, not allergic, not toxic & bactericidal.
  - The 3 most commonly used are silver sulphadiazine, silver nitrate solution and mafenide acetate.
- 5- After application of local cream, the wound is managed by either **exposure method** or by **occlusive method** (Both of them are equally effective).



	Open method	Closed method
<b>Definition</b>	The wound is managed by leaving it exposed under complete aseptic precautions	The wound is covered by bulky occlusive dressing changed every 2-3 days
<b>Indications</b>	1- Burns of face, neck, perineum 2- Burns involving one side of trunk	1- Circumferentially burns. 2- Limbs (to prevent stiffness and adhesions).
<b>Advantages</b>	1- More comfortable to patients. 2- Avoid repeated dressing. 3- Decrease anaerobic bacterial growth.	1- ↓ cross infection. 2- ↓ fluid loss by evaporation. 3- ↓ pain by covering exposed nerves. 4- ↓ Edema of tissues by compression

Following the previous regimen of wound care, all partial thickness burns should heal within 2-3 wks, while full thickness burns will require closure by Autologous skin grafting.

### ♦ OPTIONS IN TREATMENT OF DEEP BURNS:

#### 1- Autologous skin grafting :

- ▶ Partial thickness skin grafts (Thiersch grafts) are commonly used to cover the large raw areas produced by burns.
- ▶ A graft is applied after spontaneous separation of eschar (3-4 wks) or early burn wound excision.
- ▶ Early burn wound excision is the preferred method for deep burns of the hand.
- ▶ Patients are usually subjected to surgery 3-5 days post burn (before bacterial infection sets in), where tangential excision of the damaged dermis is carried on.
- ▶ When healthy bleeding tissues are reached a skin graft is applied.

#### 2- Biological dressings:

##### ▶ Indications:

- 1- If autografts are not enough
- 2- If the local wound condition is not favorable

##### ▶ Advantages:

The wound will be less painful, ↓ fluid & protein loss and control infection.

##### ▶ Examples:

1. Allografts (cadaver's skin)
3. Amniotic membrane.

2. Xenograft skin (pig's skin)

4. More recently artificial skin substitutes are used with promising results.

##### ▶ Technique:

\* All biological dressings are only applied after removal of eschar and are changed every 3-4 dys

\* It is to be stressed that biological dressings are only temporary and that permanent closure can be achieved only by autograft skin.



# Principles of skin coverage

## 1- Skin Grafts

### Definition

It is segment of epidermis & dermis that has been completely departed (cut) from its blood supply & donor site → transferred into a recipient site (skin loss).

### Types

- 1- Split thickness graft (**T**hiersch graft)
- 2- Full thickness graft (**W**olfe graft)

### Steps

1. Separation of the required segment by surgical knife (dermatome) or scalp. blade <sup>for Full thickness</sup>
2. The recipient area should be surgically clear & has formed granulation tissue (capable to regenerate due to adequate blood supply)
3. **After application of the graft:** The process of **(TAKE)** takes place which aims at nutrition of the graft by:
  - **Imbibition** of plasma (48 hrs) from newly blood vessels
  - **Vascularization** (after wards)
4. **Healing of donor site:** depends on the degree of thickness split or full.



	Split thickness	Full thickness
<b>Definition</b>	Epidermis + superficial part of dermis	Epidermis + full thickness of dermis
<b>Indications</b>	1- Covering large area of granulation tissue. 2- Coverage after: a) Deep burn.      c) infected field b) Malignant tumor resection.	1- Facial wounds <sup>creating small area</sup> 2- Palmar aspect of hands and plantar aspect of feet. 3- Site of pressure on sole of the foot
<b>Donor sites</b>	1- Trunk, thighs 2- Upper arm, forearm	1- Post-auricular skin 2- Upper eye lid 3- Supraclavicular
<b>Advantages</b>	1- Early separation & application. 2- Increase TAKE by graft. 3- Can cover wide area. 4- Early detection of recurrence of malignancy. 5- Donor site heals spontaneously. in 4-5 days perfect	1- Direct closure of donor site. 2- Minimal contraction. 3- Better sensation. 4- Better cosmesis. 5- Resistant to trauma. 6- Aesthetic surg. used in it
<b>Disadvantages</b>	1- More liable contraction. <sup>لا يلبس</sup> 2- More liable for pigmentation. <sup>المزق المند</sup> 3- Weak resistance to trauma. <sup>قليلة</sup> 4- Poor sensation. 5- Poor cosmesis. 6- not in Aesthetic surgery	1- Limited donor site. 2- Favourable granulation tissue. 3- Less TAKE. may failure occur. 4- Asepsis must be perfect. 5- Scar at the donor site.

6- high failure rate



- ✓ Healing in split thickness graft occurs according to the degree of thickness
  - Minimal → 1 week
  - Intermediate → 2 weeks
  - Thick → >2 weeks

### Whenever you take skin graft

It is the duty of the surgeon to choose the most suitable for each case. The following points should be put into consideration:

- 1- Healing by 1ry or 2ry intention
- 2- Color of the graft.
- 3- Skin appendages (hair follicle, sweat glands, sebaceous glands)
- 4- Sensation of the graft.
- 5- Durability of the graft.
- 6- Growth of the graft.

## Graft survival

- **Phase I (24 – 48 hours)** → plasmatic imbibition.
- **Phase II (2 – 4 days)** → insoculation → Recipient bed capillaries align with those of the graft.
- **Phase III (5 – 7 days)** → Revascularization → anastomosis & neovascularization → it needs graft immobilization with mild compression.
- ▶ The thinner the graft, the faster is the take.
- ▶ Bare bone, bare cartilage & bare tendon are all bad recipient sites for grafts (poorly vascularized), a flap is better applied.

not covered by Periosteum

## 2- Flaps

### Definition

Tissues to be transferred from one site of body to another one with their blood supply. (no imbibition)

### Indications

1. Wound with poor vascular bed (e.g. overlying bare bone, bare cartilage, bare tendons)
2. Reconstruction of facial features.
3. When sensation is required.

### Types

#### I- Skin flaps

##### A- Local flaps:

- **Random pattern flaps:**
  - These flaps have no anatomically recognized blood supply. Thus, they should have strict length to width ratio in order to survive.
  - A safe random pattern flap has a length to width ratio of 2:1 maximally.
- **Axial pattern flaps:**
  - They are supplied by known arteries and have no limitations regarding length to width ratio.
  - Adjacent nerves can be included, and the flap can be a sensory one.
  - Axial flaps may retain their attachment to the donor area and are termed pedicled flaps.
  - If they retain their blood supply without the skin attachment, they are termed island flaps.

##### B- Distant pedicled flaps:

- **Distant** → a flap needed to remote site from donor site e.g. from L.L. to U.L. (Free) done by Micro va
- **Pedicled** → blood supply reaches through a pedicle which needs to be cut after neovascularization.

or through a carrier if no microvascular surger in the center.



## II- Musculocutaneous (myocutaneous) flaps

- These are axial flaps that receive their blood supply from the underlying muscles through perforator vessels.
- The muscle is lifted from its bed with the overlying fascia and area of skin.
- The incorporation of the pedicled muscle in the flap ↑ the survival of the cutaneous component.
- Famous examples are the latissimus dorsi myocutaneous flap that is used to cover wide defects resulting from wide radical mastectomies, and the other example is pectoralis major myocutaneous flap used to cover defects in the neck or face.

## III- Fasciocutaneous flaps

- They have the same principles as the previous one, but their blood supply is through fasciocutaneous perforators.
- is an attempt to avoid the functional deficit of muscle transfer and the sometimes excess bulk of myocutaneous flaps.

## IV- Microvascular free flaps

- It is now possible to anastomose vessels of less than 1 mm in diameter.

## Advantages of flaps

- Good color & texture matching
- Provide extravascular supply & sensation
- Allow for future operation on the same area
- Can be used on a carrier for bone, muscle, skin

## 3- Tissue expanders

- Tissue expanders are inflatable silicone implants.
- They are placed subcutaneously in collapsed state.
- Over several weeks the expander is gradually inflated with saline through a subcutaneous port.
- The overlying skin is gradually stretched to accommodate a larger area.
- Finally, the expanded skin can be used to cover defects and the tissue expander is removed.

### What is the composite graft?

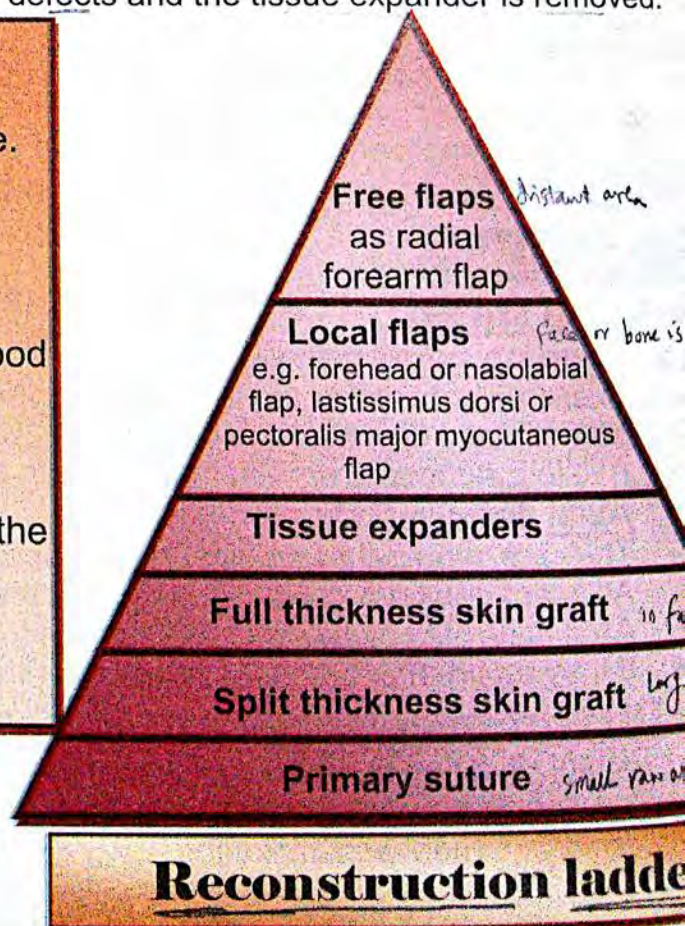
It is the skin graft which includes an underlying tissue e.g. subcutaneous tissue, cartilage or bone.

### Graft

- Types: split, full thickness
- Split: Trunk, Thigh, ↑Take, ↑Trauma
- Full thickness: Full dermis, Face, Foot, For good cosmesis & sensation

### Flap

- Indications: wounds (with ↓vascularity, in the face), sensation is required
- Class.: skin flaps (local, distant)
- advantages: cosmesis, vascularity, carrier





# Aesthetic surgery

## Definition

Surgery to improve appearance for correction of any disfigurement.  
Pt. selection is important as there is no pathology to correct, but an improvement in body image is asked for.

## Examples

1. Rhinoplasty.
2. Face lifting.
3. Eyelid surgery.
4. Breast surgery (augmentation or reduction mammoplasty).
5. Liposuction (body sculpting surgery):
  - ▣ Special cannula with 1 cm incision → connected to high vacuum machine → aspirate excess fat from abdomen, buttocks or trochanteric areas.
  - ▣ Autologous fat injection → aspirated fat is reinjected to augment other areas.

# Chronic Leg Ulcers

## 1. Chronic Traumatic Ulcers

- \*Produced by trauma then it becomes chronic from negligence and repeated infection.
- \*Finally it becomes fixed to the bone and this prevents contraction of the base of the ulcer and interferes with the growth of the epithelium.

**Causes:** Wounds, burns, radiation, bedsores.

### Characters:

- Number: Usually single.
- Site: Skin over medial side of tibia or bony prominence.
- Edges: Punched out.
- Floor: Healthy or unhealthy granulations.
- Base: Indurated.
- Margin: Pigmentation, inflammation.
- Discharge: Serous or purulent.
- Inguinal L.N.: Firm, tender, mobile.

### Treatment:

- ✓ Conservative: Like varicose ulcer.
- ✓ Surgery: Cover with skin graft or flap.

## 2. Inflammatory Ulcers

- a) Chronic osteomyelitis ulcer: See orthopedics.
- b) Chronic specific ulcers: Rare, T.B., Syphilis, Madura foot discharge sulphur granules.

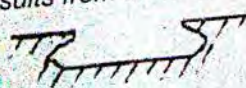
### Syphilitic Ulcer: (Rare)

- Site: It occurs on the medial surface of the upper third of the tibia.
- Number: It may be solitary or multiple.
- Edge: Punched out and may be serpiginous.
- Floor: Covered with yellowish (wash leather) slough.
- Base: Fixed to bone.
- W.R is positive.



### Tuberculous Ulcer:

- It results from the breaking out of a tuberculous arthritis or osteitis.
- Edge: thin undermined
- Margin: bluish (Cyanotic).
- Floor: pale granulation tissue
- Base: Slight induration



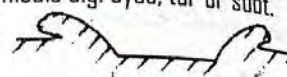


**3. Neoplastic Ulcers**

- Primary skin tumors as sq. cell carcinoma, melanoma
- Ulcerating deep malignancy as osteosarcoma, fibrosarcoma

**1. Squamous-cell carcinoma(epithelioma):**

- It may occur de novo in the skin or on the top of a chronic scar (**Mariolin's ulcer**).
- **Premalignant conditions:** chronic venous ulcer & prolonged irritation of the skin by chemicals e.g. dyes, tar or soot.
- **Shape:** Irregular in outline.
- **Edges:** Raised and everted.
- **Base:** Indurated and soon becomes attached to the deeper structures.
- **Discharge:** A blood-stained occurs and increases if there is superadded 2ry infection.
- **Inguinal LNs** are first not palpable but later they become involved and become hard.

**2. Malignant melanoma:**

- It usually affects adults.
- It may start de novo as a pigmented (dark brown or black) lesion, which grows progressively with a tendency to ulcerate and bleeding.
- It may take the form of a rapidly growing, fleshy, ulcerated tumor (**amelanotic melanoma**).
- **Satellite nodules** may be present around the tumor (d.t. spread by lymphatic permeation).
- Inguinal LNs are first not involved but later become palpable & hard.
- Blood borne metastases may be seen in liver & lungs in advanced cases.

**4. Vascular Ulcers**

	(A) Ischemic Ulcer	(B) Venous Ulcer
Site	Between the toes, in the dorsum of the foot or around the maleoli	In the ulcer bearing area(Gaiter area) just above the medial malleolus
Edge	Punched out	At first → irregular, sloping and serrated, then → punched out
Margin	Hyperemic	Skin around the ulcer is pigmented
Floor	Granulation or pus	Infected ulcer → dirty granulation tissue Non infected ulcer → healthy granulation tissue
Base	Difficult to be palpated	Indurated(hard)

(C) Lymphoedema Ulcer: from rupture of an infected bulla.

**5. Neurotrophic Ulcers**

**It is painLESS**

**Cause:** skin anesthesia in some neurological diseases e.g. peripheral neuritis, nerve injuries or DM.

**Site:** sole of the foot at ball of the big toe or heel (pressure areas).

**Pathology:** Skin anesthesia → trauma not felt by the patient → callosity & adventitious bursae → infection of bursae → separation → deep penetrating ulcer to bone & joints.

**Treatment:**

- Conservative treatment + control neurologic disease.
- Amputation if destroyed bone or joints.

**6. Blood Diseases**

E.g. Sick cell anemia & congenital spherocytosis.

**7. Autoimmune Disorders**

E.g. SLE, rheumatoid arthritis.



# Bed sores (Pressure ulcers)

## Definition

A localized area of soft tissue injury resulting from compression between a hard prominence & an external surface. It is a type of avascular necrosis.

## Pathology

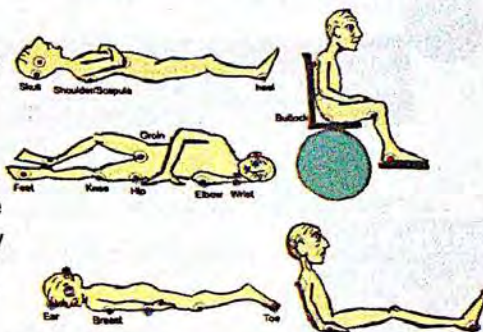
### STAGES:

- I → Non-blanchable erythema.
- II → Partial thickness skin loss "epidermis".  
Manifested as: abrasion, blister, shallow crater.
- III → Full thickness skin loss.  
SC tissue is exposed (damage or necrosis of SC tissue).
- IV → Muscles or bones are exposed.  
Tissue necrosis of any supporting structure (muscle – bone – tendon – joint).



### SITES:

- 1) Common anatomical pressure points.
- 2) Positional pressure points: by abnormal position of the body.
- 3) Instrumental pressure points e.g. by bed rails.
- 4) Internal viscera exposed to unusual pressure e.g. trachea pressed by balloon of endotracheal tube (especially if a ryle is present) or severely distended colon in Ogilvie syndrome.



## Etiology

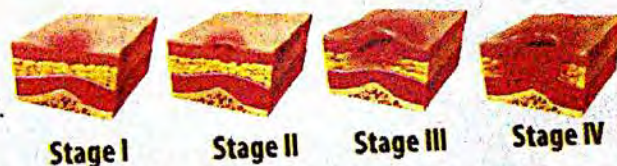
1. Prolonged recumbency.
2. Warmth & moisture of skin (soiling by urine, stool, wet sheets or edema).
3. Shear forces: during manipulation & positioning e.g. rolling of the patient in bed.
4. Bad general condition: e.g. pneumonia, malnutrition or electrolyte imbalance.

## Diagnosis

- Frequent inspection of pressure points in high risk patients for early non-blanchable erythema (stage I).

## Complications

- a) **General:** Bacteremia, septicemia, toxemia.
- b) **Local:** Osteomyelitis, cellulitis, pyoarthrosis.



## Treatment

### A. PROPHYLAXIS: (Most important)

1. Reposition every 2 hours.
2. Skin care & improve general condition.

2. Pressure reducing mattresses.

### B. DEFINITIVE TREATMENT:

- **Stage I:** as prophylaxis, more frequent turning of the patient.
- **Stage II:** as I + dressing to prevent dryness of the wound for better healing.
- **Stage III & IV:** Debridement:
  - 1) Chemical (small wounds): saline dressing + collagenase (Irujol).
  - 2) Surgical (large wound): may require myocutaneous flap.  
*as it is on bony promin*



# Skin & Subcutaneous Tissue

## A- Benign skin lesions:

1. Sebaceous cyst.
2. Dermoid cyst.
3. Callosity.
4. Corn.
5. Wart.
6. Papilloma.
7. Molluscum sebaceum
8. Congenital vascular anomalies
9. Lipoma.
10. Neurofibromatosis.
11. Benign lesions of melanocytes. (Naevi)

## B- Precancerous skin lesions:

- 1- Squamous keratosis.
- 2- Bowen's disease.
- 3- Xeroderma pigmentosa

## C- Malignant skin Lesions:

- 1- Basal cell carcinoma.
- 2- Squamous cell carcinoma.
- 3- Malignant melanoma.

## A. Benign Skin Lesions

### 1- Sebaceous Cyst (Epidermoid Cyst)

#### Definition

Retention cyst of sebaceous gland.

#### Etiology

Acquired cyst caused by obstruction of sebaceous gland duct by inspissated sebum or scarring → retention of sebaceous secretion into sebaceous gland.

#### Pathology

#### SITES

- Anywhere in the skin related to hair (scalp, scrotum, axilla & groin).
- Never in palms and sole "No sebaceous glands"

#### MACROSCOPIC

نقطة سوداء Sebum لا يتعرض الهواء لونه يسود

- Cystic swelling attached to skin at a point "Punctum"
- Contains: semisolid, greasy sebaceous, material with bad odour.

#### MICROSCOPIC

- A true cyst: lined by stratified squamous epithelium.

#### Clinical picture

- Age:** rarely before adolescence. Adult
  - Complaint:** a slowly growing painless subcutaneous swelling.
  - Signs:**
    - It is well defined, small, tense, cystic swelling, non-compressible (to differentiate between it & hemangioma). <sup>paget test</sup>
    - Attached to the skin at one point which is the site of the duct (punctum) "black spot" <sup>DD from dermoid</sup>
    - On squeezing it discharges sebum.
    - It is slowly growing, may attain large size and may be solitary or multiple.
- NB.** If inflamed → ↑size, tender, fixed to deep structures



**Complications**

As any cyst

- 1- Commonest → infection and suppuration
- 2- Sebaceous horn → dried → inspissated sebum. Protrude from the punctum over the skin.
- 3- Cock's peculiar tumor (very rare) → (ulceration of sebaceous horn) *Wing name*
- 4- Local alopecia: due to stretch of the skin for long time.

**NB** Simulate squamous cell carcinoma but base is not indurated

Cock's peculiar tumor



Sebaceous horn in ear

**DD**

- 1- Dermoid cyst
- 2- Cock's peculiar tumor (SCC. BSC)

	Sebaceous cyst	Dermoid cyst
Age	After adolescence	At childhood
Site	Related to hairy skin	Related to lines of fusion
Consistency	Tense cystic	Lax cystic
Skin	Attached to skin by punctum where sebum can be squeezed	Not attached to skin

**Investigations**

- Not important. It is a clinical diagnosis.
- May be needed with complications:
  - 1- Biopsy: in cock's peculiar tumor.
  - 2- Culture and sensitivity with recurrent infection.
  - 3- Fasting blood sugar with recurrence of infection in spite of adequate treatment

**Treatment**

- 1- Uncomplicated → excision through an elliptical incision to include the punctum.
  - 2- Infected → Incision and drainage *give 4-6 then excision after resolve of inflammation*
  - After inflammation subsides → excision
- Multiple cysts of the scrotum → excision of the skin bearing the cysts = derofing**

**2- Dermoid Cyst**

*قسط الكبريت*  
Lining epith

- 1- Sequestration dermoid cyst.
- 2- Implantation dermoid cyst.
- 3- Tubulodermoid cyst d.t. distension of remnants of embryonic ducts e.g.
  - Thyroglossal duct → Thyroglossal cyst.
  - Cervical sinus → Branchial cyst.
- 4- Teratomatous dermoid cyst of the ovary and testis (sacroccygeal tumor).
- 5- Inclusion dermoid.



## 1) Sequestration dermoid cyst

### Definition

A congenital true cyst lined by stratified squamous epithelium.

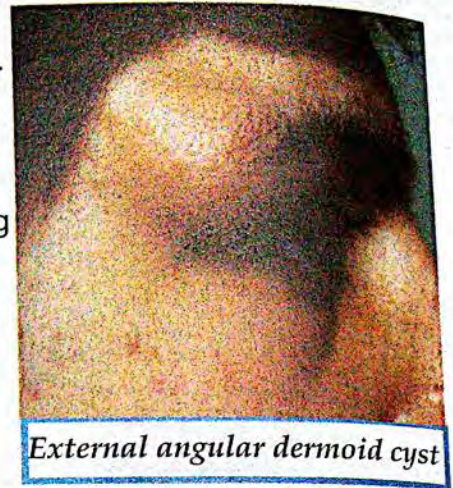
### Etiology

- A **congenital** cyst.
- Caused by sequestered piece of epithelium in the subcutaneous tissue **at a line of fusion** of the body during fetal life but it appears later in life.

### Pathology

#### SITE

- Along the lines of fusion:
  - 1- Face → **external angular** (commonest) → Internal angular
  - 2- Ear → post-auricular → Pre-auricular
  - 3- Neck → in midline → Sublingual & **supramyelohyoid** (in the floor of the mouth) → **Inframylahyoid** → suprasternal
  - 4- Trunk → in midline



External angular dermoid cyst

Never in a limb (develop from buds → no line of fusion)

### MACROSCOPIC

- Cystic swelling.
- Contains: yellowish greasy sebaceous material.

### MICROSCOPIC

- Outer fibrous layers.
- Wall lined by stratified squamous epithelium.

### Clinical picture

External angular dermoid cysts lie on bone defect caused by constant pressure

- **Age:** Childhood (Although present since birth, it may not appear clinically except after few years when it begins to distend).

#### Complaint:

A slowly growing painless subcutaneous swelling related to the previous sites.

#### Signs:

- A well-defined, globular, **lax**, cystic swelling which is **not attached to the skin**.
- The underlying bone may be hollowed out.
- There may be a **pedicle connecting the deep aspect of the cyst to dura matter**.

#### D.D: sebaceous cyst

### Complications

As any cyst (Infection, rupture, hemorrhage, pressure)

- 1- Cerebral compression (very rare) → Dumbbell shaped or hourglass dermoid
- 2- Intracranial complication with the dura matter should be investigated by skull x-ray before excision to be sure the sutures are closed.
- 3- Recurrence after excision → if incompletely excised

### Investigations

- Skull x-ray → to exclude presence of bone defects (if present, we wait till it closes)

open suture → wait till 10 year or if not closes



**Treatment**

1- Uncomplicated:

- Surgical excision (best lines of treatment)
- In children with dermoid cyst in the scalp it is better to wait till closure of the skull sutures because some cysts may communicate with the dura.

2- Infected → incision and drainage followed by excision after inflammation subsides.

*Surgery for a dermoid cyst is more difficult than sebaceous cyst since dermoid cyst is deeper.*

**II) Implantation dermoid cyst****Definition**

- Acquired dermoid cyst

Cyst + Scar

**Etiology**

- Implantation of skin into subcutaneous tissue by:

- 1- Pricking wound on the tip of a finger as during sewing.
- 2- Use of skin as graft in hernioplasty.

**Site**

- In a tip of finger.

**Diagnosis**

- Related to scar traumatic or surgical.

**TYPE OF PATIENT**

- Sewer or manual worker with a swelling related to tip of finger

**COMPLAINT**

- Slowly growing swelling at 1st painless then painful

**SIGNS**

- They are small & tense cystic swellings.
- The overlying skin is sometimes scarred.
- It may be tender due to compression on nerve endings at pulp of fingers.

**Complications and Treatment**

- See before.

**III) Thyroglossal cyst**

- ➔ See general book (Thyroid part)

**IV) Branchial cyst****Embryology**

- Normally the 2nd branchial arch grows rapidly covering the 3rd and 4th arches then fuse with the 5th arch
- Resulting in a space called (cervical sinus). when it obliterated.

**Etiology**

- Cervical sinus persists → branchial cyst.
- ± 2nd arch does not completely fuses with the 5th arch → congenital branchial fistula.

**Pathology****SITE**

- Upper part of the neck.
- Related to carotid triangle.
- Partially deep to sternomastoid muscle protruding beneath its anterior border. if st. mast. contracted → ↑ in size

Tubercle dermoid cyst

Tubercle dermoid cyst



**MACROSCOPIC**

- A cyst with a fibrous cord passing between external and internal carotids
- Connect cyst to pharynx "end above tonsil"

The track extend up to side wall of nasopharynx "**fossa of Rosenmuller**"

**MICROSCOPIC**

- Lined by squamous epithelium.
- Contain mucoid substance **rich in cholesterol** (rectangular crystals with one missing angle)
- Rich in lymphoid tissue so it is liable to infection.

**DD**

- **Cysts rich in cholesterol:**
  - Branchial cyst.
  - Spermatocoele.

- Dental-dentigerous cyst.
- Primary vaginal hydrocele

**Clinical Picture****AGE**

- Although congenital, it appears at the age of 20 years *as it slow growing*

**COMPLAINT**

- A slowly growing painless swelling at lateral side of the upper part of the neck

**SIGNS**

- **General:** FAHM if infected.

▪ **Local:**

- **Site:** Protrude beneath the anterior border of upper 1/3 of sternomastoid muscle
- **Shape:** Rounded or oval
- **Surface:** Smooth
- **Edge:** well defined
- **Consistency:** Tense. It may be pulsating, compressible *cystic by touch*
- **Skin overlying:** normal.
- **Special signs:** on it bulges out.

**Complications**

1. Infection: is the commonest.
2. Acquired branchial fistula d.t. rupture, incomplete excision or incision of the abscess,
  - Fistula appears at anterior border of lower third of sternomastoid muscle it is crescentic in shape, discharging mucoid material or pus if infected.
3. Adenocarcinoma: very rare ☒

Branchial fistula may be

**Congenital**  
(Usually)

- 1- Since birth
- 2- Longer
- 3- No scar

**Acquired**  
(Rare)

- 1- Later on in life
- 2- shorter
- 3- Related to scar.

branchial cyst ← سماه branchial، الجراح افكره فخراج ففتحه وفضاه، وغير ملية والجرح قفل كله مانا عنه (Fistula) واولها يبرزه ثم يخرج انسابا من وشره  
Thyroglossal fistula → acquired only



The cyst is in carotid Δ that also contain up deep cervical LN that is commonest site for TB lymph node

### Swelling at lateral side of the neck:

- 1- Cold abscess (TB C/P)
- 2- Cyst in a thyroid lobe.
- 3- Laryngocele, pneumatocele.

- 4- Carotid artery aneurysm.
- 5- Fistula with TB sinus.

### Investigations

- If fistula → fistulogram. → xray → cyst in fossa & Rosenmüller
- If cyst:
  - U/S:
    - Ensure the diagnosis.
    - Exclude DD as cold abscess.
  - Discharge → Ziehl Neelsen stain
    - Characteristic rectangular cholesterol crystals with missing angles.
  - Routine preoperative.



Branchial fistula

### Treatment

- **Cyst** → Complete excision through transverse neck incision.
- **Fistula** → Excision through multiple transverse neck incisions to remove the whole tract (**Step ladder operation**). A ureteric catheter may be introduced in the track to facilitate the operation.

## V) Teratomatous dermoids

- These are benign forms of teratomas.
- The cyst is lined by squamous epithelium but contains teeth, hair, bone or cartilage.
- Most commonly in the ovary but may be found in the testis or posterior mediastinum, Pe

## VI) Inclusion dermoids

- These are due to inclusion of the epidermis during closure of a cavity.
- They include sublingual, suprasternal, intracranial and intraspinal dermoids

= sequestrated cyst

## 3- Callosity

- It is an overgrowth of the epidermis with thickness of the horny layer.
- Sites: Toes & sole from wearing ill-fitting shoes – Fingers & hands of manual workers.

**Cause** Prolonged friction or pressure

**Clinical picture** It appears as a horny yellowish plaque & usually not painful

**Treatment** Shaving + painting with salicylic acid and ether.



۱۳ اسامی  
قوی و حاکم  
بسم الله  
کوه خفت  
لوحه

Improper ttt of a callosity

- It may be hard or soft. The central down-growth of a hard horny plug of epithelial cells into the dermis causing much pain due to pressure on sensory nerve endings

Paint with 20% salicylic acid in collodium OR excision (rare)

## Cause

### Filterable virus

Common in the hands and soles of the feet. It can occur in any part of the body.

Small, horny with irregular surface, usually multiple

- 1-Chemical paintings with glacial acetic acid.
- 2-Electric cautery under local anesthesia.
- 3-Surgical excision.
- 4-Cryosurgery.

(Pedunculated papillomas "skin tags")

- This is a benign tumor, usually pigmented which commonly develops in large numbers in the face, arms and upper trunk.
- It consists of central axis of connective tissue, blood vessels and lymphatics, surrounded by epithelium (squamous, transitional, cuboidal or columnar according to the site)

- skin, kidney, colon, tongue and lips

- Malignant changes
- Bleeding (hematuria, bleeding per rectum, nipple discharge)

- Excision, cryosurgery or cautery



## 7- Molluscum sebaceum (keratoacanthoma)

### Definition

- It is keratinizing squamous cells which resolves spontaneously.

### Incidence

- Middle age ♂ = ♀.

### Etiology

- Prolonged exposure to sun.

### Pathology

- Common in the face.

### Clinical picture

- Firm, rounded, irreversible papule which enlarges rapidly over period of 8 wks. → producing rounded slightly umbilicated mass (< 2 cm in diameter), can be containing horny plug covered by a crust.

- Healing occurs by shedding of the horny core.

- Spontaneous healing takes about 6 m.

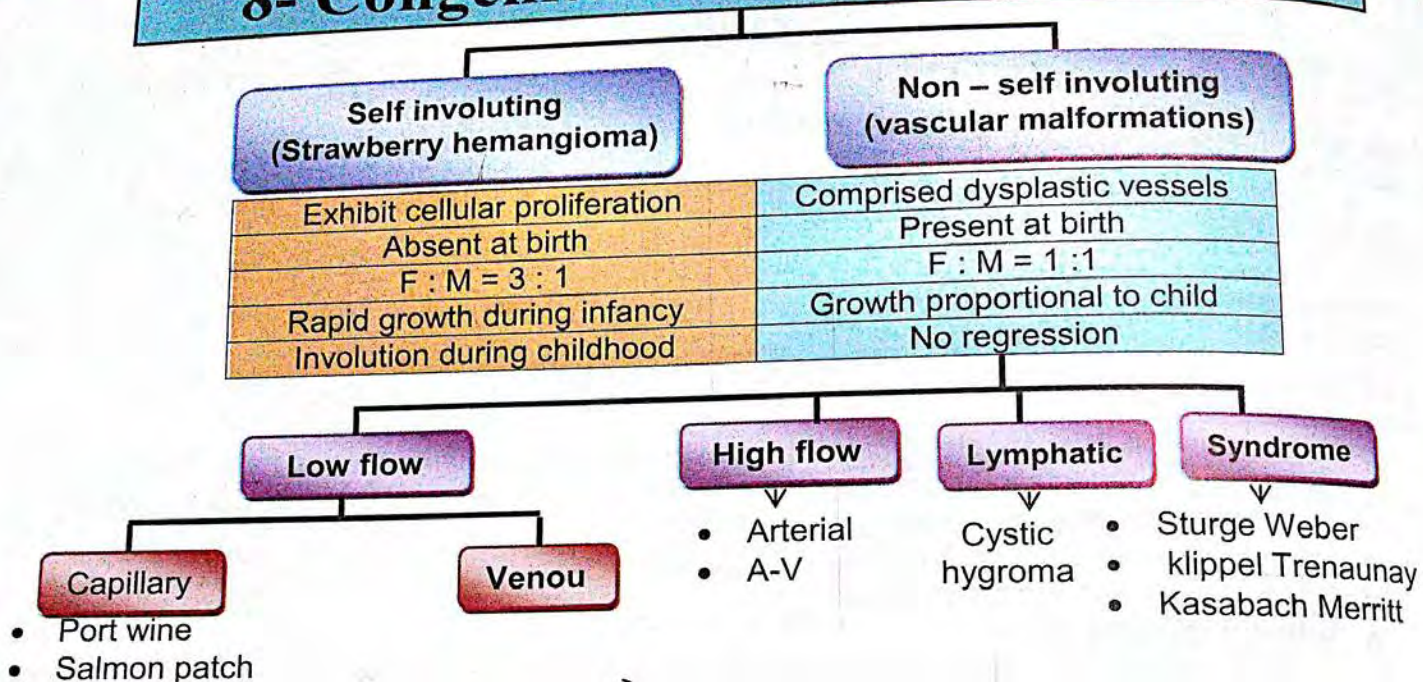
### Clinical importance:

- It mimics an epithelioma /or rodent ulcer.
- Pathological examination: reveals abrupt transition from normal to hyperplastic epithelium.

ttt: Not excision



## 8- Congenital Vascular anomalies



### Investigations

- 1- **Doppler U/S:** Differentiates high flow from low flow lesions.
- 2- **MRI or MRA:** The most useful for assessing the extent of the lesion & the degree of involvement of surroundings.
- 3- **Angiography:** Useful in some cases.

### i- Self involuting hemangiomas

#### Hemangioma (Strawberry hemangioma)

#### Definition

- Benign tumor of endothelial cells of capillaries.

#### Incidence

- Most common & most rapidly growing tumor in infancy.
- 70% are present at birth and 30% appear within the 1st year of life.
- Female : Male = 3 : 1
- 10% of white infants.

#### Pathology

- Site:** Anybody surface but the most common site is face.
- The lesion usually presents by the following 3 stages:**
  1. **Stage of proliferation:** short after birth a pale or reddish patch and increases in size over 6 months.





**2. Involution phase:**

- Usually starts at the end of first year, central pallor appears and the color of the lesion slowly fades.
- There is progressive decrease in the size of the lesion. This stage continues till the age of 10 years.

70% regress after 7 years of age, 5% regress after 5 years of age

- 3. Involved phase:** The skin finally is normal in 50% of patients. Some residual skin changes as discoloration, scarring, telangiectasia may present.

**Clinical picture**

- Lesion start as erythematous raised patch with irregular surface
- During the 1<sup>st</sup> 2-3 wks after birth
- grows stationary for 2-3 yrs
- Then spontaneous regression starts & completed by age of 5-7 yrs.

**Complication**

According to the site

1. In the face → Squint.
2. In the eye lid → ↓ visual field → amblyopia + blindness.
3. Ulceration is a common complication.
4. In the parotid gland may lead to auditory canal obstruction.
5. Bleeding is not common.
6. Infection.
7. Airway obstruction.
8. Large visceral haemangioma may entrap platelets leading to thrombocytopenia. → *Petech*
9. Large visceral or cutaneous haemangioma may lead to congestive heart failure. → *Razabach*

**Treatment**

- 1) **Conservative:** *Main line* Reassurance of patients & observation till spontaneous involution (cosmetically better than excision scar)
- 2) **Non-conservative treatment:** *Indicated in;*
  - a. Lesions obstructing airways.
  - b. Lesions interfere with vision.

► **Modes of treatment:**

  - 1) Corticosteroids. or BB (propranolol)
  - 2) Laser photocoagulation. , embolization
  - 3) Surgical treatment.



## ii- Non - self involuting hemangiomas

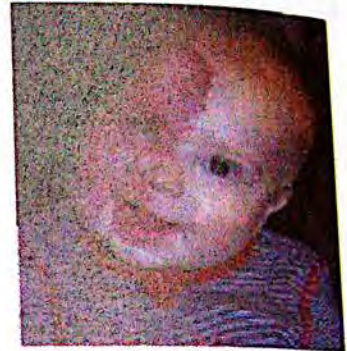
### I- Low flow Malformations

#### A. Capillary malformations

##### Portwine stain (Naevus flammeus)

↓  
 - at birth  
 - No sex pred  
 - stable size

- Commonest type of vascular malformation
- The lesion is present since birth and it doesn't undergo involution. *more 2 - Not raised - Not involuted*
- The lesion is dark purple in color and it doesn't raise above the surface. Pressure causes blanching but the color returns immediately after release of pressure.
- Sometimes the lesion takes the distribution of one of the branches of trigeminal nerve, but the lesion doesn't cross midline. *Not raised*
- Sometimes a portwine stain of the face is associated with similar lesions in the meninges → **Sturge Weber Syndrome**:
  - 1) Lepto-meningeal A-V malformation overlying sensory or motor areas.
  - 2) Gigantism seen in middle finger, left thumb, scrotum, lower limb.
  - 3) Portwine stain with trigeminal distribution.



- detect it

##### ➡ Treatment: *No tx or by laser*

- Pulsed dye laser is the treatment of choice during childhood. Requires general anesthesia and multiple sessions may be needed.
- YAG laser is the treatment during adulthood. Results are not as favorable as children.

### B. Venous malformations

(Previously called cavernous hemangioma)

#### Definition

- Multiple large inter communicating sinus ( vascular spaces )
- It is less common than capillary (portwine)

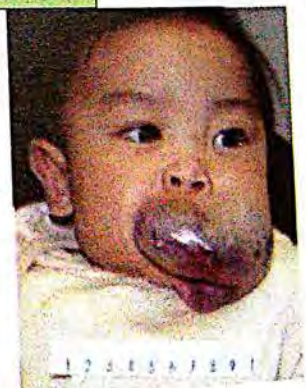
#### Site

- External: Cheeks, lips, tongue, eye, ear, extremities .....ect
- Internal: The commonest site is liver.

#### Clinical picture

- 1- Present since birth / no spontaneous involution. *قري*
- 2- Compressible swelling with some discoloration of overlying skin.
- 3- Sign of emptying is very characteristic: Pressure causes blenching but color returns immediately after release of pressure.
- 4- If in the liver → sequestration of platelets → thrombocytopenic purpra
- 5- Add clinical picture of the site ( tongue, lips , ear .....ect).

macroglusia  
 macroglia





**Investigation**

- 1- Arteriography: pre-operative : shows extent of the lesion ( both diagnostic & therapeutic).
- 2- CT Scan : to show extent of the lesion

**Treatment**

- 1- Compression therapy may relieve pain and edema.
- 2- Percutaneous sclerosis may be performed with hypertonic saline or 100% alcohol. There is a high recurrence rate; multiple sessions may be required.
- 3- Surgical excision. Preoperative embolization or sclerosis facilitates intraoperative haemostasis.
- 4- Interstitial laser coagulation.

**II- High flow malformations****I- Arterial (plexiform hemangioma) (Cersoid aneurysm)****Definition**

- It is congenital A-V fistula.

**Pathology**

**Site** Usually in the scalp, especially in temporal region or occipital region may involve underlying bone (in relation to superficial temporal artery).

**Macroscopic picture**

- A bluish cystic swelling

**Microscopic picture**

- Consists of arteries and veins

**Clinical Picture****► Complaint:**

- ♦ Cosmetic disfigurement.

- ♦ Headache.

**► Signs:**

- ♦ **General:**

- Fever if inflamed

- Water hammer pulse.

- ♦ **Local:**

- Inspection: Irregular swelling at temporal region, with normal skin overlying.
- Palpation: pulsating compressible swelling.
- Auscultation: machinery murmur over it.

**Complications**

- 1) Hemorrhage (very dangerous as it's arterial).
- 2) Cosmetic disfigurement.
- 3) Infection.
- 4) Ulceration of skin overlying.
- 5) Degenerative changes e.g. calcification.

**DD**

From other types of hemangioma e.g. cavernous hemangioma.



**Investigations**

- Doppler and duplex.
- External carotid angiography. *b.l. vessels in the*
- X-Ray on the skull → shows rarefaction of the bone.

**Treatment**

Surgical TTT is very difficult d.t. presence of multiple feeding arteries *intra-cranial extension*

Surgical excision with the following precautions:

1. Semisitting position. *Bloody omentum*
2. General hypotensive anesthesia.
3. Preoperative embolization.
4. Temporary ligation of the external carotid artery.

**II- Arterio-Venous Malformation**

- Characterized by abnormal connections between arteries and veins without an intervening capillary bed.
- Present at birth but may not become evident until late childhood.
- It may be localized or diffuse.
- Localized AVM presents by a localized swelling with increase surface temperature. There may be palpable thrill or murmur.
- Generalized AVM growth disturbance or skeletal distortion.

**➔ Treatment :**

- a. Ligation or embolization feeding vessel often results in rapid enlargement of collateral vessels increasing the size of the lesion.
- b. Excision. Preoperative Angiography and embolization of feeding arteries followed by excision next day. Extensive coverage by a free flap may be needed.

**Klippel Trenaunay Syndrome**

- Port wine + 2ry various veins due to A-V malformation *intra-cranial extension*

**Hereditary hemorrhagic telangiectasia**

- Is an autosomal dominant disease
- Characterized by multiple cutaneous, visceral and mucosal AVM

Hemangioma	Vascular malformation
<ul style="list-style-type: none"> <li>▪ Appears shortly after birth.</li> <li>▪ 3 stages: <ul style="list-style-type: none"> <li>– Progressive.</li> <li>– Stationary.</li> <li>– Regressive.</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>▪ Dated since birth.</li> <li>▪ Stationary or slowly progressive.</li> </ul>

\* Parkes Weber's as Klippel + Arterial malform



### III. Lymphatic Malformations (LMs)

#### Cystic Hygroma (Cavernous Lymphangioma)

##### Etiology

- It is abnormally formed lymphatic channels. *Hamartoma*
- Diffuse lymphangioma it is a hamartoma rather than true tumor of lymphatic vessels.
- It is due to failure of sequestration of part of jugular lymph sac of fetus.

##### Pathology

##### SITE

- LMs are the most common cause of congenital macroglossia, macrocheilia and macrotia.
- Skeletal involvement may cause distortion.
- Commonest sites** → root of the neck (superficial to sternomastoid m. & extends to posterior triangle).
- Less common in** → lip (macrocheilia) → tongue (macroglossia)  
→ axilla → mediastinum → groin

##### MICROSCOPIC

- Multiple intercommunicated lymph spaces lined by endothelial cells and contain lymph.
- Cysts near surface are large while deeper one are small and infiltrate muscle.

##### MACROSCOPIC

- Size → large
- Shape → irregular
- Edge → ill defined
- Color → translucent

##### Clinical Picture

##### TYPE OF PATIENT

- At birth or within first few years of life

##### SWELLING

- ↑ by: They often enlarge & become tender during periods of upper respiratory tract infection
- Number → single
- Site → lower part of posterior triangle
- Size → large
- Consistency → lax, cystic
- Surface → irregular
- Edge → ill defined
- Transillumination → Translucent (the only translucent neck swelling)
- Special character → partially compressible, non-pulsating mass.
- Increase in size on coughing or crying.



##### DD

Branchial cyst (deep to sternomastoid & anterior)

##### Complication

- Obstructed labour.
- Recurrent infection (rich in lymphatic).
- Respiratory distress due to compression of trachea to induce fibrosis.



**Treatment**

(Surgical excision is only potential curative treatment)  
 (Surgical excision followed by sclerosis may provide short-term improvement;

- Percutaneous aspiration followed by sclerosis may provide short-term improvement; usually requires additional treatment.
- Surgical excision often requires multiple, staged procedures. It is technically easier as child grows; consider waiting until at least 3 years of age.
- This could be facilitated by injection of boiling water in the swelling to introduce fibrosis to make it smaller
- **Complication of surgery:** injury to facial N.

**9- Lipoma****Definition**

- It is a benign tumor arising from adipose tissue. *signet ring appearance*

**Pathology****Pathological (structural) Classification**

- a) **Pure lipoma:** mainly adipose tissue (non compressible). *soft*
- b) **Fibrolipoma:** with extensive fibrous tissue (firm).
- c) **Hemangiolipoma or navio lipoma:** with extensive vascular tissue (partially compressible as blood vessels are compressible while fat is not).
- d) **Myxolipoma ( myxomatous tissue).** *e) neuro lipoma → painful*

**Gross picture**

- **Size:** variable.
- **Shape:** oval or rounded.
- **Surface:** Lobulated.
- **Consistency:** Always soft except, Firm in → Fibrolipoma (d.t. fibrous tissue elements).  
→ Subfascial lipoma (as it is under tension).
- **Color:** Yellowish.
- **Cut section:** thin fibrous capsule sends fibrous tissue septa divide the tumor into multiple spaces.
- **Capsule:** 2 capsules:
  - ◆ Inner true: Formed of fibrous tissue.
  - ◆ Outer false: Formed by compressed surrounding structures.
 Between the 2 capsules there is a line of cleavage that facilitates enucleation of the tumor.  
 Lipoma is classified according to presence or absence of the capsule into:  
 encapsulated or diffuse.
- **Origin:** adipose tissue.
- **Blood supply:** through the pedicle at one side of the tumor.
- **Number:**
  1. **Solitary:** well defined swelling.
  2. **Multiple lipomatosis:** is when the limbs or the trunk are the seat of multiple lipomas.
  3. **Diffuse lipomatous deposits:** this can occur in certain areas e.g.: patient with myxedema has supraclavicular fatty deposits, elderly persons may develop lipomatous deposits below the chin and some times females may develop painful fatty deposits in the thigh (**Dercum's disease**).

*Lipoma not develop at: penis, nipple, palm, eye lid, brain*



**Microscopic Picture**

- Aggregation of fat cells with signet ring appearance separated by fibrous connective tissue stroma containing blood vessels arising from the pedicle.

**Clinical Picture**

- It differs according to the site.

**Complaint**

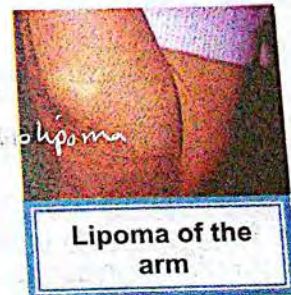
- Painless slowly growing swelling.
- Cosmetic disfigurement.
- Painful lipoma (neurolipoma, Decrum, Complicated lipoma)

**Signs**

- General:** e.g. fever if lipoma is complicated by infection.
- Local:** According to site:

**1) Subcutaneous lipoma**

- The commonest type.
- Common in back, shoulder, buttocks, forehead and limbs.
- Lobulated painless mass **attached to skin** at multiple points.
- Soft** in consistency but may be **firm** if excess fibrous tissue in it. Sometimes may give pseudo-fluctuation especially in warm weather due to high mobility of tumor in its bed and some degrees of fat liquefaction due to warmth.
- Has well defined **slippery edge** due to double capsule.
- May be solitary & multiple.
- May be pedunculated → lipoma arborescens
- Mobile over deep structures.

**2) Subfascial lipoma**

- Firm**
- Doesn't have a slippery edge.**
- Occurs under deep fascia e.g. palmar or plantar fascia or in the areolar layer in the epicranial aponeurosis, difficult to diagnose.
- Increased incidence in forehead.
- Not attached to skin.**

**3) Sub synovial lipoma**

- Beneath synovial membrane of the joint
- Rounded or oval swelling related to a joint with normal skin overlying.
- If around the knee it can be differentiated from baker's cyst by being constant in consistency whether the joint is flexed or extended.

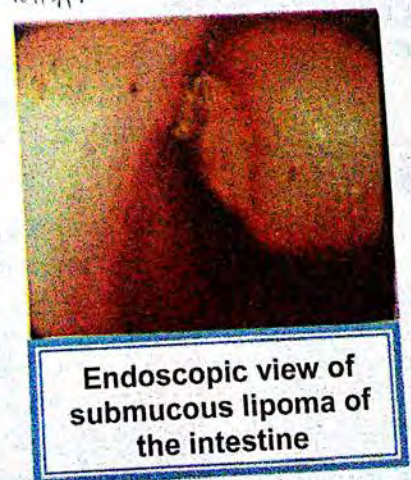
**4) Submucous lipoma**

- Beneath mucous membrane of larynx → it may cause respiratory obstruction.
- Beneath mucous membrane of the intestine → it may cause intussusception. → ↑ peristalsis

**5) Inter or intramuscular**

- Swelling in or in between muscles, common in thigh, shoulder with normal skin overlying.
- It becomes more firm on muscle contraction.
- DD:** fibrosarcoma (hard & rapidly growing).

+ fixed to mus. Cont.



Endoscopic view of submucous lipoma of the intestine



**6) Subperiosteal lipoma**

- ♦ Swelling in relation to long or flat bones. *Fixed*
- ♦ It is difficult to be differentiated from osteoma.
- ♦ may cause erosion of underlying bone

**7) Extradural**

- ♦ Only in spinal cord, never in the cranium as there is no fat.
- ♦ Presented by pressure symptoms in S.C

**8) Subserous lipoma**

- ♦ Beneath visceral or parietal peritoneum or pleura.

**9) Intraglandular lipoma**

- ♦ Inside the gland as parotid gland, thyroid gland and breast

**10) Retroperitoneal lipoma**

- ♦ Behind post. parietal peritoneum. *↳ turn to lipo sarcoma*

**11) Lipoma in the suprasternal area (Burn's space) (rare type)****Diffuse lipomatosis "Dercum disease":**

1. Type of patient: Female, usually post menopausal.
2. Site: Usually in lower limb.
3. Characterized by small, multiple swellings and painful.

**Complications****1. Dangerous types of lipoma:**

- Submucous lipoma: as it may cause respiratory obstruction or intussusceptions.
- Retroperitoneal: as it turn malignant. *or malign. from start*
- Some surgeons believe that liposarcoma is malignant from the start.
- Extradural lipoma: as it causes pressure manifestations in spinal cord only

**2. Infection.****3. Ulceration** of overlying skin and mucous membranes.**4. Degenerative changes**, liquefaction or calcification.**Investigations**

- Excisional biopsy.

- CT spinal cord if it is extradural.

- X-Ray: if Subperiosteal.

**DD**

- According to its site e.g. Subperiosteal should be differentiated from osteoma.

**Treatment**

- Surgical excision (Enucleation of tumor from its capsule) if:
  - Not accepted cosmetically.
  - Complicated.



Incision

Encapsulation

Suturing

**Prognosis**

- Subcutaneous lipoma never to turn malignant, but in thighs and buttocks there is increased incidence of malignant transformation.
- Retroperitoneal lipoma: more liable to turn malignant.

**Oral Questions**

- Dercum disease
- Dangerous types of lipoma
- Painful lipoma (neurolipoma, Dercum, Complicated lipoma)



# 10- Neurofibroma

## Introduction

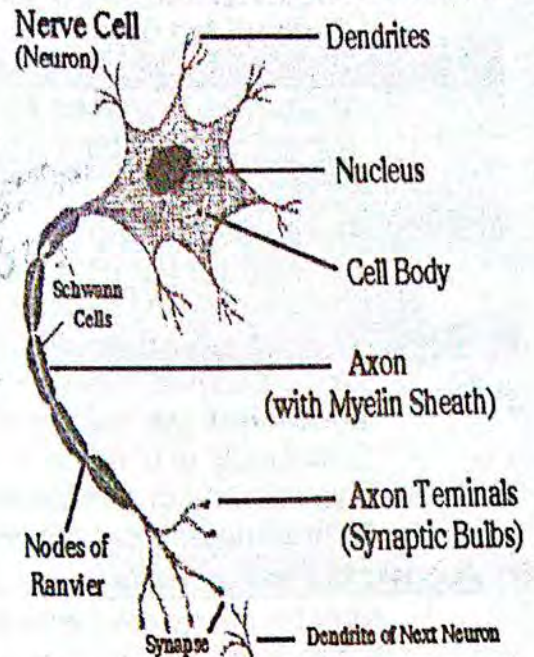
- neuron is formed of ( cell body, nerve axon, dendritis) → it is the functional unit **Comp** of nervous system
- Nerve axon is surrounded by Schwann cell which produce neurolemmal sheath

## Definition

- It is a tumor like masses formed from nerve sheaths either neurolemma (neurolemmoma) of spinal nerves or schwannoma from cranial nerves usually the 8<sup>th</sup> nerve.
- It is considered as hamartoma.

## Types

- Generalized ( Von Reckling Hausen's disease)
- Solitary.
- Patchy dermatocele (Plexiform neuroma).
- Molluscum Fibrosum.
- Elephantiasis neurofibromatosis.
- Acoustic (8th nerve)



## Clinical Picture

### Symptoms

- Patient usually presented with painless swelling that moves across and not along the nerves of gradual onset and slowly progressive course.

### O/E

- No. : Solitary or multiple.
- Size: variable.
- Shape: rounded.
- Site: subcutaneous.
- Edge: well defined.
- Consistency: firm.
- Mobility: not attached to skin.
- Cafe au lait patches: brown patches seen all over the body.

## → ACCORDING TO DIFFERENT TYPES:

### 1- Generalized neurofibromatosis (Von Reckling Hausen's disease)

- The most common type
  - Often it is familial
  - No. : multiple
  - Size: variable
  - Consistency: firm.
  - Mobility: mobile across but not along the nerve.
  - Cafe au lait patches: especially on the back.
  - Special characters: tender, ↑ ICT if arise from the intracranial nerve, no sensory or motor loss.
  - Pheochromocytoma may be present (MEN IIb)
    - hyper Parathy.
    - medulla bles



- Malignant transformation is associated with pain, anesthesia, paralysis and progressive increase in the size of lesion.

## 2- Solitary neurofibroma

- No.: single.
- Size: variable.
- Consistency: firm, tender (due to compression of nearby nerve fibers-not infiltration).
- Mobility: across but not along the nerve
- Café au lait patches.

## 3- Pachydermatocele (Plexiform Neuroma)

- Cystic swelling gives sensation as a bag of worms due to presence of multiple nerve fibers inside the swelling
- swelling is common in face → facial deformity

## 4- Molluscum fibrosum

- Soft fibrous swellings (cutaneous nerve endings are affected)
- Scalp, face and trunk are commonly affected (hand and feet escape).

## 5- Elephantiasis neurofibromatosis:

- Skin becomes thickened and replaced by grayish white glistening tissue (diffuse affection of the nerves of the skin and subcutaneous tissue).
- Commonly in children in limbs.
- Hypertrophy of a huge part of a limb.
- Differentiated from lymphedema by congenital nature & café au lait patches.

## 6- Acoustic neuroma:

- May be associated with acoustic nerve tumor.
- It has a striking familial incidence showing itself as Mendelian dominant trait.
- It is often associated with tumors of the dura and choroid plexus.

## Neurofibrosarcoma :

- Arise de novo or may develop by malignant transformation in a neurofibroma.
- It forms a painful rapidly growing tumor which invades the surrounding tissues producing anesthesia and paralysis and forms distant metastasis.
- Wide excision should be carried out in localized tumors, but amputation is indicated for extended tumors and post operative recurrence.

## Complications

- 1- Pressure symptoms e.g. deafness in acoustic neuroma.
- 2- Malignant transformation (neurofibrosarcoma):
  - Sudden change in behavior: -pain -rapid growth-hard in consistency-never paralysis.

## D.D. (Multiple swellings)

- |   |                      |
|---|----------------------|
| 1. Multiple neurofibromatosis.          | 3. Multiple melanoma |
| 2. Multiple lipomatosis.                | 4. Multiple angioma. |
| 5. Multiple lymph node enlargement.     | 6. Multiple warts.   |
| 7. Multiple exostosis (bony swellings). |                      |

## Investigations

Mainly clinical diagnosis

- Search for associated conditions e.g. MENIIb (blood pressure-serum calcitonin-urinary catecholamines).



**Treatment**

- Surgical excision is the treatment of choice
- **BUT**
  1. Debulking of the lesion is necessary to improve self image of the patient.
  2. With high rate of recurrence till age of puberty → repeated partial excision.
  3. Patient with generalized neurofibromatosis → must be fully examined because they might have acoustic neuroma.
- Neurofibroma does not affect nerves except neurofibrosarcoma and acoustic neuroma.
- Familial neurofibroma: Von Reckling Hausen disease and MENIIb.

**11- Lesions of melanocytes****A. Benign Melanoma (Naevus)****Definition**

- True neoplasm arising from melanocytes.

**Incidence**

- Naevi are the most common tumors in humans. *Commonest Neoplasm*
- At birth 2.5% of children have pigmented skin lesions.

**Types****1. Lentigo**

- Melanocytes replace the basal layer of epidermis in certain sites.
- **Histologically:** appear as rounded cells containing fine granular melanin pigment.
- **Clinically:** flat spot black or brown in color *- Never turn malign - Flat*

**2. Junctional pigmented naevus**

- **Histologically:**
  - More proliferation of melanocytes → small nodules of epidermis that bulge downward in the dermis.
  - Naevi in younger are junctional, and most of them turn intradermal by adulthood.
- **Clinically:** like lentigo but raised *- may turn malign if ch. irritation*

**3. Compound naevus**

- **Histologically:**
    - The basement membrane is disrupted and some melanocytes pass to the dermis, these melanocytes lose their capacity to melanin and called naevus cells also the dermis contains some macrophages containing melanin pigment.
  - **Clinically:**
    - Black or brown nodule raised above the surface of skin with some hair
    - sometimes, it occupies large area → giant hairy naevus.
- turn malign 5-4% if ch. irritation*



4. **Intradermal**▪ **Histologically:**

Around the age of puberty, in most cases the junctional activity ceases & the naevus cells in the dermis undergo maturation. The lesion is called intradermal naevus & may remain as such for life. Most pigmented naevi of adults are of this type.

▪ **Clinically:** like compound naevus.

**Treatment**

▪ Majority of lesions require no treatment.

▪ Indications for surgical excision:

- Cosmetic reasons

- If subjected to repeated trauma e.g. shaving. *chemical → زخم*

- If suspicion of malignant transformation.

▪ Giant hairy naevi must be excised as soon as possible. *الحزام → الحزام*

➔ **Can pigmented naevus turn malignant?**

- 1- Giant hairy pigmented naevi (commonest to turn malignant).
- 2- Junctional naevus.
- 3- If a site of repeated chronic irritation e.g. during shaving.

## B. Precancerous Skin Lesions

### 1. SQUAMOUS KERATOSIS (ACTINIC / SENILE KERATOSIS)

▪ It is a dry rough inelastic irregular pigmented area of the skin.

▪ **Histology:**

- Area of hyperkeratosis, nuclear polymorphism, ↑ mitotic figures.
- Squamous keratosis is the most important precursor of invasive cell carcinoma.

### 2. BOWEN DISEASE

- Arises in non-exposed skin.
- It is sharply, demarcated, rounded, reddish patches which enlarges slowly.
- There is marked epidermal hyperplasia usually misdiagnosed as psoriasis.

### 3. XERODERMA PIGMENTOSA

- AR.
- Deficient ability of DNA repair → Mutations impair certain oncogenes & tumor suppressor genes that may lead to predisposition to squamous & basal cell carcinoma.



17 Radiation

السليم الشب  
بالاختلاف في الاستجابة

Melanoma

Non melanoma  
SCC  
BCC

## VOLUME -II

241

# C. Malignant Skin Lesions

## 1. BASAL CELL CARCINOMA (RODENT ULCER)

### Definition

- Locally malignant tumor from basal layer of the epidermis or from equivalent cells of hair follicles, sweat or sebaceous glands

### Incidence

- Age: > 40 years
- Sex: Male > Female
- Fair skinned patients
- commonest malignant lesion of the skin

### Predisposing factors

- Exposure to sun rays, Ultra-violet rays (Most important) so the disease is more common in Farmers & Sailors. (actinic or solar keratosis)
- Predispose to multiple basal cell carcinoma all over the body:
  - Ionizing radiation.
  - Patients receiving immunosuppressants.
  - Premalignant Lesions
    - Xeroderma pigmentosa**: extreme sensitivity to sunlight, progressive dryness of the skin, and malignant changes to BCC and SCC.
    - Keratoacanthoma**: fleshy, elevated, central hyperkeratosis, rapid growth & involution.
    - Actinic keratosis**: most common, sun exposed areas, multiple, well circumscribed.
    - Bowen's disease**: more common in elderly men, solitary, erythematous, scaly plaque (Erythroplasia of Queyrat).
    - Leukoplakia**: chronic inflammation of oral mucosa, it usually occurs in older men, who are smokers.

### Pathology

#### Site

- 90% in the face (sun)
- Area above a line from lobule of the ear till angle of mouth, commonest sites are inner and outer canthi of eye and nasolabial fold.



### Macroscopic

#### A- Common types:

- Nodular form**: pearly white or blue translucent nodule with dilated capillaries over it (it is the earliest lesion). It is covered by thin epidermis. The nodule then ulcerates after sometime with serous discharge and bleeding. Healing sometimes occurs in one area of the lesion while further ulceration occurs.

- Ulcer form** (Rodent ulcer) → the commonest 75% nodulo-ulcerative ✓
  - Site** → In the face above line joining tragus with angle of mouth (> 90%). Nasolabial fold ✓
  - Shape** → Rounded, oval or irregular.

Commonest site



3. **Number** → usually single but may be multiple.
4. **Base** → Indurated, early mobile & late fixed.
5. **Floor** → red and granular and often covered with dry crust or scab.
6. **Edge** → Rolled in, beaded. *raised & rolled in*
7. **Base** → early soft & late indurated.
8. **L.N.** → not enlarged (locally malignant)  
(If enlarged → infection or SCC change)
9. **Discharge** → blood or pus.

3- **Excavating type:** the ulcer erodes deeply into the underlying structures leading to destruction of the nose and infiltration of the nasal sinuses.

**Q: Why edge of ulcer is rolled in and beaded?**

- **Raised and rolled in:** as the lesion becomes necrotic at its center but grows quite quickly at its periphery so that it raises above the surface of lesion
- **Beaded:** due to fibrosis which divide tumor edge into beads



### B- Uncommon types

1. Pigmented type (DD melanoma).
2. Cystic BCC
3. Flat superficial spreading BCC
  - Presents as red scaly patch.
  - Resembles psoriasis or eczema.

### Microscopic

- Rounded solid masses of cells (**pallisade appearance**):
  - Low columnar epithelium at periphery as (**basal cell**).
  - Polyhedral cells at center as (**Prickle 's cells**)
- The masses are separated by fibrous tissue stroma which infiltrated by lymphocytes.
- The slow rate of growth of the tumor is due to the long time the cells take to complete one mitotic cycle.

### Spread

- Only direct spread to surrounding (**Locally Malignant**)
- invade basement memb. & cartilage & bone & any surrounding but not spread by blood or Lymphatics*

### Clinical Picture

- Type of patient:
  - ♂ > 40 years
  - Fair colored people
  - Farmers & sailors
- Nodule: Painless nodule → Ulcer resistant for treatment
- Ulcer:
  - Slowly growing but progressive.
  - Characters : as before (in pathology)
- Lymph Nodes:
  - Not enlarged except in:
    - 2ry infection → firm, tender and mobile.
    - Epitheliomatous transformation → stony hard, mobile but later fixed.

**Epitheliomatous transformation is suspected if:**

- 1) Growth becomes rapid
- 2) Edge become everted
- 3) LN becomes hard & fixed

*↳ turn to SCC*



**Differential Diagnosis**

1. Ulcer of Squamous Cell Carcinoma (SCC).
2. Malignant melanoma.
3. Cock's peculiar tumor.

4. Septic granuloma.
5. Chancre.

**Complications**

- Infiltration of the surrounding (it may erode the underline skin)
- Secondary infection → meningitis and cavernous sinus thrombosis (Cause of death)
- Hemorrhage from erosion of big vessels.
- Epitheliomatous transformation (Baso-squamous carcinoma)

**Investigations**

It's mainly a clinical diagnosis by biopsy is mandatory to ensure diagnosis & exclude D.D.

1. Biopsy (Excisional or incisional):
  - Malignant cells derived from prickle cell layer penetrating basement membrane in groups with peripheral pallisade appearance.
2. X-ray → To detect bony involvement (rodent ulcer).

**Treatment****A - Surgical (Main line)****Indications:**

- a. Small lesions.
- b. Infiltration of the underlying cartilage or bone as bone cells will protect malignant cells from the effect of radiotherapy. Furthermore, radiotherapy can cause necrosis of the involved bone or cartilage.
- c. Radioresistant lesions.
- d. Recurrence after previous irradiation.

**Method**

1. Excision with safety margin 0.5 cm
2. Better to be elliptical for cosmetic closure of the wound.
3. The raw area is covered by skin graft or by primary closure
4. The pathologist should check that an adequate safety free margin has been excised, and if not, revisional surgery or radiotherapy should be applied.

**B - Irradiation**

- Tumor is very radio-sensitive
- The dose is fractionated over several weeks to diminish the scarring and necrosis.
- Best by iridium (less penetration) or deep x-ray therapy
- Use shield protection in irradiation

**Indications** → debilitated patients or recurrent after surgery.

**Contraindications:**

- Ulcer infiltrates bone and cartilage (to avoid irradiation necrosis).
- Ulcer near the eye (to avoid irradiation Cataract).
- Recurrence after irradiation (to avoid irradiation resistance).

**Recently**

1. Cryosurgery by liquid nitrogen (especially in eye lids and ears).
2. Topical cytotoxic therapy (5 Fluorouracil ointment (Effudex)).

\* Moh's teg. → remove cell layer by layer → near vital structures



**SUMMARY:**

- 1- Ulcer < 2 cm → Irradiation or excision with 0.5 cm safety margin & skin graft.
- 2- Ulcer > 2 cm → Excision with 0.5 cm safety margin & skin graft.

**Prognosis**

- If the lesion is completely excised the cure rate is 100%.
- Recurrence of the lesion is due to leaving behind foci of malignant cells and this is more liable to occur if there is infiltration of bone or cartilage.

## 2. SQUAMOUS CELL CARCINOMA (EPITHELIOMA)

جلد بالذات الاسم الثاني

**Definition**

- Malignant tumor from skin squamous epithelium. *prickle cells*

**Age & sex**

- Male > 40 yrs

**Predisposing factors**

*As basal cell carcinoma + marjolin ulcer & carcinogenic agents*

- Exposure to sun rays, Ultra-violet rays (**Most important**) so the disease is more common in Farmers & Sailors.
- Previous Irradiation.
- Albinism & Xeroderma Pigmentosa (AR).
- Longstanding irritation of the skin as in chronic ulcers, old burn scars & sinuses (A carcinoma arising on top of scar is called Marjolin Ulcer & there is usually a delay in its diagnosis.)
- Prolonged exposure of the skin to carcinogenic agents as coal tar derivatives.
- Patients receiving immunosuppressants.

**Pathology**

**Site**

- Any site covered with squamous epithelium especially upper part of the face, lower lip and the dorsum of hands.
- On top of squamous metaplasia (may be)

**Macroscopic**

**Types**

- Starts as a small nodule then enlarged to take one of the following forms → Ulcer (commonest) Nodulo-ulcerative

**Ulcer (CCC)**

1. **Shape** → Rounded, oval or irregular.
2. **Number** → usually single but may be multiple
3. **Base** → Indurated and it becomes rapidly fixed to underlying tissues..
4. **Floor** → necrotic
5. **Edge** → everted = raised or rolled out
6. **Margin** → early soft & late indurated.



*Epithelioma (Squamous cell carcinoma)*

75-100 % → well diff

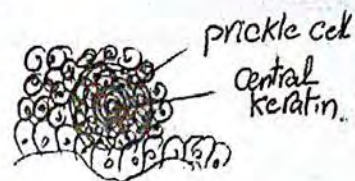
70-75 % → Med



7. L.N. → Early enlarged & soft (due to infection)
- 2ry infection may occur and there may be blood stained discharge.
  - Late hard (due to infiltration)

### Microscopic

- Differentiated SCC → with **cell nests OR Epithelial pearls** (Prickle cells + keratin in the center)
- Undifferentiated SCC → with masses of malignant cells (Anaplastic cells with basophilic cytoplasm which provide no cytological evidence of their origin)



Cell nests if present carry better prognosis than sheets



### Spread

- Direct > lymphatic > blood

➤ In a patient with Marjolin's ulcer the scarring makes lymphatic spread late.

### Clinical Picture

- Type of patient:
  - ♂ > 40 years
  - Fair colored people
  - Farmers & sailors
- Nodule
  - Painless nodule → Ulcer resistant for tt.
- Ulcer
  - Rapidly growing
  - Characters : As before (in pathology)
- Lymph Nodes
  - Enlarged in
    - 2ry infection → elastic & tender
    - Metastasis → Hard & fixed



### Differential Diagnosis

1. Rodent ulcer
2. Malignant melanoma.
3. Septic granuloma.
4. Chancre
5. Keratoacanthoma.

### Complications

1. Infiltration of the surrounding
2. Secondary infection
3. Hemorrhage
4. Distant metastasis & cachexia

### Investigations

1. Biopsy → excisional or incisional
2. X-ray → To detect bony involvement
3. sentinel L.N study: affected L.Ns
4. CT scan.



**Treatment**

- Two modalities of treatment are available (Surgical and radiological).

**A-SURGICAL****Indications of surgery:**

- Small lesions.
  - Infiltration of cartilage or bone.
  - Radioresistant lesions.
  - Marjolin's ulcer.
  - Block dissection of metastatic LNs.
- Excision with safety margin is at least 2 cm except in the face where it is 1 cm.
  - Better to be elliptical for cosmetic closure of the wound.
  - The raw area is covered by Skin graft or by Primary closure

**B-IRRADIATION**

- The main indication of radiotherapy is for tumors of the head and neck particularly for poorly differentiated tumors. The resulting skin is rather fragile.

**If LNs enlarged by metastasis (SCC only)**

- If LNs are close to tumor → excised with 1ry lesion in 1 block.
- If LNs are away from tumor → block dissection later on (after 2 wks), to avoid postoperative lymphedema and picking up of micrometastasis.
- No prophylactic block dissection in skin malignancy.

**Prognosis**

- 90% 5 year cure rate.

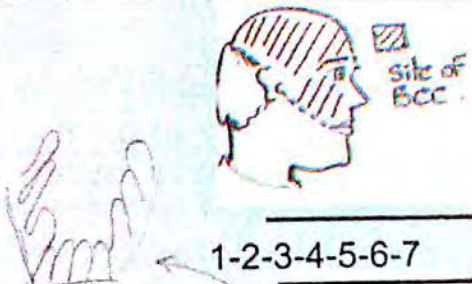
**More details****TTT of malignant melanoma (operable cases – 1ry tumor):****Other authors believe that:**

- < 1 mm → 1 cm safety margin.
- 1 – 2 mm → 2 cm safety margin.
- > 2 mm → 3 cm safety margin.

**Surgical TTT of SCC:**

- Other authors believe that → 1 cm safety margin is taken for all lesions



	BCC	SCC
<b>Definition</b>	Locally malignant	malignant
<b>Incidence</b>	Male old age	
<b>PDF</b>	<ul style="list-style-type: none"> <li>Exposure to sun rays, <b>Ultra-violet rays (Most important)</b> so the disease is more common in Farmers &amp; Sailors.</li> <li>Albinism &amp; Xeroderma Pigmentosa (AR). Predispose to multiple basal cell carcinoma all over the body.</li> <li>Ionizing radiation.</li> <li>Patients receiving immunosuppressants.</li> </ul>	<ul style="list-style-type: none"> <li>Longstanding irritation of the skin as in chronic ulcers, old burn scars &amp; sinuses (a carcinoma arising on top of scar is called Marjolin's Ulcer &amp; there is usually a delay in its diagnosis.)</li> <li>Prolonged exposure of the skin to carcinogenic agents as coal tar derivatives.</li> </ul>
<b>Pathology:</b>		Any site
<b>1. Site</b>		
<b>2. Macro-</b>		Nodular or ulcer
<b>3. Micro-</b>	Cell mass (pallisade) with fibrous stroma	differentiated (cell nest) & undifferentiated
<b>Spread</b>	Only direct (locally malignant)	Direct, blood & lymph
<b>C/P</b>		
<b>Type of patient</b>	♂ > 40 years, fair colored people, farmers & sailors	
<b>Nodule</b>	Painless nodule	Ulcer resistant for ttt.
<b>Ulcer</b>	slowly growing	Rapidly growing
<b>L-node</b>	No LN except if infected or malignant transformation	Enlarged in infection and metastasis
<b>Complications</b>	<ul style="list-style-type: none"> <li>- Hemorrhage, infection, infiltration</li> <li>- Malignant transformation</li> </ul>	<ul style="list-style-type: none"> <li>- Metastasis</li> </ul>
<b>DD</b>	<ul style="list-style-type: none"> <li>- Malignant melanoma</li> <li>- Septic granuloma</li> <li>- Chancre</li> <li>- Cock's peculiar tumor</li> <li>- SCC</li> </ul>	<ul style="list-style-type: none"> <li>- Keratoacanthoma</li> <li>- BCC</li> </ul>

Investigations: biopsy – X-ray – CT & sentinel LN study.

The best way to deal with enlarged lymph node in BCC is follow up, while in SCC is block dissection.



### 3. MALIGNANT MELANOMA

= Melanoma

It is either denovo or on top of benign melanoma.

#### Predisposing factors

As all skin malignancy + racial factor & benign lesion

1. Prolonged exposure to sunlight (UV rays) <sup>sudden exposure</sup>
2. On top of benign melanoma, exposed to frequent irritation (chemical – mechanical).
3. Albinism, retinitis pigmentosa.
4. Racial factors (rare in negros).

#### Incidence

- Disease of adult and old age.
- Male : female (1.2: 1).
- The incidence is ↑ in western countries which may be due to defective ozone layer.

#### Pathology and clinical types (according to WHO classification)

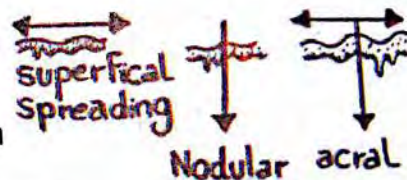
##### 1- Superficial spreading melanoma (the most common) 64%

- **Age:** usually middle age.
- **Site of lesion:** any part of the body  
in male → (mainly in the trunk)  
in female → back and legs
- **Character of lesion:** raised above surface and has irregular edge.
- **Prognosis:** good as malignant melanocytes spread along the epidermis (radial growth).



##### 2- Nodular melanoma 12-25%

- **Age:** usually in youngs.
- **Site:** common in trunk, head and neck
- **Character:** raised above surface, grey or black in color with smooth surface and liable to ulceration.
- **Prognosis:** bad as malignant melanocytes invade the dermis (vertical growth) without radial growth phase



##### 3- Acral lentiginous melanoma 2-8 %

- **Age:** more than 60 years of age (dark skinned patient)
- **Site:** palm, sole, under nail
- **Character:** may simulate any other type.
- **Prognosis:** very poor (starts by radial then later on vertical growth)

##### 4- Amelanotic melanoma

- **Malignant melanoma** which arise in the eyes, meninges or at mucocutaneous junctions as the anal canal.
- **Diagnosed by:** DOPA reaction test – biopsy.
- **Prognosis:** poor.



##### 6- Lentigo maligna (Hutchinson's melanotic freckles) 1-15%

- **Age:** elderly.
- **Site:** usually in face.
- **Character:** it begins as a flat brown macule which grows very slowly. Some areas may regress.
- **Prognosis:** it is the least malignant type. ✓

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## 7- Malignant transformation on top of benign melanoma:

- **Asymmetry:**
  - ↑ size & thickness.
  - One half unlike the other half.
- **Border**
  - Irregular – poorly defined.
- **Color**
  - ↑ pigmentation
  - Varies from tan, brown, black (sometimes white red or blue)
- **Consistency** → hard + LNs
- **Character** → itching – tingling – ulcer – bleed.
- **Diameter**
  - Usually > 6mm
  - Satellite nodules develop around it

## Spread

- **Direct** → radial or vertical growth.
- **Lymphatic** → deposits & retrograde permeation with satellite nodules around the tumour.
- **Blood** → high affinity to live (metastasis specially from choroids).
- 2ry deposits are usually black

## Classification (Clark's histological stages)

**I- Breslow classification** ✓ (more used because it is better in predicting prognosis)

1. Skin infiltration < 0.75 mm.
2. Skin infiltration 0.75 – 1.5 mm.
3. Skin infiltration 1.75 - 4 mm.
4. Skin infiltration > 4 mm.

**II- Clark's classification (according to depth in skin):** ✓

- a. Epidermal. I
- b. Dermo-epidermal junction. II
- c. Superficial papillary dermis. III
- d. Deep papillary dermis. IV
- e. Subcutaneous tissue. V

## Clinical picture

(The only sure method of diagnosis is histological examination, however malignant melanoma can be suspected clinically with A, B, Cs of melanoma)

### 1) Symptoms

- 1- **Denovo lesion.** More common
- 2- **Malignant changes** in benign naevus.
  - Rapidly growing, itching, pain, change of color, hemorrhage or ulcer.
- 3- Occult presentation.
- 4- **Transit metastasis** → Enlarged micro-metastasis after removing of the 1<sup>st</sup> tumor.

### 2) Signs

1. **Nodule or ulcer** of variable colors (from amelanotic to black)
2. **Satellite lesions** may be seen.
3. **Regional L.N.** or liver metastasis.

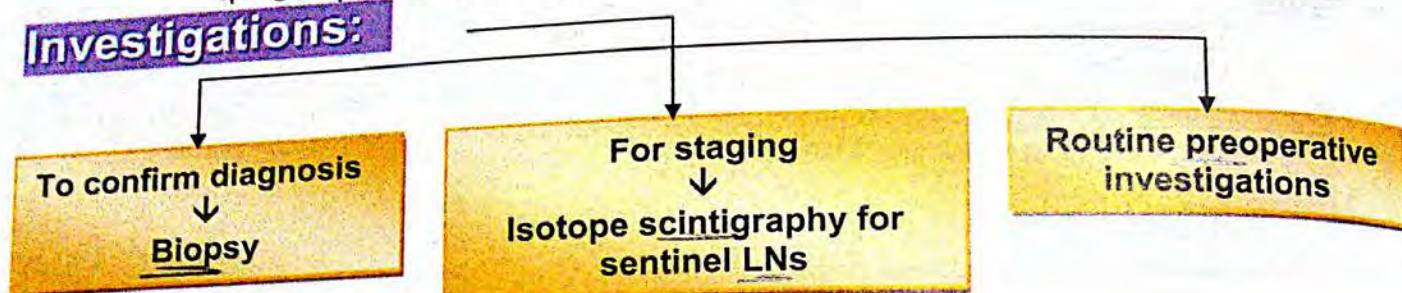


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DD

- 1- Granuloma.
- 2- Pigmented basal cell carcinoma.
- 3- Hemangioma
- 4- Compound or junctional naevus

## Investigations:



## →: How to take biopsy?

- 1- The line of incision should confirm to the possible subsequent excision.
- 2- Safety margin should be 3 mm.
- 3- Biopsy should include the whole skin and subcutaneous tissues to allow pathologist to determine Clark's level and Breslow thickness. *Full thickness*
- 4- Paraffin section is better than frozen section.

## Treatment

### A- Operable:

Surgical excision of the 1ry lesion with adequate safety margin of skin and SC tissues but not including deep fascia

#### 1. For 1ry tumor:

- $\leq 1\text{mm} \rightarrow 1\text{cm}$  safety margin.
- $1 - 4\text{ mm} \rightarrow 2\text{ cm}$  safety margin.
- $> 4\text{mm} \rightarrow 3\text{ cm}$  safety margin.

*\*Resistance to IR Radiation ✓*  
*BCC & SCC*

#### 2. For draining LNs:

- Prophylactic dissection of LNs is not <sup>Done</sup> performed.
- Radical dissection is performed if they are large & firm, but if not frankly malignant by clinical examination → FNABC is performed. *but not in the same operation*

### B- Inoperable tumor (stage 4)

- Metastasis is treated by interferons, chemotherapy and interleukin-2.

*done after 2 w.*  
*if remote from the incision*

## Prognosis

- According to type & rate of growth.
- Prognosis of malignant melanoma depends on depth of the tumor as depth ↑ prognosis become more worse.

*not irradiation*

## Malignant skin tumors of vascular origin

1. Haemangio-endothelioma.
2. Haemangio-pericytoma.
3. Haemangiosarcoma. The tumor is caused by exposure to vinyl chloride.
4. Kaposi's sarcoma.
  - The tumor may occur as a sporadic or endemic variety.
  - The latter occurs in certain countries in Africa and it may have a relation to CMV infection, Kaposi's sarcoma is also one of the manifestations of immunosuppression associated with AIDS.



## Points to remember (Skin & S.C. Tissue)

### Strawberry hemangioma

- **Incid.:** Commonest benign tumor in infancy, (♀:♂=3:1)
- **C/P:** Patch ↑, →, ↓ in size
- **Comp.:** Site dependant
- **TTT:** Mainly reassurance

### plexiform hemangioma

- **C/P:** swelling (disfigurement), headache, comp.
- **Comp.:** as cyst
- **Invest:** Doppler, angiography
- **TTT:** excision

### Cystic hygroma

**Etiology:** hamartoma

**C/P:** lax cystic translucent partially compressible non-pulsating swelling

**Comp.:** inf., resp. distress, obst. labour

**TTT:** excision

What	Veous malformation	Lymphatic malformation
↑	High venous pressure	Upper respiratory tract infection
↓	Compression	Potentially compressible

### Lipoma

- **Types:** commonest is s.c.
- **C/P:** swelling, pain, comp.
- **Comp.:** as cyst + liposarcoma
- **Invest:** biopsy if needed, imaging if deep
- **TTT:** excision

### Neurofibroma

- **Types:** commonest is generalized
- **C/P:** swelling + café au lait patches
- **Comp.:** pressure, neurofibrosarcoma
- **Invest:** only in familial type
- **TTT:** excision

### Benign melanoma

- Melanocytes are pigmented cells that arise from neural crest and then migrate to lodge in between the basal cells of the epidermis
- Its function is to form and transfer melanin pigment to adjoining keratocytes.
- Their proportion to the basal cells is constant as 1:10 to 1:15 and their number per unit area of the skin is fixed irrespective of race or skin coloration.
- Differences in skin color are due to the amount of melanin granules.
- Various hematomas can also arise from the melanocytes.
- **Naevi:**
  - **Types:** lentigo, junctional, compound, intradermal
  - **TTT:** no ttt but excision if: cosmesis, liable for trauma / malignancy, qiant hairy naevi

### Basal cell carcinoma

- **Etiology:** as skin cancer "U.V. rays"
- **Path.:** face, nodule or ulcer, palisade app.
- **Spread:** only direct
- **C/P:** ♂ > 40 years with nodule, ulcer, LN
- **Comp.:** as cancer + baso-squamous carcinoma
- **Invest:** clinical diagnosis + biopsy, X-ray
- **TTT:** surgical, irradiation

### Squamous cell carcinoma

- **Etiology:** as skin cancer, marjolin's ulcer, carcinogens
- **Path.:** ulcer, cell nests
- **Spread:** direct > lymphatic > blood
- **C/P:** ♂ > 40 years with nodule, ulcer, LN
- **Comp.:** as BCC + distant metastasis
- **Invest:** biopsy, X-ray, CT & sentinel LN study
- **TTT:** surgical, irradiation, ttt of enlarged LN

### Malignant melanoma

- **Etiology:** as malignancy, racial, benign lesions
- **Types:** superficial spreading (commonest)
- **Class.:** Clarck's "depth"
- **C/P:** as cancer (nodule or ulcer)
- **Invest:** as cancer + biopsy
- **TTT:** - operable: excision
- Inoperable: chemotherapy



# Muscles, Tendons & Fascia

## A- Chronic tendonitis:

- 1- Rotator cuff tendonitis.
- 2- Tennis elbow.
- 3- Stenosing tenovaginitis.
  - a- Trigger finger.
  - b- De Quervain's tenosynovitis.

## B- Chronic bursitis:

1. Anatomical bursae.
2. Adventitious bursae.

## C- Soft tissue sarcomas.

## D- Miscellaneous.:

1. Carpal tunnel S. (see neurosurgery).
2. Dupuytren's contracture.
3. Volkmann's ischemic contracture. (see orthopedics).

## A. Chronic Tendonitis

### 1- Rotator Cuff (Supraspinatus) Tendonitis

- It is the commonest cause of shoulder pain. ✓

#### Definition

- Inflammation of tendon of rotator cuff muscles: "SIT" ✓
  1. Supraspinatus (the commonest).
  2. Infraspinatus.
  3. Subscapularis.
  4. Teres minor.
- It extends to involve the subacromial bursa.

#### Etiology

- Repeated trauma from sports.

#### Clinical picture

- Painful active abduction when shoulder moves between 60° & 120° (Painful arc syndrome).

#### Treatment

1. NSAIDs.
2. Shoulder immobilization for few days only.
3. Gradual active exercise to restore full range of shoulder movement.
4. Local injection of corticosteroid lidocaine → in resistant cases.

### 2- Tennis Elbow

#### Definition

- Pain in the elbow at rest & while moving hand (wrist joint).

#### Etiology

كافش شرط في لاعبيه التنس  
Tennis players

1. Direct trauma to common extensor origin at lateral epicondyle.
2. Repeated atheletic activity

#### Treatment

1. Rest.
2. Local injection of corticosteroid lidocaine → in resistant cases.



### 3- Stenosing Tenovaginitis

#### Definition

- It is a case caused by a fibrous stricture in a tendon sheath, including:
  - Trigger finger.
  - De Quervain's tenosynovitis.

#### a. Trigger finger

#### Definition

- Thickening of fibrous flexor sheath at MCP joint producing pain on tendon movement.

#### Incidence

- Middle aged women & young children.

#### Pathogenesis

- Flexion of finger → part of the tendon proximal to constriction get swollen → can't extend the finger → lock the finger in flexion.
- Attempts to extend the finger may require passive assistance which will cause the tendon to snap through the strictured area. This is likened to the snap of the trigger of a pistol, hence the name "trigger finger".

#### Clinical picture

- Local tenderness on MCP joint.
- Passive assistance needed to extend the affected finger.
- Swelling at the level of the head of metacarpal bone.

#### Treatment

- Division of constricting fibrous flexor sheath.

#### b. De Quervain's Tenosynovitis

#### Definition

- Inflammation of tendon sheath of:
  - Abductor pollicis longus. *✓ at anatomical snuff box*
  - Extensor pollicis brevis.
 while crossing the wrist.

#### Clinical picture

- Active & passive movements of the thumb exaggerate the pain & limit movement.

#### Treatment

- Division of the constricting tendon sheath.



## B. Chronic Bursitis

### Definition of bursae

- It is a sac lined with synovial membrane containing fluid.

### Etiology

- 1- Traumatic: affect anatomical and adventitious
- 2- Infective:
  - Suppurative
  - Tuberculosis
  - Syphilis
- 3- Tumors: very rare

### 1- Anatomical bursae

- Anatomical bursae are normally found to allow easy movement between tendons, bones, and skin. Chronic inflammation of such bursae usually results from repeated friction and presents with mildly painful cystic swellings. Crepitus is a grating sensation that may be noticed by the patient if the bursa lining is rough, or if the fluid contains small loose fibrinous particles.
- Common sites
  - 1- Around the knee:
    - Pre-patellar (housemaid)
    - Infra-patellar (clergyman's knee)
    - Semi-membranous
  - 2- Olecranon (students)
  - 3- Subhyoid
  - 4- Radial bursa
  - 5- Ulnar bursa

### I. Semimembranous Bursitis

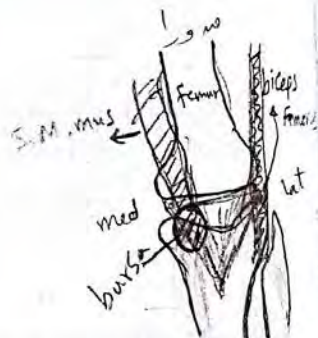
### Clinical picture

#### 3) History (symptoms)

- Adult age, presenting with painless or painful swelling in the popliteal fossa

#### 4) On examination (signs)

- Cystic swelling on the medial side of the popliteal fossa just above the joint level.
- Flaccid with flexion and tense with extension
- Contraction of the semimembranosus muscle during flexion of the knee makes the swelling diminish in size. *S.m.mus.*



### D.D.

#### 1- Baker's cyst: Mid Line of popliteal fossa

- a. Is a pulsion diverticulum of the knee joint
- b. With rheumatoid arthritis or osteoarthritis, more in elderly patients
- c. Presents as a cystic swelling below the level of the knee joint and deep to the gastrocnemius muscle
- d. The characteristic finding is that it can reduce into the joint. This is elicited clinically by compression of the cyst where a swelling appears at each side of the Patella.

#### 2- Popliteal aneurysm

#### 3- Other swellings in the popliteal fossa

4. Subsynovial lipoma



## Investigations

- Plain X-ray for the knee joint may be done to diagnosis associated lesion

## Treatment

- Excision for primary type
- If secondary to knee effusion, treat the cause.

## II. Ulnar Bursitis

### Anatomy

- Larger than radial bursa.
- Distally connected with synovial sheath of little finger.
- Proximally → run between the flexor retinaculum and pronator quadratus → extend to the forearm (**called space of Parona**).
- Envelop the flexor tendons of the medial 4 fingers.

### Etiology

#### Organism

- Staph (80%), Strept, E. coli, G -ve bacilli.

### Predisposing Factors & Route

- 1- Bad hygiene.
- 2- Bad general condition.
- 3- More in manual workers & housewives.

### Clinical Picture

#### Symptoms

- **General** → FAHM.
- **Local:**

Pain → dull aching then become throbbing when pus is formed.  
→ Decreased by elevation of the hand.

Swelling → according to site e.g. pulp space → distal phalanx, acute paronychia  
→ nail fold, edema at the dorsum of the hand is common, irrespective of the site of infection.

Disturbance of function → limited movement.

Swelling of little finger, palm, distal part of forearm.

#### Signs

##### General:

- See Before.

##### Local:

- See before.
- Slight semiflexion of the little finger (hook sign).
- Limitation of movements of the medial 4 fingers.
- Edema of the dorsum.
- **Kanavel's sign:** tenderness over an infected ulnar bursa between transverse palmar creases & hypothenar muscles.



**Complications**

1. Sloughing of the tendon due to interfering with nutrition of the tendon.
2. Adhesions inside the synovial sheath → limitation of movement.
3. Osteomyelitis.
4. Arthritis.

**Treatment****Before Suppuration**

▪ **General:** antibiotics, analgesics, antipyretic. (AAA)

▪ **Local:**

1. Hot fomentation.
2. Arm position → to diminish pain & edema.
  - Minor infection → arm to neck sling.
  - Major infection → elevated above level of body.
3. Hand position:
  - If resolution is expected → **position of rest:**
    - ⇒ Description of position: the patient grasps a ball of cotton with max Flexion of little finger, least flexion of index with the thumb in opposition.
  - If stiffness is expected → **position of function**
    - ⇒ The fingers are approximated to the thumb as if holding something.
    - ⇒ Especially in tenosynovitis for fear of fibrosis of tendon & shortening → clawing of hand.



**Position of rest**

**After suppuration → Incision & drainage**

1. Should be done once pus is formed.
2. Under general anesthesia, ring anesthesia for minor cases (better to be avoided).
3. Bloodless field by:
  - Elevated the limb for 2 minutes.
  - Sphygmomanometer cuff is inflated for 40 mmHg above systole.
4. Incision:
  - Along radial border of hypothenar eminence
  - In severe cases → counter incision at the lower part of forearm
5. All pus is removed & granulation tissues are curetted.
6. No drain is allowed because it causes pressure to delicate structures but a piece of tulle-grass might be allowed.
7. Dry dressing is employed; changed after the 1<sup>st</sup> day, then every 2 hours.



**Anatomy**

- Small in size.
- Distally connected with synovial sheath of the thumb.
- Proximally → run between the flexor retinaculum and pronator quadratus → extend to the forearm (called space of Parona).
- Envelops the tendon of flexor pollicis longus.

**Etiology****Organism**

- See before.

**Predisposing Factors & Route**

- See before

**Clinical Picture****Symptoms**

- See before + swelling of thumb, thenar eminence & distal part of forearm.

**Signs**

- **General:** see before.
- **Local:**
  - See before + thumb is semiflexed.

**Complications**

- Sloughing of the tendon due to interfering with nutrition of the tendon.
- Adhesions inside the synovial sheath → limitation of movement.
- Osteomyelitis
- Arthritis.

**Treatment**

- See before +

**Incision**

- On the ulnar side of thenar eminence stopping proximally 1.5 inches distal to the distal crease of the wrist to avoid injury of the motor branch of median nerve
- In severe cases → counter incision

**2- Adventitious bursae**

d.t friction

1. Over the head of shoulder (porters) <sup>سبيل</sup>
2. Over external malleoli (trailors)
3. Over the big toe (bunion)
4. Over the amputation stump.
5. " elbow (students)
6. " knee (house made) <sup>مطبخ</sup>



## C. Soft Tissue Sarcoma

**Definition**

- Malignant connective tissue tumors arising in the extra skeletal connective tissue. *= not in Bone*

**Incidence**

- Commonest in the 5<sup>th</sup> & 6<sup>th</sup> decade of life, yet they occur in all age groups including children. *old*
- 1 % of all malignant tumors.

**Etiology**

- **Exact etiology is poorly understood but those are common association:**

1. Following radiation for other malignancies: e.g. Hodgkin's lymphoma.
2. Lymphangiosarcoma on top of the chronic post mastectomy arm oedema.
3. Neurofibrosarcoma may develop in patients with Von Recklinghausen's disease.

**Types**

1. Malignant fibrous histiocytoma.
2. Liposarcoma.
3. Rhabdomyosarcoma.
4. Synovial sarcoma.

5. Malignant nerve sheath tumor. *neuro*
6. Leiomyosarcoma.
7. Fibrosarcoma.
8. Angiosarcoma.

**Pathology****SITE:**

- In extremities and pelvic girdle. (Commonest)
- Also in trunk and retroperitoneal.

**CELL OF ORIGIN:**

- Primitive multipotential mesenchymal connective tissue cells, which differentiate during the process of neoplastic transformation.

**MACROSCOPIC:**

- **Capsule:** Well defined false capsule and contents can be easily enucleated; however it is an integral part of the tumor infiltrated with malignant cells which spread well beyond it. = Budding
- **Cut section:** fleshy with areas of necrosis and hemorrhage. - Spindel cells, Round cells, bl.

**Grades**

- **Depends on :**

- a) **Histological grading** has more influence on prognosis than the type of the tumor, including:

1. Extent of mitosis.
2. Extent of necrosis.
3. Cellular anaplasia.
4. Pleomorphism.

- b) **DNA ploidy:** determines the tumor aggressiveness. *poly ploidy (normal cell diploidy)*

**Spread**

- a) **Local:** first within the musculofascial compartment in which it arises.
- b) **Direct:** Fascial septa resist spread temporarily, after which extra compartmental spread occurs. 1



**Blood:** spread from high grade tumors goes mainly to the lungs. *Bursing theory*

d) **Lymphatic:** spread is unusual.

## Clinical Picture

- Painless Swelling enlarging over several months (delayed presentation so the tumor is large since first presentation).
- **Consistency:** soft or firm according to amount of deposited collagen.

## D.D

1. Benign soft tissue tumors: e.g. lipoma.
2. Deep seated hematomas.
3. Malignant lymph nodes.
4. Bone tumors.
5. Tumor like conditions of the soft tissues:
  - Fibromatosis: e.g. desmoid tumor (Paget's recurrent desmoid tumor). It occurs most often in the rectus sheath & the external oblique aponeurosis of middle aged women. It grows at a very slow rate & has a tendency for recurrence after an apparently adequate excision. That is why it has been considered in the past to be a low grade soft tissue sarcoma. Wide surgical excision is the only treatment.
  - Nodular and proliferative fasciitis.
  - Proliferative myositis and myositis ossificans.

## Investigations

### A. For diagnosis

- ▶ **Biopsy:** FNABC or Open biopsy if FNABC is not enough.

### B. For staging

- ▶ **Radiology:**
  - CT scan or MRI: for direct spread.
  - CXR and CT scan : to detect pulmonary metastases.

## Treatment

	Operable	Inoperable
	A combination of radical surgical excision & adjuvant (complementary) radiotherapy is the standard ttt. The extent of surgery depends on the extent of tumor invasion.	(pulmonary metastases , huge retroperitoneal masses, sarcomas that are adherent to important irremovable structures.
1 <sup>st</sup> line	Enucleation	Combination chemotherapy is the main line of palliation (though not so effective)
2 <sup>nd</sup> line	Amputation is indicated if resection will lead to useless limb.	Palliative surgical excision may be added.

\* less sensiti. to Chemo & Radiotherapy.



## D. Miscellaneous

### 1- Carpal Tunnel Syndrome

- ▶ This is the commonest type of nerve compression syndromes.
- ▶ The condition is commonly confused with the hand pain produced by cervical spondylosis.
- ▶ Treatment : Surgical division of the flexor retinaculum produces gratifying results. After decompression, the median nerve should be inspected, and if it still shows a constriction, release of its tight epineurium is required.
- ▶ For details, see neurosurgery.

### 2- Dupuytren's contracture (Palmar fasciitis)

#### Pathology

- ▣ Progressive thickening & contraction of palmar aponeurosis.

#### Incidence

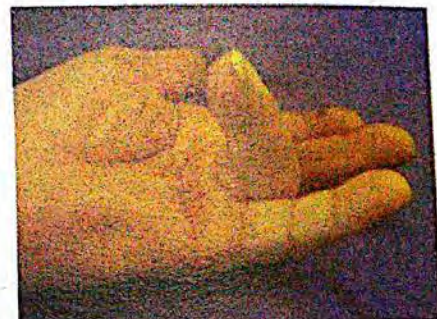
- ▣ M : F = 10 : 1.
- ▣ Bilateral in 1/2 cases & affects primarily the medial side of the palmar apponeurosis.

#### Etiology

1. Idiopathic.
2. ↑ incidence in: cirrhotics, alcoholics, epileptics under phenytoin treatment & diabetics.
3. Familial.

#### Clinical Picture

- ▣ Starts as a nodule at the base of the ring or little fingers.
- ▣ Skin adheres to fascia & contracts as well.
- ▣ The other fingers progressively become involved.
- ▣ Flexion deformity:
  - Involves metacarpophalangeal & proximal interphalangeal joints (distal interphalangeal joints are free).
  - The flexion deformity is not lessened by flexing the wrist joint
- ▣ Palpation of the palm reveals:
  - Firm, irregular tight nodule, 1 – 2 cm proximal to the base of the ring finger.
  - Tight strands can be felt running from the nodule to the bases of the ring & little fingers & proximally to the flexor retinaculum.



#### Treatment

a) **Early:** Physiotherapy.

b) **Late:**

- ▣ Surgery: Main line

1. Subcutaneous fasciotomy (mild cases).
2. Aponeurosis excision (severe cases).
3. Additional surgeries in severe cases:

- Joint capsulotomy + skin grafting after excision of deformed skin.

### 3- Volkmann's ischemic contracture

- ▶ See orthopedic surgery.



## Hands &amp; Feet

**A- Congenital Anomalies****B- Hand Injuries:**

1. Hand zones injury
2. Traumatic amputations of the hand
3. Mallet fingers

**B- Swellings:**

- 1- Simple ganglion.
- 2- Compound Palmar ganglion.
- 3- Giant cell tumor of tendon sheath.
- 4- Glomus tumor.

**How to examine hand??****Examine each system in turn****1st: The musculo-skeletal system (bone, joints, ms, tendons)****Inspection**

➤ look for :

- Any abnormality in shape, size, contour of the hand
- Any discoloration, scars, sinuses
- Muscle wasting (thenar & hypothenar)
- Wrist joint

**Palpation**

➤ Feel bony areas, site of tenderness, any swellings

**Movement**

- Check the range of movement of all joints
  - a) **Campo-metacarpal joint of the thumb** (Flexion, extension, abduction, adduction, opposition)
  - b) **Metacampo-phalangeal joints of the fingers** (Flexion, extension, abduction, adduction)
  - c) **Inter-phalangeal joints** (Flexion & extension)
- Inability to move the joint may be caused by joint disease, skin & fascial thickening, divided tendons, and paralyzed muscle

**2nd: the circulation****Inspection**

- Pallor (anemia or ischemia)
- Ischemic atrophy of the pulp of the finger
- Ischemic ulcers, small abscesses & gangrene

**Palpation**

- Temperature of the skin
- Both pulses (radial & ulnar at the rest)

**Capillary return test:**

Observe for rate of filling of vessel below the nail after emptying it (N=1-2 sec)

**Allen test**

1. Ask the patient to make a fist & then compress both radial & ulnar arteries at the wrist of the hand
2. After 10 sec ask patient to open the hand → palm will be white
3. Release the compression on radial artery & watch blood follow to the hand
4. Repeat the procedure but release the compression on ulnar artery



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### Auscultation

- For any A-V fistula or vascular tumor
- Measure the blood pressure in both arms

## A. Congenital Anomalies

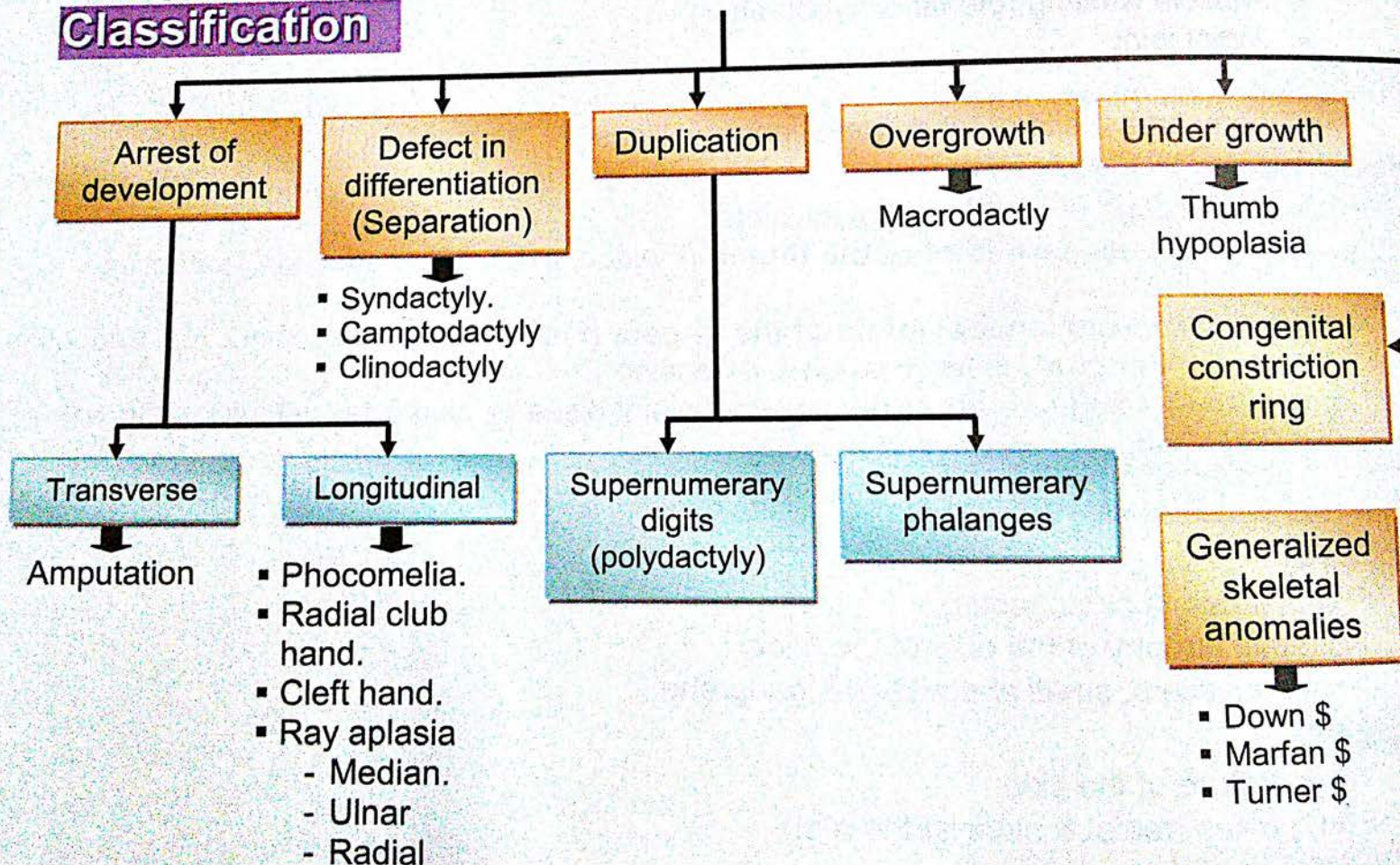
### Incidence

- 1.14 / 1000 live birth
- 5% have other syndromes.
- Hand anomalies are the 1<sup>st</sup> common congenital deformity.

### Etiology

- Genetic (present since time of conception)
- Non Genetic
- Environmental
- Sporadic
- Combination (environmental + Genetic)

### Classification



Radial club hand

Clinodactyly (radial or ulnar)



Camptodactyly flexed





## 1- Polydactyly

### Definition

- Presence of more than the normal number of fingers or toes.

### Etiology

- Usually inherited as an autosomal dominant gene.
- Female = Male (because it is autosomal and not sex-linked)
- It may be isolated or a part of syndrome.

### Diagnosis

- By external observation:
  - It varies from an unnoticed rudimentary finger or toe to fully developed extra digits.
  - When extra digits are fused, it is called polydactyly.
- By investigations
  - X-ray.
  - Fetal sonogram



### Treatment

- Goals of treatment
  - To produce a functional limb
  - To improve cosmesis

It is not always possible to achieve these goals in a single stage

- Conservative
- Physiotherapy
- Prosthetic
- Surgical

#### 1-Timing of surgery (variable)

- From neonatal period to 4-5 years
- Staged operation should be designed to be completed by school age
  - If growth is increasing the deficiency: at 1 year of age
  - If the developmental pattern necessitates: at 2 years of age
  - If patient cooperation is necessary: at 4-5 years of age

#### 2-Surgical removal of the extra digits or partial digits

### Prognosis

- Isolated lesions have an excellent prognosis; otherwise the prognosis depends on the syndrome.

#### Remember

- ▶ **Etiology:** autosomal dominant, ♂=♀
- ▶ **C/P:** rudimentary or developed extra digits
- ▶ **Invest.:** X-ray, fetal sonogram
- ▶ **TTT:** mainly surgical



## 2- Syndactyly

### Definition

- Webbing or fusion of 2 or more fingers or toes

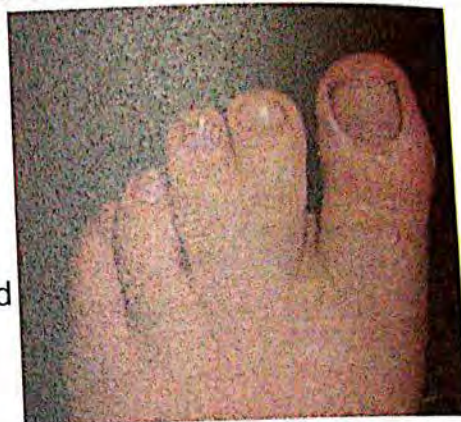
Commonest anomaly of Hand

### Etiology

- As polydactyly (syndactyly results from failure of apoptosis that normally occurs between digits)

### Diagnosis

- It does not interfere with the function of the feet, toes or hand but it may impair function of fingers.
- Most commonly affecting the 3<sup>rd</sup> web space, followed by the 4<sup>th</sup> then the 2<sup>nd</sup> and rarely the 1<sup>st</sup> web space.
- 50% bilateral.
- By external observation:**
  - Degrees:
    - Simple:** digits connected only by soft tissue
      - May be full "extending to the tip of the digits or partial "not extending to the tip of the digits"
    - Complex:** the condition is complicated with shared bones, nerves, vessels and or nails.
      - It may be a polysyndactyly (see before)
      - Examine for associated anomalies.
- By investigations:**
  - X-ray.
  - Fetal sonography



### Treatment

- Goals of treatment**
  - To produce a functional limb
  - To improve cosmesis
- Conservative**
- Physiotherapy**
- Prosthetic**
- Surgical**

#### 1- Timing of surgery (variable)

- From neonatal period to 4-5 years
- Staged operation should be designed to be completed by school age
  - If growth is increasing the deficiency: at 1 year of age
  - If the developmental pattern necessitates: at 2 years of age
  - If patient cooperation is necessary: at 4-5 years of age

#### 2-

- In case of webbed toes, surgical correction is a purely cosmetic operation with no medical benefits.
- Release of fingers, zigzag incision.
- Surgical correction separation almost always with the addition of a skin graft from the groin.

### Prognosis

- As polydactyly.

#### Remember

- Etiology:** autosomal dominant, ♂=♀
- C/P:** simple or complex, 50% bilateral
- Invest.:** X-ray, fetal sonogram
- TTT:** mainly surgical



## B. Hand Injuries

### Classification

#### 1. Tidy injuries:

- These are caused by sharp objects as knives and broken glass.
- The skin is cleanly cut and the tendons, nerves and vessels are commonly affected.

#### 2. Untidy injuries:

- These are caused by crushing forces and by burns and cause tissue devitalization.
- All hand tissues may be affected including bones.

### Emergency care

1. An amputated hand or digit is kept in a clean polythene bag and is placed in a container full of cold water at 4°C (it should not be frozen).
2. The patient is then urgently referred to a centre that is equipped with microsurgery facilities.
3. Prophylactic antibiotics & tetanus prophylaxis are administered when indicated.

### Assessment of injury

- Clinical and radiological assessment should include the skin, nerves, arteries, tendons, and skeleton.
- The wound is inspected and the hand is examined for deformities, and for sensory and motor deficits.
- In many cases pain limits the value of these tests, and the final diagnosis of the extent of injury is obtained after surgical exploration.

### Treatment of minor injuries

- **Subungual haematoma** is a painful condition. Relief of pain is obtained by evacuating the blood accumulating beneath the nail. A hole is drilled in the nail using the needle of a syringe. The procedure is painless and, therefore, requires no anesthesia.
- Minor skin wound is stitched under local infiltration anesthesia.

### Principles of surgery for hand injuries

#### 1. Anaesthesia.

- a. GA is preferred.
- b. Alternatives are local intravenous anaesthesia with a tourniquet, and nerve blocks with local anaesthetics.
- c. The brachial plexus, median, or ulnar nerve may be blocked according to the site of injury.
- d. Digital nerve block is used for injuries of the distal parts of the fingers.
- e. It should be remembered that the digital arteries are end arteries, and if they are thrown into prolonged spasm by the addition of adrenaline to the digital block, gangrene of the finger may occur.

2. A **tourniquet** provides a clear bloodless field. It should be released within one hour.
3. The use of **magnifying loops** or microscope is desirable.
4. **Careful wound toilet**, using saline irrigation, removes foreign bodies and debris.
5. Excision of **devitalized tissues** in untidy injuries.
6. **Hemostasis**

- a. obtained by ligating small bleeding vessels. (radial or ulnar artery can be ligated without affecting viability of the hand).
- b. If facilities and experience are available, repair of an injured artery is a better alternative.
- c. Arterial repair is a necessity if both main arteries are injured.



**7. Nerves**

- a. Tidy injuries → Primary repair of cut nerves.
- b. Untidy injuries or evidently contaminated wounds → The repair is better postponed after wound healing and resolution of inflammation.

**8. Tendons**

- a. The same principles of timing the repair apply to tendon injuries.
- b. Suturing is done with no absorbable nonirritant material, e.g. prolene.
- c. Success of tendon repair is endangered by the development of adhesions which limit its mobility. This problem is most marked in the case of flexor tendon injuries, in the area between the distal palmar crease and the middle of the fingers, where the flexor digitorum superficialis and profundus tendons are enclosed within the digital fibrous flexor sheath. With refinement of surgical technique, the tendency is now for direct suturing irrespective of the site of injury.
- d. Tendon grafting is reserved for complicated cases with loss of substance and for recurrent cases.

**9. Finger tip injuries with loss of skin:**

- a. If there is skin loss only, the finger tip is covered by split or full thickness graft.
- b. With finger tip amputations that expose the bone, skin grafts will not take, and local skin flaps are usually used.
- c. Examples of such solutions include cross finger flap, or the advancement of two lateral triangles of skin and subcutaneous tissue to cover the defect.

**10. Skin closure**

- a. Is to be done without tension.
- b. Contaminated wounds are left open.
- c. Wounds of human and animal bites are highly contaminated with a mixture of bacteria, including anaerobes, and should never be sutured.

**11. Microsurgical replantation** of severed parts gives good results when it is done early for a clean cut amputation. The operation is useless if the part is severely crushed or if 12 hours have elapsed after the injury.

**Postoperative care**

- The hand is bandaged in the position of function, and is kept elevated for a few days to minimize edema formation.
- Physiotherapy is started after one week to allow restoration of hand function.



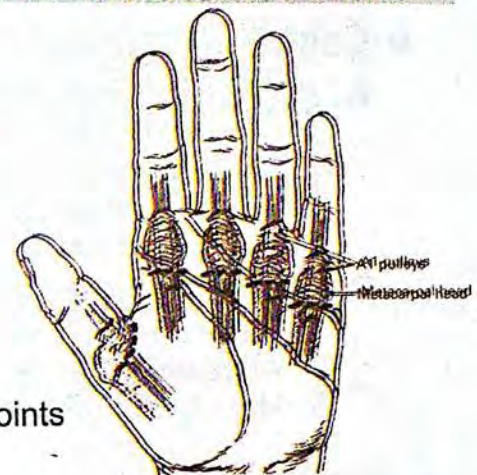
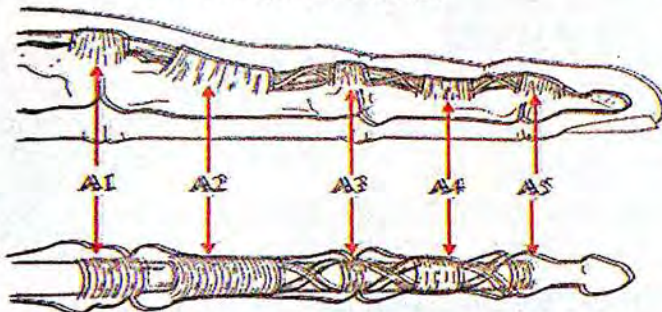
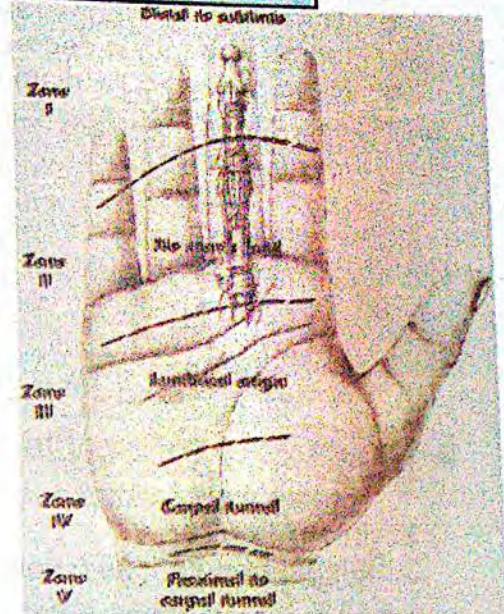
# 1- Hand zones injury

## Anatomy

### ► Zones of injury:

#### 1. FLEXOR TENDONS:

- Flexor tendons are divided into 5 zones
- Zone 1 is distal and Zone 5 is proximal
- The five zones are
  - a) Contains flexor digitorum profundus only distal to the insertion of flexor digitorum superficialis
  - b) From insertion of flexor digitorum superficialis to the proximal edge of the A1 pulley
  - c) From the proximal edge of the A1 pulley to the distal edge of the carpal tunnel
  - d) Within the carpal tunnel
  - e) Proximal to the carpal tunnel



#### 2. EXTENSOR TENDONS:

- Extensor tendons are divided into 8 zones
- Zones 1, 3 and 5 lie over the DIP, PIP and MCP joints

## Introduction

- Flexor and extensor injuries are common
- Flexor tendon injuries are often associated with neurovascular damage
- Extensor tendon injuries often associated with articular damage
- Require careful assessment and management
- Accurate surgical repair required requiring meticulous surgical technique
- If poorly managed can lead to significant functional disability.

## Treatment

### ► General rules:

1. All flexor tendon injuries require operative exploration, therapy or both.
2. In the emergency department: lacerations with both ends are visualized for repair only can be there.
3. Multiple tendon injuries or those with difficult exposure (i.e.) more proximal should be attempted only in the OR.
4. General treatment to extensor tendon injuries includes: direct repair + splinting for 6-8 weeks.

- G-anath. - good hemostasis - hand in function position  
 - not add adrenalin to xylocaine if you use local anath.



► **For partial tendon lacerations:**

- ▣ The rule is "No repair" as rates of rupture in repaired tendons may be higher and tensile strength is decreased.
- ▣ **Repair:** any  $>50\%$  diameter should be ligated.

► **Methods of tendon repair:**

- ☒ The usual method of is **(modified Kessler suture)**: *prolene (Kessler suture) cause fibrosis > exte*
  1. Good tensile strength.
  2. Small amount of ischemia induced.

The tendon is repaired by approximation of the epitenon with fine sutures.

**[Timing]:** Repair within 6 days prevents significant contraction.

## 2- Traumatic amputations of the hand

► **Indications for replantation of an amputated digit:**

1. Thumb amputations.
2. In children.
3. Clean amputations (sharp division) at the hand, wrist or distal forearm.
4.  $<12$  hr    5. In microvascular center    6. Non smoker    7. Not multiple    8. etc.

► **Contraindications to replantation:**

**A. Absolute contraindications:**

1. Severe medical problems or associated injuries increasing the risk of surgery.
2. Multilevel injury to the amputated part.
3. Inability to stop smoking for 3 months post replant.
4. Psychiatric illness that precipitated self-amputation.

**B. Relative contraindications to replantation:**

1. Severe crush or avulsion.
2. Amputation between MCP and PIP joints of a single digit.
3. Heavily contaminated wound.

► **Preparation of replantation**

**a) Preparation of the patient:**

1. Debridement of stump with irrigation and dressing with non-adherent gauze.
2. Tetanus prophylaxis.
3. IV antibiotics.
4. IV hydration.

**b) Preparation of the amputated part:**

1. Debridement with irrigation.
2. Wrapping in gauze moistened with lactated Ringer's solution or normal saline.
3. Placement of the wrapped part in sealed container immersed in an ice bath.

→ store in water  $4^{\circ}\text{C}$  (not  $-4^{\circ}\text{C}$ )



### 3. Mallet finger (baseball finger)

#### Definition

- A fixed flexion deformity of DIPJ of a finger

#### Etiology

- Trauma (it is known as baseball finger because commonest cause of injury is a blow on tip of finger)

#### Pathology

- Loss of extensor mechanism of DIPJ due to rupture of extensor tendon or avulsion fracture



#### History

- Inability to extend the tip of a finger (would be great disability to a person with occupation require fine hand movement)

#### Examination

- With the finger extended the distal phalanx remains flex 15 - 20°.

## C. Swellings

### 1- Simple Ganglion

- 95% of hand swellings are benign

#### Definition

- Chronic cyst containing mucoïd material related to a tendon.

#### Etiology

- Mucoïd degeneration of fibrous tissue of tendon sheath.

#### Pathology

- Cyst contains jelly like mucin.

#### Clinical Picture

##### ⇒ Symptoms

- Painless swelling at dorsum of the hand or around the ankle.

##### ⇒ Signs

- General: may be fever if infection.
- Local: localized, tense, cystic (by Paget test, because giving a false impression of being hard), rounded swelling, moves across the tendon. its mobility is ↓ by pulling on the tendon. (characteristic physical sign)



#### Complications

- 1- Infection.
- 2- Hemorrhage.
- 3- Calcification.

- 4- Rupture.
- 5- Malignant changes.

#### Investigations

- X-ray on hand.

- Excisional biopsy.



**Treatment**

- It is not indicated unless the patient insists. *not for fear of complicat. as it rare*
- Aspiration or rupture of cyst by applying direct pressure, may be followed by recurrence.
- Complete excision under GA until its root in the presence of good light, tourniquet & bloodless field (it is the only definitive treatment).

## 2- Compound Palmar Ganglion (TB of ulnar bursa)

**Definition**

- TB synovitis of synovial flexor sheath at the fingers → distended with TB granulation tissues.

**Etiology**

- **Causative organism:** Mycobacterium TB.
- **Route of infection:**
  - o Direct, inoculation.
  - o Lymphatic spread.
  - o Blood spread ✓

**Pathology**

- ⇒ **Site:** - Palm. - Distal part of the forearm.
- ⇒ **Macroscopic:**
  - Aggregation of TB follicles lymphangitis and lymphadenitis.
- ⇒ **Microscopic:**
  - TB tubercle formed of central caseation surrounded by epithelial cells, giant langhans cells fibroblasts and fibrocysts. *or Millon seed appearance*

**Clinical Picture**⇒ **Symptoms:**

- Swelling at palm of the hand and distal part of the forearm.
- May be on associated TB toxemia, night fever, night sweating, anorexia and loss of weight.

⇒ **Signs:**

- **General:** TB toxemia.
- **Local:**
  - **Inspection:**
    - Swelling at palm and distal part of forearm, larger in size, may extend to thumb or little finger.
    - Overlying skin may show signs of inflammation.
  - **Palpation:**
    - Swelling with smooth surface, ill-defined edge, cystic in consistency and fluctuant: show "cross-fluctuation" due to band of constriction at flexor retinaculum.
    - LNs may show TB lymphadenitis. *as at Posas abscess*

**Complications**

- 1- Secondary infection.
- 2- TB spread and toxemia.
- 3- Hemorrhage.
- 4- Rupture.



## Investigations

### ⇒ Lab:

- Tuberculin test.
- ESR >100
- Aspiration and culture on Lowenstein Jensen media.
- PCR.
- CBC → leukopenia with relative lymphocytosis.

### ⇒ Imaging: CXR.

## Treatment

### ⇒ Medical treatment:

- Sanatorial treatment.
- Immobilization in plaster of paris.
- Antituberculous drugs.

### ⇒ Surgical:

- Aspiration by z-technique.
- If failed → Complete excision under umbrella of anti-tuberculous drugs.

## Prognosis:

- Depends on a patient's resistance and virulence, and load of bacteria.
- Good immunity → fibrosis.
- Low immunity.
- Coalesce.
- Caseation.
- Cold abscess.

## 3- Giant Cell Tumor of Tendon Sheath

- Painless mass on volar or dorsal aspects of finger. *Like a tumor but in tendon*
- Interfere with tendon movements, compress digital nerve & erode bone.

## Treatment

- Meticular excision. *Locally malignant*
- Recurrence is treated by re-excision combined with radiotherapy.

## 4- Glomus Tumor (Angioneuroma)

## Definition

- The tumor arising from A-V shunt in extremities under nails

## Pathology

- Vascular, neuron & smooth muscle fibers elements.

## Clinical picture

- Appear as minute very tender purple spot under the nail
- Paroxysmal pain is induced by pressure or change in temperature

## Treatment

- By excision *Microsurgery*

*tendon sheath*  
 \* *desmoid tumor*  
 ↳ occur in  
 at Rectus sheath  
 in multiparous  
 ↳ occur in F  
 Polypoid  
 Gartner's  
 in post. r. c.  
 sh.  
 ↳ locally m  
 Recurr. af  
 excis



## Face, Lips & Palate

### i- Congenital anomalies

- ▣ Cleft lip and palate

### ii- Trauma

- ▣ Maxillofacial injury

### iii- Neoplasm

- ▣ Lip cancer

- Develop.

- Embry. dev.

- Max. fac.

- Lip

## i. Congenital anomalies

### Congenital anomalies of the face

1. Cleft lip.
2. Cleft palate.
3. Preauricular sinus: This is due to imperfect fusion of the auricular tubercles.
4. Dermoid cysts: Sequestration dermoid cysts occur at the lines of embryonic fusion. The most frequent is the external angular dermoid.
5. Pierre Robin syndrome: Cleft palate + micrognathia (receding mandible) + posterior displacement of the tongue obstructing the oropharyngeal airway.
6. Mandibular prognathism (protrusion).

### Embryological considerations

- The development of the oral region occur (4<sup>th</sup>-8<sup>th</sup>) Intra-uterine.
- The oral membrane is surrounded by 5 process
  - ✓ Fronto-nasal part
  - ✓ Maxillary part
  - ✓ Mandibular part

### Development of lips & palate

1. Upper lip → by fusion of Fronto-nasal + Maxillary
2. Lower lip → fusion of 2 Mandibular process.
3. Ant part of (alveolar margin + palate) → Fronto-nasal process.
4. Post part of (alveolar margin + palate) → Maxillary process

## Cleft Lip (Hare Lip) & Cleft Palate

### Incidence

- ▣ Cleft lip and cleft palate are the second most common congenital deformity (hand deformities are the first).
- ▣ Females : males. = 2 : 1 (1:700 live births).
- ▣ 25% of additional anomalies: neurologic, cardiac & club foot.
- ▣ The incidence is less in black & oriental races.

### Etiology

#### A. Familial risks:

- ▣ General population: 0.14%.
- ▣ One child affected: 5%.
- ▣ One parent & one child: 15%.
- ▣ Two children: 20%.



**B. Environmental factors:**

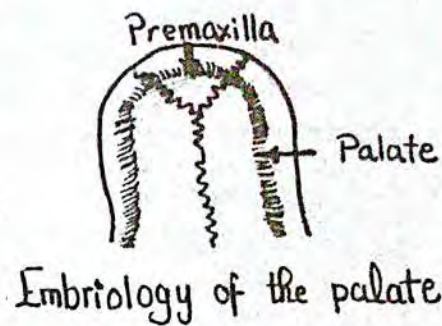
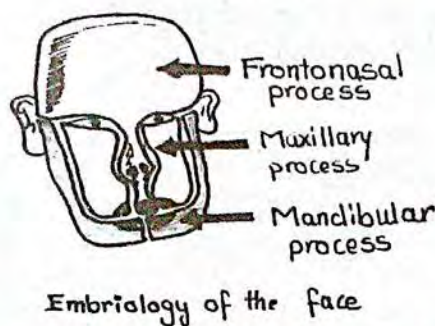
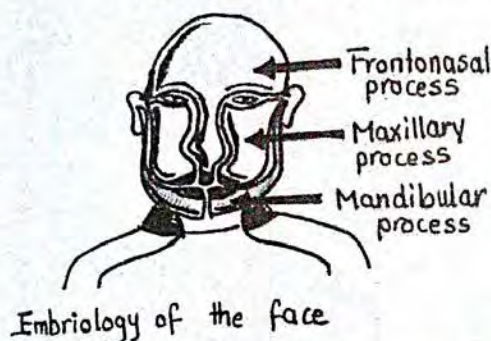
1. Drugs: steroids, diazepam, phenytoin & phenobarbital.
2. Irradiation.
3. Viral infections (e.g rubella) *measles*
4. Maternal smoking & alcohol intake.
5. Advanced maternal / paternal age. *hypovit & stress & poor health*

**C. Syndromes associated with facial clefts:****I) Treacher Collins syndrome: (AD)**

- Absent or deformed zygoma + deformed ears + micrognathia + dropping part of lower eyelid + conductive hearing loss + slanting eyes + cleft lip & palate (6%).

**II) Pierre Robin syndrome:**

- Isolated cleft palate + retrognathia + posteriorly displaced tongue (glossoptosis). *respiratory distress*

**III) Others:** e.g. Crouzon's and Apert's syndrome**I) Cleft Lip (Hare Lip)****Definition**

- Failure of fusion between the median part of frontonasal process and one or both lateral maxillary processes in developing face.

**Types****I) Lateral or median:**

- In the upper lip: Usually lateral. *Mark ✓*
- In the lower lip: It is median. *♀ > ♂*

**II) Unilateral or bilateral:**

- Unilateral in 85% of cases (More in the left side).
- Bilateral in 15% of cases

**III) Complete or incomplete:**

- Complete → The cleft extend upward to the nostril.
- Incomplete → The cleft does not extend to the nostril.

**IV) Complicated or uncomplicated:**

- Complicated → With cleft palate, the commonest.
- Uncomplicated → Without the cleft palate.



الوجه من الأنف مع عيب



**C/P & Complications**

1. Flaring & flatness of nares on the affected side if complete.
2. Disfigurement.
3. Abnormal teeth growth
4. Nasal tone.
5. Short lip-nose distance on the affected side.
6. In 35% of cases → Associated congenital anomalies e.g. cleft palate, coloboma, encephalocele etc.

if isolated Cosmetic only

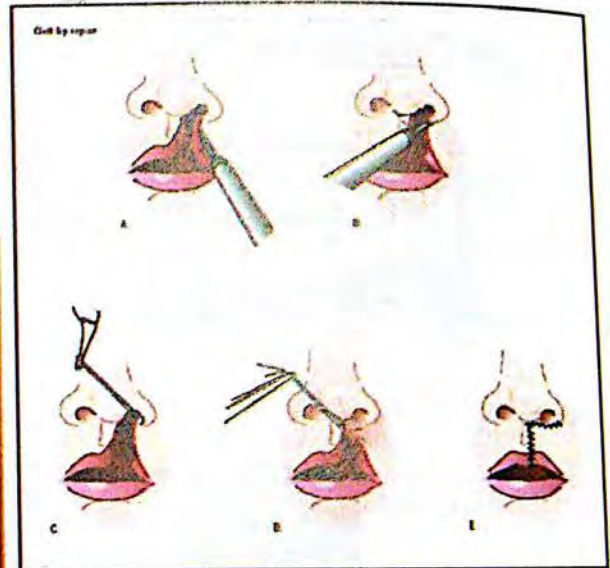
**Treatment** Surgery is the only treatment (Millard's operation)

- **Timing:** 3-6 months <sup>السنه</sup>
- **Pre-requisites:** The infant weight should be at least 10 pounds and Hb% at least 10 g%
- **Aim of surgery:** Improving appearance. There is no functional loss.
- **Principle:**
  - 1- Paring of edges. → Convert to raw area
  - 2- Repairing the defect with suturing the three layers of lip (Skin, muscle and mucous membrane). in Zig Zag way

- Sutures are made in zigzag way not in a straight line (Why?)  
To avoid notching of the lip margin as the scar contract.

**Remember**

- ▶ **Types:** lateral, unilateral, complete, complicated
- ▶ **C/P:** - Nose (flatness, disfigurement)  
- Bad (teeth, tone of voice)
- ▶ **TTT:** surgical (Millard's operation)



## II) Cleft Palate

**Types**

1. Cleft uvula. → in all types amust
2. Cleft soft palate.
3. Cleft soft and hard palate (complete)
4. Complete cleft + one side of premaxilla (Bipartite cleft).
5. Complete cleft + both sides of premaxilla (Tripartite cleft).

**Pathology**

- Caused by arrest of fusion between the two palatal processes & possibly with the premaxilla
- Cleft palate forms 1/3 of all facial clefts.

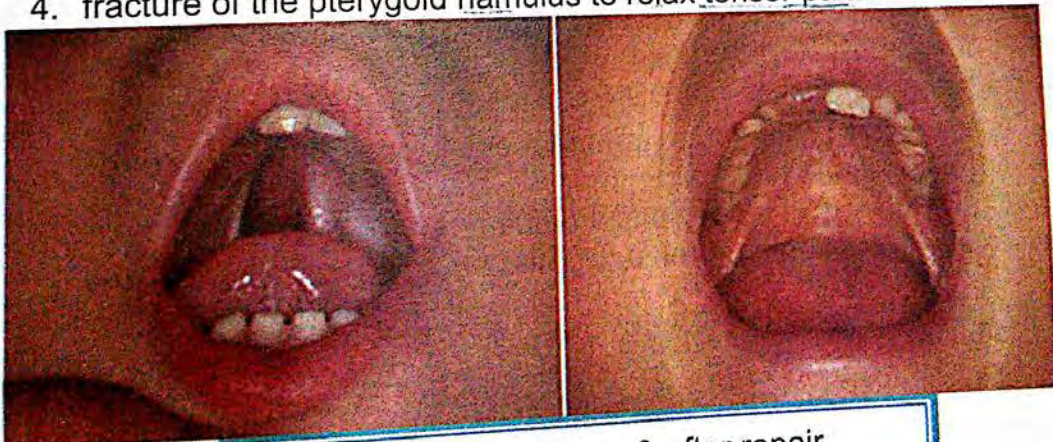


**C/P & Complications**

- (Due to communication between the oral & nasal cavities):
- 1) Impairment of suckling: due to inability to create -ve intra-oral pressure.
  - 2) Impaired speech: due to
    - ✓ Inadequate velopharyngeal mechanism: Opposition of velum (the muscles of the soft palate) against the pharyngeal wall to separate the oral from the nasal cavity is impaired. Nasal tone is due to naso-oral communication. *not correct if TTT delayed > 15 yrs*
    - ✓ Hearing loss.
  - 3) Inadequate emptying of the middle ear due to abnormal levator palati insertion, preventing adequate aeration of Eustachian tube thus predisposing to recurrent otitis media. This may lead to hearing loss.
  - 4) Impairment of dentation if the alveolar margin is reached.
  - 5) Distortion of facial growth.
  - 6) Recurrent chest infection (due to reflux into nose & aspiration pneumonia).
  - 7) Usually associated with other congenital anomalies.

**Treatment**

- **Time:** 12-18 months *\* Longenick operation*
- **Pre-operative management:**
  - 1- Attention to feeding. As there is inefficient breast feeding, a bottle with a large hole is used or spoon feeding in an upright position.
  - 2- Prevention and treatment of chest infection.
- **Objectives of surgery:**
  1. Closure of oro-nasal communication.
  2. Achieving a competent velopharyngeal sphincter.
- **Principles of surgery:**
  1. Paring of edges.
  2. Suturing is done in three layers in the middle line (nasal mucosa, muscle layer, then oral mucosa). *only periosteal*
  3. Lateral relaxation incisions are needed.
  4. fracture of the pterygoid hamulus to relax tensor palate



Cleft palate before &amp; after repair

- **Post-operative treatment:**
  1. Speech therapy.
  2. Orthodontic treatment.

**Remember**

- ▶ **Types:** cleft uvula ± soft p. ± hard p. ± maxilla
- ▶ **C/P:** - Disfigurement
  - Poor suckling, sinusitis
  - Bad (teeth, tone of voice, chest)
- ▶ **TTT:** surgical + speech therapy + orthodontic TTT



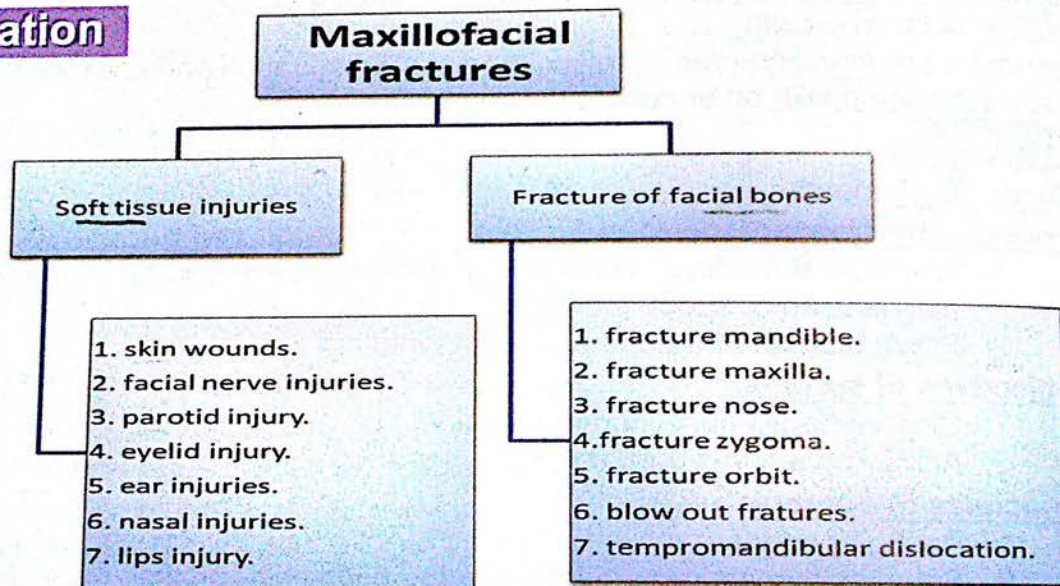
## ii. Trauma

## Maxillofacial injuries

## Introduction

- Maxillofacial fractures are frequent with:
  1. Road traffic accidents.
  2. Fights.
  3. Contact sports as soccer.
- Isolated facial fractures rarely cause shock.

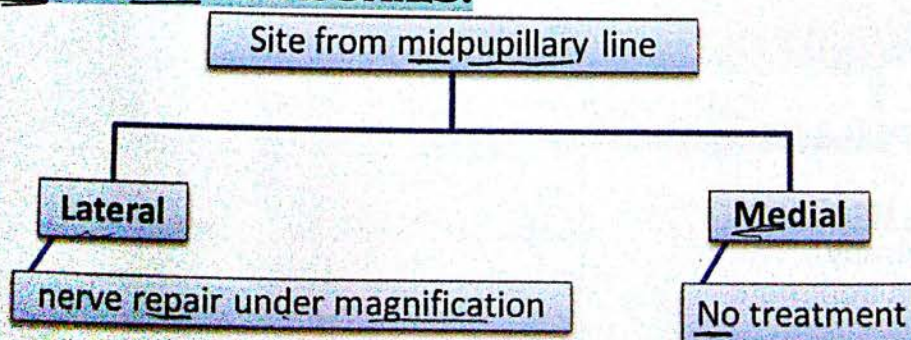
## Classification



## A. Treatment of Soft tissue injuries

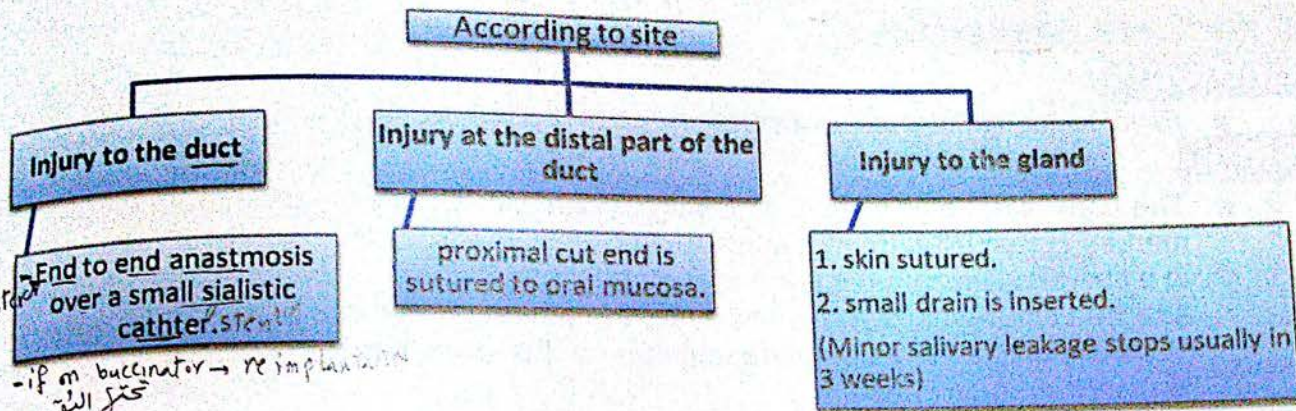
➔ **SKIN WOUNDS:**

- Should be treated in theatre under sterile conditions. if < 6 hr. (شيل الغرز بعد ٤-٥ أيام) في أكثر
- Minimal wound debridement.
- Cut wounds and lacerations are sutured.
- Avulsed flaps are sutured back after ensuring vascularity at the tip.

➔ **FACIAL NERVE INJURIES:**



## ➔ PAROTID INJURY:



## ➔ EYELID INJURIES:

- Repair of cut levator palpebrae superioris. (otherwise ptosis will occur)
- Tarsus should be repaired.
- Lacrimal apparatus injuries should be recognized and repaired. (otherwise epiphora and dacrocystitis will result)

## ➔ EAR INJURIES:

- Full thickness tears are sutured by cutaneous perichondrial sutures.
- Hematomas should be evacuated to avoid cauliflower ear. *removal of cartilage*

## ➔ NASAL INJURIES:

- Nostril tears should be sutured carefully in two layers.
- Septal hematoma should be evacuated to avoid septal hematoma to avoid saddle nose deformity. *packing for 3 day → then external fixation*

## ➔ LIPS INJURIES:

- Should be sutured in three layers with respect to anatomical landmarks.
- Intraoral injuries: edges are debrided and loosely approximated.



## B. Fracture of facial bones

### 1. Fracture Mandible:

#### Etiology

- Falls, kicks, fist blows, car accidents, or pathological.

#### Sites

- The body is the commonest & usually occurs close to the mental foramen due to marked curvature & deep canine socket. *angle*
- In bilateral cases, the digastric & geniohyoid muscles pull the chin fragment & the attached tongue backwards, impairing the airway. Fractures of the angle are minimally displaced as they are splinted by the masseter & the pterygoid muscles.

#### Types

- Usually compound into the mouth as the muoperiosteum is firmly attached to bone.

#### C/P

1. Pain: especially on attempts to open the mouth.
2. Tenderness over the mandible.
3. Impairment of speech, chewing and swallowing.
4. Malocclusion of the teeth and irregularity of the line of the teeth. *Step Ladder Sign*
5. Blood stained saliva. Fractures of the mandible are usually compound into the mouth because the mucoperiosteum is firmly attached to the bone.
6. Anaesthesia (or hypoesthesia) of the lower lip. (distribution of inferior alveolar nerve) *Tingling numbness*
7. Swelling of lower face and hematoma in the floor of the mouth (**Coleman's sign**).
8. Abnormal range of mobility.

### Investigations

- a) **Plain X-ray** is diagnostic.
- b) **Panorex**:
  - Shows the whole mandible. (Poor visualization of condylar fractures and alveolar process fractures). *C.I in polytraumatized pt.*
- c) **CT**: may be needed (good for condylar fractures)

### Treatment

- 1) First aid:
  - a. 4 tailed bandages for support.
  - b. Analgesics+ Antibiotics+ Mouth hygiene. *مرين الاسنان*
- 2) Reduction under anaesthesia + fixation by interdental wiring or arch bars (for 3-6 weeks) + liquid diet. This technique is appropriate for majority of lower jaw fractures. *through a tube*
- 3) **ORIF**: by plates and screws for more complicated fractures. *open reduction internal fixation*



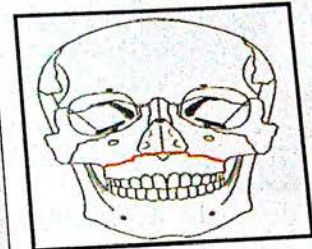
## 2. Fracture Maxilla: [Le Fort fractures]

### Etiology

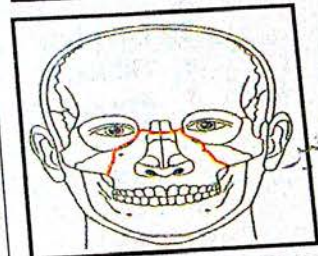
- Car accidents.

### Types

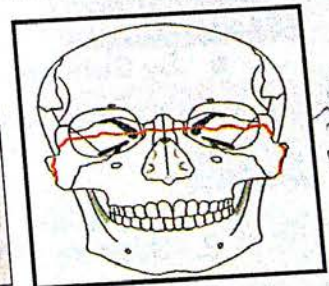
	SHAPE	ACROSS	TREATMENT
Le Fort I	Transverse	Above level of the teeth.	Intermaxillary fixation to <u>inferior orbital margins</u> by wires.
Le Fort II	Pyramidal	Base of the nose, posterior wall of maxillary antrum & across the orbit	Intermaxillary fixation to <u>zygomatic process of frontal bone</u> by wires.
Le Fort III	Craniofacial dysjunction	Separate facial bones from its cranial attachment.	TTT of Le Fort II + correction of nasal and zygomatic fractures.



نقطة



نقطة  
ومناخ



نقطة  
ومناخ  
وشحن

### C/P

- Pain.
- Swelling.
- Excess salivation.
- Malocclusion.
- Hypoesthesia. (Not in Le Fort I but in **Le Fort II**) → Infraorbital nerve.
- Epistaxis.
- Diplopia.
- Crepitus.

### Investigations

- CT facial bones: Axial cuts and Coronal cuts.

### Treatment

- ABCD → airway & cervical spine care
- Coronal incision for exposure.



### 3. Fracture Nose:

**C/P**

- Pain – Swelling – Epistaxis – Crepitus – CSF rhinorrhoea.

#### Treatment

- Reduction: digital or instrumental.
- Fixation:**
  - Intranasal packing for 3 days.
  - External splint for 7 days.
- Neglected old fractures: osteotomy.

### 4. Fracture Zygoma:

**C/P**

- Enophthalmos.
- Ocular dystopia.
- Numbness and anesthesia of the cheek & upper teeth. (Infraorbital nerve injury)
- Difficult mouth opening.
- Periorbital echymosis.
- Subconjunctival hemorrhage.
- Depressed cheek.
- Palpable stepping.
- Epistaxis.

#### Treatment

- By **Subciliary incisions** for exposure of the wound.

### 5. Fracture orbit:

**C/P**

- Periorbital echymosis.
- Subconjunctival hemorrhage.
- Dystopia.
- Numbness and Hypoesthesia.
- Diplopia.

### 6. Blow out fractures:

- Depressed fracture of orbital floor. Contents of the orbit herniate in the maxillary sinus.
- There is diplopia & limited up & down gaze &/or enophthalmos.
- Blow by a fist is the commonest cause.

### 7. Temporomandibular joint dislocation:

#### Type of patient

- Very common in middle aged females & commonly bilateral.

#### Etiology

- Direct blows.
- Yawning.
- Wide opening of the mouth under anaesthesia.

**C/P**

- Pain.
- Mouth held open with fixed jaws.
- In unilateral cases: chin is deviated to the opposite side.
- Dysarthria.



**Treatment**a) **Reduction:**

- Under anaesthesia: by downward traction on the molars with the padded thumb, together with upward rotation of the body with the outside fingers.

b) **In recurrent cases:** excision of the meniscus.**iii. Neoplasm****Lip cancer**

➔ Epithelioma is the **commonest lip malignancy**

**Etiology**

- 1) Prolonged exposure to the ultraviolet rays of the sun.
- 2) Continuous irritation and hyperplasia due to cigarette smoking or the use of hot tobacco pipes.

**Pathology****Histological picture**

➔ Squamous cell carcinoma which is usually well-differentiated.

**Gross picture**

- The lower lip is more affected than the upper.
- The lesion usually starts as a nodule or erosion which resists treatment.
- Later the typical ulcer becomes evident.
  - Raised everted edges
  - Indurated base and margin (may extend beyond the edge).
  - Possibly spread to cervical lymph nodes

**Lymphatic drainage**

- The central part to lower lip drains to submental nodes.
- The lateral parts drain to submandibular nodes. *by up lip → sub. mandibular*
- Later upper deep cervical lymph nodes are involved.

➔ Direct spread to other Lip  
by implantation  
"Kissing Cancer"

**Treatment****A. Primary tumor**▶ **Surgery**

- Excision should include the lesion with a safety margin.
- For lesions involving up to one third of the lip surgical treatment can be accomplished by "V" shaped excision and primary suture in 3 layers; mucosa, muscle and skin.
- For bigger lesions plastic reconstruction will be needed.

▶ **Radiotherapy**

- Is a good alternative because squamous cell carcinoma is radio-sensitive.

*not done if → recurrent after Radioth or invade mandible*

**B. Lymph nodes**

- If there are lymph node metastases, a suprahyoid or a complete block dissection is performed.

**Prognosis**

- Epithelioma of the lip has a better prognosis than that of the cheek, tongue or the floor of the mouth.



Lip Cancer, stomatitis, Cysts, Tongue {anom. cancer inflam. ulcer} Jaw Swell

## SPECIAL SURGERY

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### Ulcers of the Lip

Lip cancer	T.B. ulcer	Aphthous ulcer
Cold sores	Hereditary hemorrhagic telangiectasia	Impetigo
Lip burn	Canker sores	Candidiasis
Dermatitis	Contact dermatitis	Zinc deficiency
Chancre	Leukoplakia	Erythema multiform
Lichen planus	Behcet's ulcer	

## Mouth, Cheek & Tongue

### i. Congenital anomalies

#### 1- Tongue tie (Frenotomy)

oprative جراحه

#### Definition

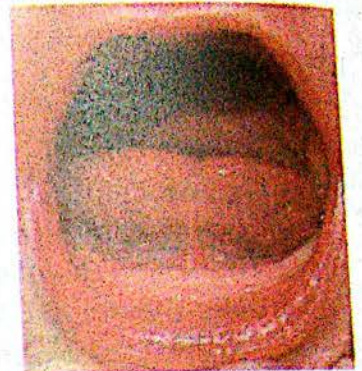
- Adherence of the tongue to the floor of the mouth anteriorly by complete frenulum, affecting the function of the tongue.

#### Timing of surgery

- Should be before speech development

#### Technique

- Cut the lingual frenulum. by Castry → جراحة بسيطة
- Most babies don't need stitches.



### 2- Macroglossia

#### Definition

- Persistent painless enlargement of the tongue.

#### Etiology

##### A. Congenital:

- Cavernous hemangioma.
- Congenital A-V malformation.

- Lymphangioma.
- Neurofibromatosis

##### B. Acquired:

- Cretinism.
- Amyloidosis.

- Acromegaly.



**ii. Trauma****Tongue injuries****Etiology**

- Biting is the commonest cause.

**Clinical picture**► **Type of patient:**

1. Epileptic patients can bite their own tongue during attacks.
2. Polytraumatized patient associated with jaw fractures.

► **Symptoms:**

- Bleeding → lingual artery (if the patient is unconscious → aspiration of blood).

**Treatment**

1. Pull the tongue (compress the lingual artery against the mandible).
2. Suturing lacerations.
3. Hematoma compressing airway → tracheostomy.

**iii. Inflammation****1- Chronic Superficial glossitis**

- It is a **precancerous** condition.

**Etiology**

- This is due to chronic irritation (**S**moking, **S**harp tooth, **S**epsis, **S**yphilis, **S**pirits and **S**pices). It occurs in middle and old age.

**Site**

- Anterior 2/3 of the tongue.

**Pathology**

- Hypertrophy of the papillae produces red hyperaemic patches.
- Overgrowth of the epithelium makes it thickened, indurated and opaque so that the red patches are replaced by white ones (**leukoplakia**).
- In the next stage, the epithelium may be shed over a considerable area producing a red glazed tongue.
- Submucous fibrosis occurs causing ulcers, fissures and warty projections.

**Treatment**

- 1- **E**limination of the **i**rritating source.
- 2- **M**outhwash.
- 3- In resistant cases, **e**xcision of the **l**esion.

**Protection from commensals**

1. Regular desquamation and rapid replacement of surface cells.
2. Saliva that washes the oral cavity continuously.
3. The mild antibiotic activity of saliva.



## 2- Tongue Ulcers

- Site, Size, Shape, Pain, Edge, Floor, Base, LN, Treatment

## A-Traumatic ulcers

## 1-Dental ulcer

- Site: on the side of the tongue opposite a decayed or broken teeth or an ill fitting denture
  - Size: small
  - Number: single
  - Shape: oval or rounded
  - Pain: painful
  - Edge: sloping
  - Floor: containing granulation tissue
  - Base: soft
  - LN: septic enlargement of draining LN
  - Treatment: Remove affecting tooth, take biopsy of the ulcer edge & antiseptic mouth hygiene
- surrounded by leukoplakia

## 2- Frenal (post- pertussis)

- Occurs in children with whooping cough as they protrude their tongue during cough.
- They are transverse linear ulcer on the undersurface of the tongue in the midline.

## B- Inflammatory

## Stomatitis

- ▶ This is a group of inflammatory, erosive, and ulcerative conditions that affect the mucous membrane of the oral cavity

## Predisposing factors

1. Anaemia and Vit.B12 deficiency that lead to thin, atrophic epithelia and loss of tongue papillae.
2. Immunodeficiency and autoimmune diseases.

## Monilial stomatitis

- This is a fungus infection by candida species characterized by formation of white membranous lesions.
- It occurs in debilitated, chronically ill patients under cytotoxic drugs, cortisone therapy or prolonged treatment by broad-spectrum antibiotics.
- It affects mainly the tongue.
- Treatment is by gentian violet and amphotericin-B lozenges.



## a) Acute

## 1- Aphthous ulcer (Dyspeptic ulcer)

- **Etiology:** unknown *stress*
- **Site:** The whole oral cavity especially near the tip of tongue
- **Size:** up to 0.5 cm *finger, palm, cheek*
- **Shape:** rounded or oval
- **Number:** multiple
- **Pain:** painful
- **Margin:** red
- **Base:** soft and yellow
- **LN:** Not enlargement
- **Treatment:** antiseptic mouth wash, NaHCO<sub>3</sub> lotion & anesthetic gel, heal normally within 10-14 days. *5-10 mm, not pre-canorous*

## 2- Lichen planus

- Autoimmune disease associated with tongue ulcers and hyperkeratotic lesions.

## 3- Herpetic ulcers

- Unilateral eruption of small vesicles on the tongue and cheek, gingival and lips. Skin of the cheek and around nostrils can be also affected.
- They don't cross the midline.
- After they rupture they leave small yellow superficial areas of ulceration with bright red margins.
- The patient is unwell, febrile with enlarged submandibular lymph nodes.

## b) Chronic

## 1- Tuberculous Ulcer

- **Site:** Sides & tip of tongue due to autoinoculation from pulmonary T.B.
- **Size:** Small
- **Number:** multiple
- **Shape:** Oval, shallow
- **Pain:** Painful
- **Edge:** Undermined *Cyanotic margin*
- **Floor:** Contain pale yellow granulation tissue & tubercles
- **Base:** Soft *cheesy substance*
- **LN:** Enlargement of submandibular lymph node
- **Treatment:** antituberculous therapy & anesthetic paint.



## 2- Syphilitic Ulcer

- Occurs in the 3 stages of syphilis

A- Chancre <sup>LN</sup>

- Painless reddish indurated elevation which occurs on the dorsum near the tip, associated with gross painless enlargement of the submental and submandibular lymph nodes. The lesions full of spirochetes and heals in 6 weeks.

## B- Secondary syphilis (snail track)

- The following lesions may be present:
  - Snail-track ulcer: multiple linear ulcers on the sides and undersurface of the tongue.
  - Mucous patches.
  - Hutchinson's wart: It is a condyloma at the midline of the dorsum of the tongue.
  - These lesions full of spirochetes and associated with cutaneous syphilis.

## C- Tertiary Syphilis Gummatous ulcer

- The Gumma starts deep in the tongue nearly always in the midline. Finally it ulcerates on the dorsum leaving a punched out ulcer. Its floor is covered with a yellowish wash-leather slough.

## C- Leucoplakic ulcer

- Superficial ulcers resulting from desquamation of the keratinized layer leaving red glazed tongue. *Ch. irritation of tongue - pre cancerous*

## D- Malignant ulcer

➔ See tongue cancer

## iV: Neoplasm

## 1- Intra-oral Tumors

## ➔ Benign

- Hemangioma.
- Lymphangioma.
- Papilloma.

## ➔ Premalignant

- Leukoplakia.
- Xeroderma pigmentosa.
- Behcet's disease.

## ➔ Malignant

- SCC of lips, **tongue**, palate, and gums.
- Malignant salivary gland tumors.
- Melanoma.
- Lymphoma.



## Carcinoma of the tongue

### Site

- Lateral → 50%.
- Posterior 1/3 → 20%.
- Dorsum → 10%.
- Undersurface → 10%.
- Tip → 10%.

### Incidence

- Male : female = 10 : 1. The recent lowering of incidence in males is due to more efficient ttt of syphilis, improved standards of oral hygiene. The recent increase in females is due to increase of smoking in females.
- More common in the 6<sup>th</sup> decade.

### Predisposing factors

- Sharp teeth, Spirits, Spices, Smoking, Syphilis (3ry), Papilloma, leucoplakia.

### Pathology

#### A. MACROSCOPIC:

- Malignant ulcer: deep irregular floor with necrotic tissue raised nodular everted edge & hard indurated base.
- Raised oval plaque. *Papillary*
- Hard submucosal nodule (less common).
- Deep indurated fissure.
- Diffuse infiltrating tumor (wooden base) is rare.
- The surrounding mucus membrane may show leukoplakia.



#### B. MICROSCOPIC:

- Squamous cell carcinoma → 90%. *cell nests ↑ → well diff*
- Basal cell carcinoma or adenocarcinoma (from minor salivary glands) → rare.
- Posterior 1/3 tumors are less differentiated. *anaplastic carcinoma or lymphoma*

### Spread

- Direct:**
  - Floor of the mouth & mandible → posterior 1/3 → tonsils, pharynx & larynx.
  - May cross midline to the other side of the tongue.
- Lymphatic:** *Main line*
  - Unlike SCC of the lip, SCC of the tongue spreads early to the LNs of the neck.
    - Tip → submental L.N → bilaterally to the submandibular and upper deep cervical LNs.
    - Margin → submandibular and upper deep cervical L.N of the same side.
    - Posterior 1/3 → directly to the upper deep cervical LNs.
- Blood:** rare, it is more likely for tumors of the posterior 1/3.



- ▶ T0 No evidence of tumor.
- ▶ Tis Carcinoma in situ.
- ▶ T1 <2 cm.
- ▶ T2 2-4 cm.
- ▶ T3 >4 cm.
- ▶ T4 involvement of the base.
- N0 No LNs.
- N1 Ipsilateral single LN <3 cm.
- N2 Ipsilateral or contralateral LNs <6 cm.
- N3 LNs > 6 cm.
- ▶ M0 No metastases.
- ▶ M1 distant metastases.

➤ The classic clinical picture of tongue cancer is that an old man sitting in the outpatient clinic with cotton wool in his ear, and blood stained saliva dribbling from the mouth

- Symptomless.
- The patient may complain of <sup>painless</sup> persistent ulcer with indurated base and everted edge.

- Pain → Tongue: - 1<sup>st</sup> → due to infection,  
- Later → due to lingual nerve affection.  
→ Ear → referred by auriculo-temporal nerve. Lingual N.  
→ On swallowing: tumors of posterior 1/3

- Salivation: It may be blood stained and smells badly.
- Difficult speaking.
- Enlarged cervical LNs. Mobile then fixed
- Ankyloglossia. Fixed tongue: infiltration of floor

- Inhalation pneumonia. → Death
- Haemorrhage from erosion of the lingual artery or in tumors of posterior 1/3 → erosion of ICA.
- Cachexia due to starvation.
- Asphyxia

- Biopsy from the ulcer edge. Any ulcer or fissure that resists treatment should be biopsied.
- FNAC of suspected cervical LNs.
- CT of neck and mandible.



**Treatment**

- Surgery and radiotherapy are the main lines of treatment.
- Chemotherapy is used as an adjuvant in some cases.

**A. Radical treatment of early cases****Surgery**► **Indications:**

1. Small growths T0, T1 and T2.
2. Incomplete regression or recurrence after radiotherapy.
3. Cancer on top of a precancerous lesion as leukoplakia.
4. Presence of the tumor very close to the mandible or infiltrating it.

► **Preoperative preparation**

- ▣ Care of teeth and oral hygiene.
- ▣ Preoperative irradiation by 4000 rad may be advised.

► **Resection procedures**

	<b>Resection procedure</b>	<b>Safety margin</b>	<b>Defect closure</b>
<b>CIS</b>	Excision	1 cm on sides & 0.5 cm in depth	Advancing mucosal flap from floor of the mouth
<b>Anterior 2/3</b>	Partial glossectomy, hemiglossectomy or near total glossectomy	1.5 cm	Pectoralis major myocutaneous flap
<b>Posterior 1/3</b>	<ul style="list-style-type: none"> <li>► Total glossectomy (difficult access) → needs median mandibulotomy.</li> <li>► Irradiation</li> </ul>		Pectoralis major myocutaneous flap
<b>Unilateral L.N. metastasis</b>	Complete neck dissection		
<b>Bilateral L.N. metastasis</b>	<ul style="list-style-type: none"> <li>► Complete neck dissection</li> <li>► Selective neck dissection on the less affected site preserving the IJV</li> </ul>		
<b>Mandible</b>	<ul style="list-style-type: none"> <li>► Commando operation (combined mandibulectomy &amp; neck dissection operation)</li> </ul>		Osteomyocutaneous flap

**Radiotherapy**► **Indications**

- ▣ T1 and T2 (less than 4cm) may equally benefit from surgery or radiotherapy.

► **Advantages**

- ▣ Avoiding the disfiguring side effects of surgery. & Preserve Tongue Function

► **Disadvantages**

- ▣ Mucositis, dysphagia and osteoradionecrosis.



\* Prognostic value in Melanoma  
↓  
Depth.

### ► **Methods**

- Brachytherapy → cesium or iridium needles.
- Teletherapy → external beam irradiation.

## **B. Palliation for advanced cases**

### ► **Indications**

- 1- Unresectable primary growth.
- 2- Fixed lymph nodes in the neck.
- 3- Distant metastases.

### ► **Methods**

- 1- Radiotherapy.
- 2- Palliative resection.
- 3- Analgesics, nasogastric feeding or tracheostomy may be required.
- 4- Chemotherapy.

## **Prognosis**

- 1- TNM staging [**Lymph node involvement is the most important prognostic index**].
- 2- The degree of tumor differentiation. Poorly differentiated tumors develop local recurrence even if surgery and radiotherapy are combined.
- 3- Extension of the tumor posteriorly to the oropharynx carries bad prognosis
- 4- Combined surgery and radiotherapy improve prognosis.
- 5- Prognosis is better in females than males.

### **Remember**

- **Site:** lat. Margin of ant. 2/3
- **Etiology:** **5S** (**S**harp teeth, **S**pirits, **S**pices, **S**moking, **S**yphilis)
- **Path.:** SCC (mass, nodule, fissure, ulcer)
  - **C/P:** old ♂ - **Early:** asymptomatic or as path. - **Late:** pain, salivation, difficult speaking
- **Comp.:** as cancer + pneumonia + asphyxia
- **Invest.:** biopsy, CT
- **TTT:** surgery + radiotherapy ± adjuvant chemotherapy, palliative TTT in late cases

## **2- Carcinoma of the cheek**

- As squamous cell carcinoma.

### **Treatment**

#### **1- Radiotherapy:**

- Interstitial or external beam irradiation is the treatment of choice.

#### **2-Surgery:**

- Surgery is indicated for recurrent or residual tumors followed by reconstruction (as for the tongue cancer). Neck nodes as long as they are mobile are treated by neck dissection.



### 3- Cysts of the floor of the mouth

#### Ranula

- It is a retention cyst arising from sublingual salivary gland.

#### Pathology

- The wall is composed of: thin fibrous capsule, which is lined by macrophages.
- Contains gelatinous material.
- If it extended down to the neck over the posterior margin of myelohyoid, it forms "plunging ranula".
- It may rupture & refill again.



Simple Ranula

#### D.D.

- Lingual dermoid cyst.
- Sublingual dermoid cyst.

#### C/P

- Cystic, bluish, and translucent swelling with prominent blood vessels over it and stretch submandibular duct. *not in midline*
- Overlying: covered by m.m. & crossed by Wharton's duct.
- May extend down in the neck → plunging ranula.

#### Treatment

- Marsupialization (deroofing) & suture cyst wall to oral mucous membrane (of choice). *to avoid whartin duct inj*
- Excision (difficult) in recurrent cases.

### Lingual and sublingual dermoid

- Opaque swellings
  - lined by stratified squamous epithelium.
  - filled with mucous (fluctuant), or with a doughy mass of keratin.
- They are found in the midline of the tongue, or in the floor of the mouth, either in the midline (the commonest type), or laterally in the submandibular region.
- Although congenital, sublingual dermoids usually appear after puberty.
- Treatment is excision through the floor of the mouth, but a submandibular incision can be used for large ones.



1) Bone tumors

I. Benign

- a. Osteoma
- b. Chondroma

II. Malignant

- a. Osteosarcoma
- b. Fibrosarcoma

c. Giant cell lesion of the jaw

c. Secondaries

d. Cancer maxilla

2) Odontomes

"Cyst or cystic tumors related to development of teeth"

1. Epithelial odontomes;

- A. Dental cyst
- B. Dentigerous cyst
- C. Adamantinoma "ameloblastoma"

2. CT & composite odontomes are not present in man.

3) Epulides

Swelling of mucoperiosteum or gum

- A. Fibrous epulis
- B. Granulomatous epulis
- C. Myeloid epulis

D. Sarcomatous epulis

E. Carcinomatous epulis

General scheme

1- Common clinical picture:

- Toothache.
- Loose teeth.
- Hard swelling on the bone.
- Ulceration of the mucous membrane.
- Loss of sensation in the lower lip.

2- Investigations:

a. Radiological:

- Plain X-ray: erosion & destruction of the underlying bone.
- Panorama.
- CT - MRI
- Angiography

b. Instrumental:

- Biopsy → (Incisional / Excisional.)
- Fine needle aspiration and cytology

3- Treatment: According to etiology



## 1-Bone Tumors

### A-Benign tumors

- 1- Chondroma: see orthopedics
- 2- Osteoma: see orthopedics
- 3- Osteoclastoma: see orthopedics

### B-Malignant tumors

**A- Osteosarcoma:** see orthopedics

### B- Cancer maxilla

➤ This is the commonest malignant tumor of maxilla.

#### Pathology

- It may be columnar cell carcinoma if it arises from the maxillary antrum or squamous cell carcinoma (less common) if it arises from the hard palate, gums or tooth sockets.
- The tumor spreads by infiltration of adjacent structures. Blood borne metastasis is rare. Lymphatic spread to upper deep cervical LNs & retropharyngeal LNs.

#### Clinical picture

→ it is more common in young adults & elderly people. (♂=♀)

**Early:** → dull aching pain → referred to teeth → dental extraction.

**Late:**

C/O:

- |                                   |   |                    |
|-----------------------------------|---|--------------------|
| 1- Nasal obstruction on one side. | } | Medial wall        |
| 2- Epistaxis.                     |   | Anterolateral wall |
| 3- Swelling of the cheek.         | } | Superior wall      |
| 4- Epiphora.                      |   |                    |
| 5- Proptosis and diplopia         |   |                    |

#### Investigations

1. **Plain X-ray:** Early: it shows opacity and increase in size of the antrum.  
Later: there is decalcification and erosion of the bone.
2. **CT scan and MRI.**
3. **Maxillary sinus endoscopy (sinuscopy) & biopsy.**

#### Treatment

- 1- **Early:** Complete excision of the maxilla.
- 2- **Late:** Localized excision of maxilla & irradiation as palliation

### C- Secondaries

- Usually reach the maxilla by direct spread from nearby structure e.g. lip tongue & floor of the mouth

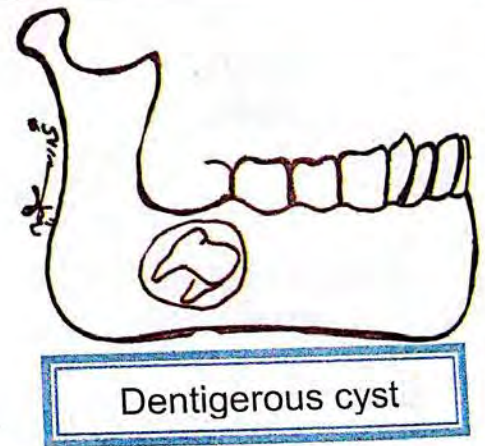
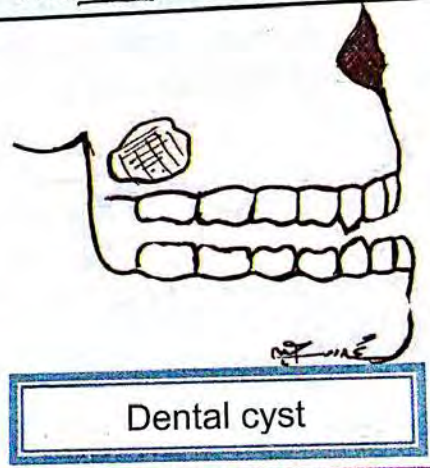
#### Treatment

Treatment of 1ry + resection of mandible "no role of radiotherapy"



# 2-Odontomes (dental swellings)

	A- Dental Cyst (RADICULAR CYST) سنة راص	B- Dentigerous Cyst جراها
Origin	Paradental epithelial debris of Malassez (only epithelial odontomes occur in man)	(only epithelial odontomes)
Etiology	- Decayed tooth - Chronic inflammation	- Unerupted tooth after 2 <sup>nd</sup> dentition (canine, premolar or 3 <sup>rd</sup> molar).
Pathology	- Adults - Upper jaw. - Cystic enlargement with egg shell crackling sensation. - Granulation tissue with exudation rich in cholesterol crystals.	- Children - Lower jaw - Cystic enlargement with bone expansion & thinning. - Granulation tissue with exudation rich in cholesterol crystals.
Investigations	- X-ray - Doesn't contain a tooth	- Contain a tooth
Treatment	Tooth extraction & curettege of cyst	



## C- Ameloblastoma (Adamantinoma) → old name

solid

♀ with painless swelling, egg - shell crackling sensation, soap bubble appearance, ttt by excision

### Pathology

- 1- Origin: ameloblasts "enamel-forming cells". The cause is disputed; but it may be a basal cell carcinoma arising from the dental epithelium or from the paradental epithelial debris of Malassez. (Mixed tumor) → turn to Sarcoma or Lymphoma
- 2- Site: at angle of Mandible & grows by both vertical & horizontal growth.
- 3- Macroscopic picture: **Solid** mass with **cystic** area & equal **lobulations**, white in color & well-capsulated with **pallisading** arrangement.  
\* The cystic areas are lined by columnar cells & contain brownish mucoid fluid. The solid areas consist of fibrous tissue with particles of enamel. Osteoclasts are not present.
- 4- It is **locally malignant tumor**.



**Clinical Picture:**

- Age & sex → female 20 – 40 years.
- Symptoms → painless progressive swelling of the angle of the mandible. It expands the jaw more on the outer than the inner side, so it is more obvious from the cheek than from the mouth.
- Signs → egg - shell crackling sensation. It is well defined & not tender. No LNs can be felt unless ulceration & 2ry infection occur.

**Complications:**

- 1- Ulceration, infection, bleeding and falling of teeth.
- 2- Pathological fracture is rare.
- 3- It is liable to recurrence after inappropriate surgery.
- 4- Sometimes, it turns malignant → mixed tumor { Sarcoma  
Carcinoma

**Investigations:**

- X-Ray → Soap – bubble or honey comb appearance.
- CT scan and MRI.
- biopsy

**D.D.**

Adamantinoma	Osteoclastoma (Giant cell tumour)
At <b>a</b> ngle of Mandible	At symphysis menti
Both Horizontal & Vertical growth	Only Horizontal growth
Equal lobulations	Unequal Lobulations
These lesions have the same clinical picture and are differentiated only by biopsy.	

**Treatment:**

- Excision + bone grafting.

## 3-Tumors of the Gum (Epulides)

عقيد ← *Epulis* is a **mass** of the gum.

**A- Fibrous epulis**

- Localized inflammatory hyperplasia of the gum mucosa due to chronic irritation.
- It is the commonest type.
- It is more common in the mandible between the incisors.

**Clinical Picture**

- Slowly growing, painless, firm pedunculated swelling arising between 2 teeth.
- It is covered by intact mucous membrane.

**Treatment**

- Teeth extraction & excision of tumour with wide base of mucoperiosteum



**B- Granulomatous epulis****Clinical Picture**

- Granulation tissue around a carious tooth or gingivitis.
- Red soft lobulated mass which bleeds easily on touch without epithelial cover.

**Treatment**

- Excision of tissue & removal of causative tooth (histological examination is essential).

**C- Myeloid epulis** *Benign**B.M*

- It may arise from the inner osteoclastic layer of the periosteum, or it may arise from the alveolus itself. This explains the presence of osteoclasts in the tumor.
- The epulis forms a soft, lobulated, encapsulated swelling, with cystic areas in cut section.
- Microscopically, there are spindle cells & giant cells together with fibroblasts & fibrous tissue.

**Clinical Picture**

- Affects the lower jaw more than the upper.
- The swelling is sessile, lobulated, bluish or brownish & is covered with intact mucosa.
- It is fixed to the underlying bone.
- As it enlarges, the adjacent teeth are loosened & fall off.
- The mucous membrane is intact.
- It may cause serious hemorrhage. *v. vascular*
- X-ray of the jaw → eating up of the bones.

**Treatment**

- Wide excision with safety margin.

**D- Carcinomatous epulis** *malign*

- This is an epithelioma arising from the mucous membrane covering the gum.

**Clinical Picture**

- General → cachexia, weight loss
- Local → fungating mass or malignant ulcer

**Treatment**

- Commando's operation (radiotherapy has no role).

**E- Sarcomatous epulis** *malign*

- This is a periosteal fibrosarcoma arising from the outer layer of periosteum. It may occur on top of a fibrous epulis.
- Bad prognosis
- Blood spread.

**Clinical Picture**

- Occurs in young age.
- Rapidly growing painful soft mass invading the surrounding structures.
- X-ray shows infiltration of the bone.

**Treatment**

- Commando's operation. *no radioth*



## *ii. Related infections*

### 1. Alveolar abscess

#### Pathology

- The abscess may result from the spread of infection from necrotic pulp into the periapical tissue.
- Pus may burst under the periosteum to form a subperiosteal abscess, which points externally or in the maxillary antrum.
- Infection may spread to the cavernous sinus.

#### Clinical features

- Marked toxemia.
- Severe pain and cheek swelling with gum inflammation.
- Regional lymph nodes are enlarged and tender.

#### Treatment

1. Antibiotics.
2. Extraction of the offending tooth to provide drainage.
3. Incision and drainage of the subperiosteal abscess.

### 2. Osteomyelitis

#### A- Acute osteomyelitis

- **Affects** the lower jaw as a complication of an alveolar abscess.
- **The commonest organism** is *Staphylococcus aureus*.
- The disease usually turns into the chronic type.

#### Clinical features

- History of alveolar abscess followed by pain, fever and swelling.
- Trismus may be present.

#### Treatment

- Antibiotics and mouth wash.

#### B- Chronic osteomyelitis

#### Etiology

1. Following acute osteomyelitis.
2. As a complication of a compound fracture of the mandible.
3. Blood borne (rare).
4. Chemical necrosis due to substances used in industry, e.g., phosphorus, arsenic and mercury.
5. Radium necrosis, if irradiation is used for tumors nearby or infiltrating the jaw.
6. Rare causes include tuberculosis, syphilis, and actinomycosis.



**Pathology**

- Affects the lower jaw because it has a single arterial blood supply, which passes near and parallel to the edge, in contrast to the upper jaw where the vessels pass at right angles to the jaw.
- Infection starts in the medulla and spreads to the subperiosteal space. In general, it is similar to osteomyelitis in other bones. However differences include:
  - Involucrum is poor.
  - Sequestra take a long time to separate.
  - If the inferior dental artery is thrombosed a massive sequestrum results.

**Clinical features**

- There is pain, fever and thickening of the jaw.
- This is followed by abscess and sinus formation.
- Trismus may be present if the molar region is involved.

**Investigations**

1. Plain X-ray will show the characteristics of chronic osteomyelitis which are bone necrosis (sequestrum) and new bone formation.
2. Culture and sensitivity of the discharged pus.

**Treatment**

1. Antibiotics and mouth hygiene.
2. Incision and drainage of an abscess, if present.
3. Saucerisation and sequestrectomy through an incision over the lower border of the mandible.



# Neck injuries

## Types

1. Penetrating: Much more common, caused by gun shots or stabs.
2. Blunt: RTA and may cause spine fracture.
  - The most commonly injured structures are the big vessels, spinal cord and aerodigestive tract in that order.

### ► Neck injuries are serious because:

1. The neck contains vital viscera and vessels.
2. Unstable cervical spine fracture and dislocations can cause paraplegia, quadriplegia, or immediate death.
3. Neck injuries are commonly associated with head, face, and chest injuries.

### → Vascular injuries presented by:

- Hemorrhage (may be severe enough to cause shock)
- Expanding hematoma.
- Injury to large vein may lead to pulmonary embolism.

### → Neurological injuries presented by:

- Fracture of the cervical spine may lead to quadriplegia or paraplegia.
- Injury of the brachial plexus or cervical nerves.

### → Injury to the larynx or trachea may present by:

- Respiratory obstruction.
- Aphonia.
- Hoarseness of voice.
- Subcutaneous emphysema.
- Air bubbling through the wound or hemoptysis.

### → Esophageal injuries:

- It will be followed by leakage and severe infection in the neck which may spread to the mediastinum.

## Investigations

1. Plain X-ray: FB, wide mediastinum, SC emphysema or fractures.
2. Duplex ultrasound: injury to the big vessels.
3. CT of skull and brain.
4. CT angiography.
5. Laryngoscopy and bronchoscopy for laryngotracheal injuries.
6. Gastrographin swallow: for esophageal injuries.

## Treatment

### 1. ABCDE

- Airway: Especially ETT can be difficult and dangerous so it should be done by the most experienced personnel.
- Breathing: Cricothyroidectomy may be easier and safer than tracheostomy.
- Trendelenberg position helps to avoid air embolism in major venous injuries.
- Circulation: IV should be avoided in the side of trauma.



2. **Tension pneumothorax:** insert a needle in the 2nd ICS.
- Minor external bleeding: local compression. Major bleeding needs exploration to stop the bleeding and perform vascular repair.
  - In case of neurological damage, neck support and evaluation of the patient initially according to the GCS, then by CT and/or MRI to define the exact neurological lesion.
  - Esophageal injuries if discovered early is treated by immediate exploration and repair.
  - Laryngotracheal injuries need surgical repair.

## DD of neck swellings

The diagnosis of a mass in the neck depends on:

- ▶ Age of the patient
- ▶ Clinical course
- ▶ Solid or cystic
- ▶ Site

### ➤ The most common neck swellings are:

- **Enlarged LNs:** These are recognized by being at their known anatomical sites and by their multiplicity.
- **Thyroid swellings:** These are recognised by being in the anatomical site of the thyroid gland (muscular triangle) and by their movement with deglutition.

## A. MIDLINE SWELLINGS

### A. Solid swellings

1. Submental LN++
2. Nodule in the isthmus of thyroid gland

### B. Cystic swellings

1. Dermoid cyst
2. Thyroglossal cyst
3. Subhyoid bursitis. This is a rare tender, oval swelling, which lies transversely below the hyoid bone. It moves up and down with deglutition and with protrusion of the tongue.
4. Laryngocoele. It occurs in musicians playing with air blown instruments. It is actually a herniation of laryngeal mucosa through the thyrohyoid membrane. It is resonant, compressible and increase in size with coughing or blowing.
5. Cysts in the thyroid gland
6. Cold abscess, which is rare in the midline.

## B. SWELLINGS IN THE SUBMANDIBULAR TRIANGLE

1. Enlarged submandibular LNs
2. Enlarged submandibular salivary gland
3. They could be differentiated from each other as the LNs are multiple, rolled over the edge of the mandible and unlike submandibular salivary gland, can't be felt in the floor of the mouth.



## C. SWELLINGS IN THE CAROTID TRIANGLE

### A. Solid swellings:

1. Enlarged upper deep cervical LNs.
2. The upper part of an enlarged lateral lobe of the thyroid gland.
3. Carotid body tumor.

### B. Cystic swellings

1. Cold abscess
2. Branchial cyst

## D. SWELLINGS IN POSTERIOR TRIANGLE

### A- Solid swellings:

1. Enlarged LNs
2. Neurofibroma arising from the brachial plexus
3. Cervical rib

### B- Cystic swellings:

1. Cystic hygroma
2. Pharyngeal pouch
3. Cold abscess
4. Pneumatocele. This is a cystic swelling in the supraclavicular region, which is resonant and non compressible. It is due to herniation of the pleura into the base of the neck.

## E. OTHER SWELLINGS THAT MAY ARISE ANYWHERE

- In addition, swellings of the skin and subcutaneous tissue are common in the neck region and should be put in mind.
  - They are added to any of the previous lists.
- |            |                |              |
|------------|----------------|--------------|
| 1. Lipomas | 2. Hemangiomas | 3. SC cysts. |
|------------|----------------|--------------|

## Radical block neck dissection (BND)

### Definition

- Removal of all LNs on one side of the neck in one mass (en block).

### Aim

- Eradication of malignancy, aiming at cure.
- This is achieved by removing the 1ry lesion and its LN metastasis by block dissection.

### Indications

1. Operable 1ry malignancy of the head or neck, with palpable malignant cervical LNs.  
**This is the main indication.**
2. Prophylactic radical block neck dissection, i.e., where cervical nodes are impalpable, is done in malignancies that are known for their high tendency to lymphatic spread. These include melanoma and carcinoma of the tongue. In other types of malignancies if LNs are not palpable the 1ry is removed then the patient should be followed up every 2 months. If the LNs become enlarged block neck dissection is done.

### Technical considerations

The operation can be done through different incisions. The **globet incision** is a popular one.



## Structures that are removed

1. All LNs on one side of the neck.
2. Other structures are also removed because of their close proximity to the cervical nodes.
  - The sternomastoid muscle.
  - The carotid sheath.
  - The IJV.
  - The submandibular salivary gland.
  - The lower part of the parotid gland.

All these structures are removed as one mass.

## Structures to be preserved

1. Carotid artery.
2. Vagus nerve.
3. Accessory nerve.

## Variations of radical BND

- Suprahyoid block dissection
- Bilateral dissection is restricted to the LNs above the level of the hyoid bone. The submandibular salivary glands are also removed because of their close proximity to these nodes.

### ► Indications:

1. Carcinoma of the lower lip.
2. Sometimes in cases of early carcinoma of the tip of the tongue and floor of the mouth.

## Modified radical BND

- It is similar to radical BND but with preservation of the IJV and sternomastoid muscle.

### ► Indications

1. Thyroid carcinoma
2. Bilateral BND. Preservation of one jugular vein on the less affected side is necessary to provide adequate venous drainage from the brain.

## The two most frequent seen neck swellings are

### 1. LN++:

- Acute lymphadenitis is easily diagnosed.
- The commonest cause of chronic lymphadenitis is the non specific type.
- Keep in mind the possibility of more serious causes like TB, HL and secondaries.
- Secondaries may arise from hidden malignancies;
  - Nasopharynx
  - Pyriform fossa
  - Nasal sinuses
  - Thyroid papillary carcinoma

### 2. Thyroid enlargement (Goitre).



# CHAPTER 4

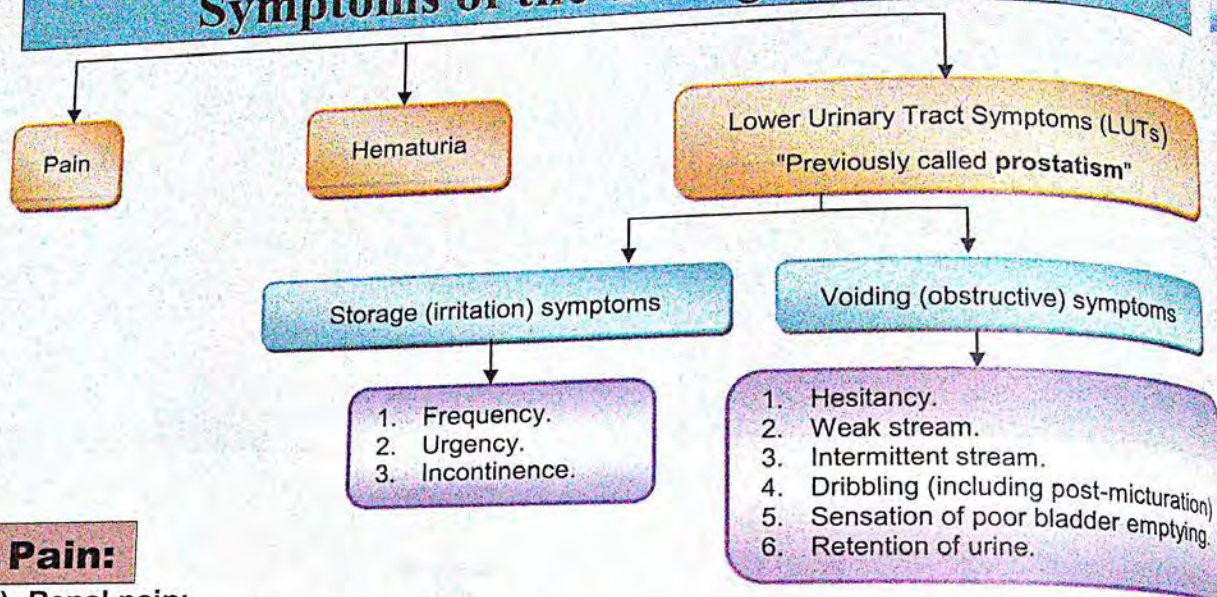
## UROLOGY

### Urology

- Symptoms of the urological system
- Investigations of urinary system
- Congenital anomalies
- Urinary tract injuries
- Urinary tract inflammation
- Urinary stones
- Obstructive uropathy
- Etiology of obstructive uropathy
- Tumors of urinary tract 364
- Urinary diversion
- Enlargement of the prostate 377
- Hematuria
- Testis



## Symptoms of the urological system



### 1. Pain:

#### a) Renal pain:

- Character: dull aching pain (deep-seated).
- Site: in the renal angle.
- It is due to stretch of the renal capsule, which may be caused by:
  - i. Inflammation.
  - ii. Calculi.
  - iii. Acute obstruction to flow from renal pelvis.

#### b) Ureteric colic:

- Character: **Severe agonizing pain.**
- Site: extends from loin to groin (**and to tip of penis if at the intramural ureter**).
- Radiation: to the ipsilateral iliac fossa and genitalia.
- Onset: Sudden.
- Duration: Rarely > 8 hours.
- Associated with nausea, vomiting and if intramural; **strangury (painful passage of few drops of urine).**
- It is due to passage of a stone or a blood clot.

#### c) Vesical pain:

- Character: variable (becomes worse by bladder filling).
- Site: suprapubic region, referred to the tip of penis.
- It is due to inflammation, stone or bladder carcinoma.

#### d) Prostatic & seminal vesicle's pain:

- Deeply-seated pelvic pain and referred to perineum, rectum or suprapubic area.

#### e) Urethral pain:

- Character: burning especially during voiding.
- Site: vulva or penis.

### 2. Frequency:

**Definition:** urine is passed more often than normal without increase in the total volume.

#### Types:

- **Nocturnal:** especially with BPH.



## ▪ Diurnal:

- Irritation of bladder wall ( $\rightarrow$  edema  $\rightarrow$   $\downarrow$  physico-elastic properties of the bladder  $\rightarrow$   $\downarrow$  capacity) e.g. stone or inflammation.
- Reduction in bladder capacity e.g. by a tumor.
- Detrusor instability.

## 3. Urgency:

**Definition:** It is a sudden strong desire to pass urine.

- Urgency alone may be due to anatomical changes as in gynecological prolapse or neurological disease.

## 4. Strangury:

**Definition:** Persistent desire of urination and severe straining at micturation with the passage of a few drops of urine that may be blood stained.

## 5. Dysuria:

**Definition:** Painful urination.

- Related to acute inflammation of the bladder, urethra, or prostate.
- Pain is described, as "burning" on urination.
- Dysuria is often associated with urinary frequency and urgency.

## 6. Oliguria:

**Definition:** Urine volume less than 400ml / 24h in adults.

**Causes:** Acute renal failure (due to shock or dehydration), or bilateral ureteric obstruction.

## 7. Anuria:

**Definition:** urine volume less than 200ml / 24h, (Anuria is one of the urological emergencies).

**Causes:**

- **Pre-renal causes:** shock and dehydration.
- **Renal causes:** toxins, drugs and renal diseases.
- **Post-renal causes:** bilateral renal obstruction or complete obstruction in a solitary kidney (If due to stones, it is called calculi anuria).

## 8. Urinary incontinence:

**Definition:** uncontrolled escape of urine.

**Types:**

### 1. True incontinence:

- Urine loss without warning secondary to defective urethral sphincters.
- E.g., ectopia vesicae, epispadias, ectopic urethral orifice and sphincteric injury after prostatectomy.

### 2. Stress incontinence:

- Urine loss with physical strain e.g. coughing, laughing and straining.
- Common in multi-parous females with weak muscle support of the bladder neck and urethra.

### 3. Urge incontinence:

- Involuntary loss of urine with strong desire of micturation.
- Occurs with acute cystitis and in cases of upper motor neuron lesions.

### 4. Overflow (false) incontinence:

- Loss of urine due to chronic urinary retention secondary to a flaccid bladder.
- The intravesical pressure finally equals the urethral resistance  $\rightarrow$  urine constantly dribbles.



**5. Enuresis:**

- Is bedwetting at night.
- Physiologic during first 2-3 years of life.
- May be functional secondary to delayed neuromuscular maturation of urethra-vesical component.
- But, may be a symptom of organic disease (e.g. neurogenic bladder).

**6. Fistula:**

- Abnormal communication between urinary and gynecological organs.
- E.g., vesico-vaginal and uretro-vaginal fistula that develops from obstetric trauma.

**9. Retention of urine:**

**Definition:** failure of bladder evacuation with working kidneys (**see later**).

**10. Hematuria:**

**Definition:** blood in urine.

**11. Other symptoms:****Chyluria:**

- The urine looks milky due to presence of lymph.
- The color clears on addition of ether.

**Necroturia:**

- Pieces of whitish substances appear in urine.
- They represent necrotic tissue of bladder carcinoma.

**Pneumaturia:**

- Presence of air bubbles in the urine.
- Usually due to vesico-colic fistula or infection with gas forming organism.

**Polyuria:**

**Definition:** ↑ urine output > 3L / day.

**Causes:****a- Renal causes:**

- 1- Nephrogenic diabetes insipidus (amyloidosis, hypokalemia, hypercalcemia)
- 2- Polyuric phase of ATN.
- 3- Diuretics.
- 4- CRF.

**b- Endocrinal causes:**

- 1- DM.
- 2- Cranial diabetes insipidus.
- 3- Cushing disease (hypokalemia, glycosuria).
- 4- Conn's disease (hypokalemia).
- 5- Hyperparathyroidism (hypercalcemia).

**c- Others:**

- 1- Psychogenic (compulsive water intake).
- 2- Drugs causing dry mouth as atropine → due to increase water intake.

**Hesitancy:**

**Definition:** difficulty to initial voiding



# Investigations of urinary system

## 1. Laboratory

1. **Urine analysis:** (normal values)
  - a) Volume: 500-1500 cc/day.
  - b) Specific gravity: 1015-1025.
  - c) Color: amber yellow, due to urochrome pigment.
  - d) PH: 5.5-6.5 (acidic).
  - e) Chemical contents:
    - Nitrogenous compounds.
    - Glucose & ketones → absent.
    - Small molecular weight proteins.
  - f) Microscopic examination:
    - Cells: R.B.Cs (0-4/HPF), pus cells (0-4/HPF).
    - Bacteria, parasites, ova → absent.
    - Casts.

2. **KFTs:**
  - a) Blood urea: 20-40 mg%.
  - b) Serum creatinine: 0.5-1.5 mg%.
  - c) BUN: 12-15 mg%.

3. **Tumor markers:**
  - e.g. PSA, acid phosphatase (in carcinoma of the prostate).

## 2. Radiology

1. **Plain X-ray:** it shows:
  - Stones (90% are radio-opaque except urate), nephrocalcinosis, calcified UB.
  - Obliterated psoas shadow in perinephric abscess and renal injuries.
2. **Ultrasonography:**
  - Confirms the site & size of the kidney.
  - It can diagnose dilatation of the pelvi-calyceal system & thickness of renal cortex.
  - Stones are easily visualized.
  - Differentiate between cystic & solid lesion of the kidney.
3. **Renal scan:** static (DSMA) & dynamic (DTPA) for accurate renal function.
4. **Intravenous urography (IVU)= Intravenous pyelography (IVP):**
  - **Procedure:**
    - Urographin is given IV → kidney uptake → concentration → excretion.
  - **Value:**
    - Anatomical description of the urinary system.
    - Stones, tumors (filling defect).
    - Rapid sequence IVP to diagnose renal artery stenosis.
    - **Functional value:**
      - Differential kidney function.
      - Vesico-ureteric reflux in voiding film.



➤ **Non-visualization of kidney in IVP May be due to:**

- Congenital absence of kidney.
- Shattered kidney.
- Renal pedicle injury.

➤ **Side effects:**

- Anaphylactic shock.
- Acute renal failure (contrast nephropathy).

➤ **Contraindications:**

- Renal impairment (blood urea > 50 mg %).
- During or shortly after pain: as pain causes renal shutdown & we cannot access kidney function.

**IVU infusion method:** (to ↓ incidence of contrast nephropathy of the dye) → urografin (2 ml/kg) + saline → infusion over 15 minutes

5. **Ascending pyelography (retrograde uretero-pyelography):**

- If the renal function is impaired or if there is intraluminal lesion suspected.
- It is done through cystoscope & ureteric catheter.

6. **Cystography & urethrography:**

- Descending: film of IVU.
- Ascending: through a catheter.

7. **Trans Rectal U/S (TRUS):**

- For suspected prostatic carcinoma especially if PSA is high or abnormal prostatic outline on DRE.

8. **Renal arteriography:**

- Mainly indicated to diagnose renal artery stenosis & A-V malformations.
- To differentiate between benign and malignant cysts:
  - If malignant → abnormal vascularity.
  - If benign → avascular.

9. **CT scan and MRI:** for accurate evaluation of swellings.

## 3. Instrumental

1. **Endoscopy e.g. nephroscopy, ureteroscopy, cystoscopy & urethroscopy:**

- Visualize stones.
- Visualize pathology of U.B mainly.
- Biopsy from any suspicious lesion.

2. **Biopsy:** can be taken by endoscopes or by open surgery.

3. **Urodynamic studies:** cystometry and flowmetry (for obstructive uropathy).



# Congenital anomalies

➤ See pediatric surgery chapter.

## Urinary tract injuries

### General considerations

- About 10 % of all injuries seen in the casualty department involve the urinary system.
- Urethral injuries are the most common of them.

### Types of trauma

- Many types of trauma such as:
  - **Blunt injuries:** motor car accident, falling from height.
  - **Penetrating injuries:** stab wound, bullets.
  - **Iatrogenic injuries:**
    - During operation.
    - Endoscopic urological procedures.
    - After radiotherapy on the pelvis.

## A- Injuries of the kidney

### Incidence

➤ **Injuries of the kidney are relatively rare due to:** *(and spleen, liver)*

- 1- The kidneys are well protected by the rib cage & by the heavy muscles of the back.
- 2- The kidneys are mobile in their adipose fat & thus flee away from the force of trauma.
- 3- The fibrous capsule does protect the parenchyma from splitting.

➤ Renal injuries are potentially serious & may be complicated by injuries of other organs.

### Etiology

- closed* 1- Blunt injuries are the commonest (80-85%) due to :
  - Direct trauma to the abdomen (common), flank or back e.g. car accidents.
  - Indirect (less common) or contre coup injury, e.g., falling from a height & landing on the feet or buttocks.
- open* 2- Penetrating wounds e.g. knives or bullets are rare. Associated visceral injuries are present in 80% of renal penetrating wounds.
- intr* 3- Iatrogenic injuries occur during surgery.

### Pathology

- In contrast to intraperitoneal organs, bleeding from renal injuries is confined to the retroperitoneal space → usually stops further bleeding by its own tamponade effect.
- Renal injury may be one of the following:
  1. **Bruising and Ecchymosis:** are the most frequent.
  2. **Subcapsular hematoma.**



3. **Laceration:** (occurs in the transverse axis of the kidney or radiate from the hilum)

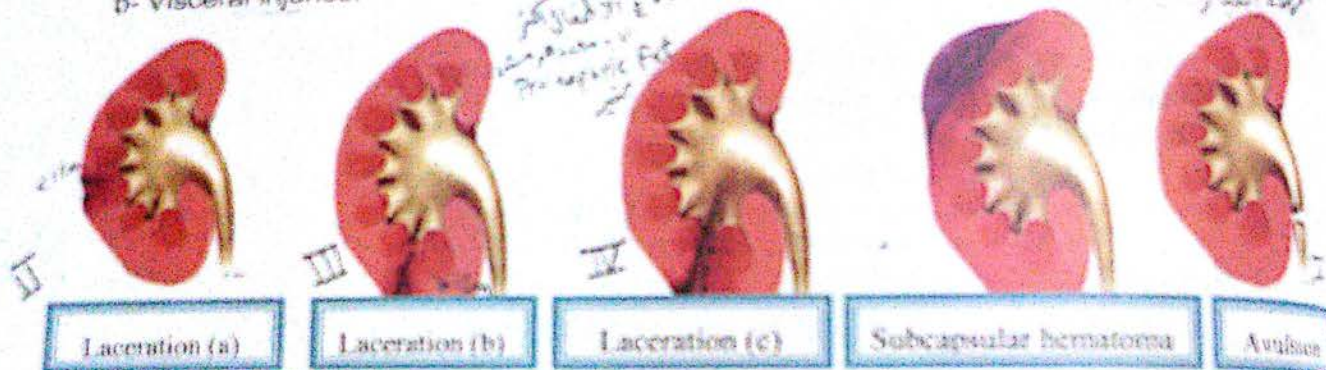
- a- Extends through the capsule → a perinephric haematoma results.
- b- Deep tear → affects the medulla → haematuria.
- c- Reaches the pelvicalyceal system → Haematuria. (with or without peri-renal urine collection).

4. **Vascular injuries:**

- a- Rupture of the whole vascular pedicle → massive bleeding (1% of blunt trauma cases) → it is an **Emergency**.
- b- Avulsion of the renal artery, vein or a segmental branch.
- c- Stretch of the main renal artery → Intimal tear with thrombosis.

5. **Associated injuries:**

- a- Tear in the peritoneum with intraperitoneal bleeding.
- b- Visceral injuries.
- c- Fracture of the spine or ribs.



### Clinical picture

#### Symptoms

1. History of trauma.
2. Pain in the flanks. It may be obscured by injury to other organs.
3. **Haematuria:** (degree is not proportionate to severity)
  - It is usually noted with the first voiding, may be late due to hypotension.
  - It can occur between third day and third week after the accident (due to clot becoming dislodged → sudden profuse haematuria).
  - It may be continuous or intermittent.
  - About 30% of vascular injuries are not associated with haematuria.

#### May be absent in:

- Superficial injury.
- Avulsed pedicle or ureter.
- Clot retention (→ ureteric colic).
- Traumatic anuria.
- Severe hypotension.

4. **Meteorism:** abdominal distension, N&V 24-48 hours after renal injury is probably due to retroperitoneal hematoma involving splanchnic nerves (resembling paralytic ileus).
5. **Oliguria** due to hypovolemia and hypotension.
6. **Retention of urine** due to clots in the bladder.





**Signs****A-General:****1. Shock:**

- Irritability, pallor.
- Sweating, subnormal temperature.
- Low B.P.
- Rapid weak pulse.

**2. Associated injuries:** (e.g. fracture lower ribs  $\pm$  pneumothorax).**B-Local:****Abdominal examination:****1. Inspection:**

- Ecchymosis & bruises in the loin.
- Fracture ribs.
- <sup>تشنج</sup> Rigidity.
- Hematuria in collected urine samples.

**2. Palpation:**

- Tenderness in the loin.
- Loins swelling due to extravasation of blood & urine.
- If the peritoneum is torn  $\rightarrow$  diffuse abdominal tenderness and distention.
- Manifestations of intra-peritoneal hemorrhage (guarding, rebound tenderness).

**3. Percussion:** shifting dullness.**4. Auscultation:**  $\downarrow$  Intestinal sounds.**5. DRE:** fullness in recto-vesical pouch (or Douglas pouch in females).

Rupture kidney is usually retroperitoneal with minimal shock with no peritoneal irritation.

**Complications****Early**

1. **Anuria**  $\rightarrow$  may be due to:
  - a. Shock.
  - b. Reflex inhibition of both kidneys.
  - c. Clot retention (due to obstruction of the bladder outflow by blood clots).
  - d. Injured solitary kidney.
2. **Bad general condition**  $\rightarrow$  Hemorrhage & shock.

**Late**

- 1- **Pseudo-hydronephrosis** <sup>ميو حول الكلية</sup> few weeks after injury due to:
  - Deep tear in the kidney  $\oplus$  ureteric obstruction associated (caused by scarring)
  - $\rightarrow$  Accumulation of urine all around the kidney. <sup>يجمع في</sup>
- 2- **Perinephric abscess.**
- 3- **Nephroptosis:** due to tear of the supporting tissues.
- 4- **Renovascular Hypertension:** after few months due to renal fibrosis  $\rightarrow$  renal ischemia. <sup>↑renin</sup>
- 5- **Renal artery aneurysm:** (if injured alone), A-V fistula (if both A. & V. are injured).
- 6- **Hydronephrosis:** due to fibrosis around the kidney leading to ureteric obstruction.
- 7- **Renal atrophy or fibrosis:** Impaired blood supply by rupture, thrombosis or fibrosis leads to atrophy.
- 8- **Perirenal cyst:** If haematoma becomes infected or liquefied  $\rightarrow$  localized collection of clear amber fluid may remain.

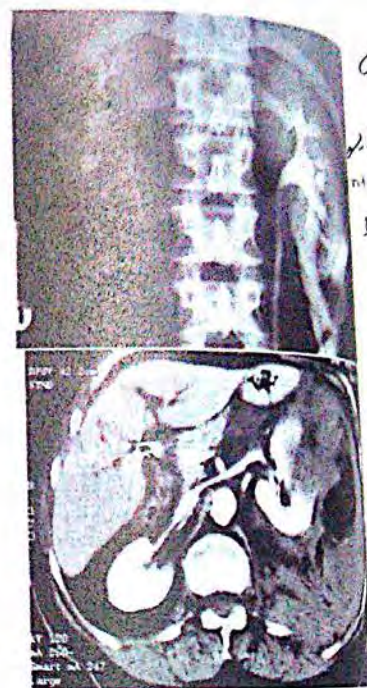


**Investigations**

Better to resuscitate the patient 1<sup>st</sup> (anti-shock measures):  
O<sub>2</sub>, Ryle, 2 IV lines, IV fluids or blood transfusion and urinary catheter

**Radiology**

1. **U/S:** *Fast*
  - Confirms the renal injury, show the size and contour of the kidney.
  - Can visualize any collection around it.
2. **Plain x-ray:**
  - Shows any foreign body, fractured ribs or associated hemothorax.
  - Obliterated psoas shadow by the hematoma.
3. **IVU infusion Urography:**
  - Is done to visualize the upper urinary tract as soon as the shock is controlled & the blood pressure is above 100mm Hg, It may show:
    - Normal function & configuration of kidney if the injury is minimal.
    - Deformed renal pelvis or calyces if there is laceration or blood clots.
    - Extravasation of contrast within the renal shadow or into perirenal space.
    - Non visualization of kidney due to total pedicle avulsion, arterial thrombosis or severe contusion causing vascular spasm.
    - Confirms the presence of a functioning kidney on the opposite side, as nephrectomy of the injured kidney may be needed. *Medical legal importance*
4. **CT scan:** *when stable condition*
  - More accurate than U/S.
  - Shows parenchymal lacerations, urinary extravasation, perirenal haematoma, non-viable renal tissue, as well as other organ injuries.
5. **Angiography:** in cases suspected to have renal pedicle (vascular) injury.
6. **Renal isotope scanning (DMSA):** *(useful in patients allergic to contrast material)*
  - Lack of uptake → injury or laceration of the renal artery.
  - Areas of decreased activity → renal contusion.
  - Absence of uptake in one pole → suggests amputation.
  - Perirenal extravasation of radioactive urine may appear.

**Laboratory**

1. **Urine analysis** → RBCs...etc.
2. **KFTs:** impaired from prolonged hypotension, bilateral injuries or injury of a solitary kidney.
3. **CBC, FBS:** (Anemia → progressive haemorrhage).



**Treatment**

- **General** → If the patient is poly-traumatized: ABCDE  
→ Treatment of shock.
- **Specific** → Conservative management 85% of cases.  
→ Surgical management if indicated.
- Treatment of associated injuries and other complications.

- Renal trauma is an acute emergency.
- Most renal injuries will be cured by conservative management, as most injuries (85%) are minor.
- The principles of trauma victims care should be followed.

**A. Conservative treatment:**

- Hospitalization with bed rest until hematuria has stopped & local signs of injury have subsided.
- Analgesics for pain.
- Large fluid intake to guard against clot retention & for hypovolemia.
- Broad spectrum antibiotics to guard against secondary infection.
- **Follow up parameters:**
  - Pulse, blood pressure, & size of any peri-renal mass.
  - Repeated samples of urine are examined & compared grossly for red color.
  - Hemoglobin & hematocrit estimations.
  - Repeated urine analysis for RBCs.

**B. Surgical treatment:**⇒ **Indication:**

1. Persistent progressive hematuria or failure to stabilize vital signs.
2. Presence of a progressively enlarging peri-renal mass.
3. Evidence of peri-renal infection.
4. Penetrating injuries.
5. Renal pedicle injury (5% of all injuries).
6. Presence of an associated intraperitoneal injury.
7. Indications for delayed surgery:
  - If hydronephrosis develops → it is treated by relief of obstruction.
  - If hypertension develops → vascular repair or nephrectomy is performed.

⇒ **Principles:**

- 1- Trans-peritoneal approach. *Mid line*
- 2- The colon is reflected medially.
- 3- Preliminary control of the vascular pedicle using vascular clamps.
- 4- Haematoma around the injured kidney is evacuated.
- 5- Traumatized & devascularized renal tissue is debrided.
- 6- a) Small defects of cortical tissue are sutured. *mattres.*  
b) Large defects are filled by omental or perirenal fat to obliterate dead space.
- 7- Water-tight closure of the pelvi-calyceal system. *& put Percut nephrostomy (catheter)*
- 8- Partial nephrectomy is done if one pole of the kidney is avulsed.
- 9- Nephrectomy is done if the kidney is shattered or with complete avulsion of vascular pedicle, provided that the other kidney is functioning well.





**C. Treatment of complications:**

- Associated injuries.
- Perinephric abscess → drainage + antibiotics.
- Hypertension → refractive to medical treatment & nephrectomy may be needed.
- Clot retention → bladder washout through a catheter or a cystoscope.
- Aneurysm of renal artery → excision or urgent nephrectomy if the other kidney is normal (to avoid fatal rupture of the aneurysm).

**B- Injuries of the Ureter****Etiology**

- Open injury:** stab wound, gunshot...etc.
- Closed injury:** e.g. kick or hyperextension of the spine...etc.
- Iatrogenic:**
  - Most common cause.
  - May occur during open surgery especially pelvic surgery e.g. hysterectomy (division, ligation, crushing or excision) or endoscopic surgery (perforation) e.g. cystoscopic catheterization, ureteroscopy and nephroscopy.
  - Ureteric catheterization may help to see the ureters and avoid them during surgery.
  - It may follow pelvic irradiation.

**Pathology**

Ureteric injuries leads to:

- Extravasation of urine, which may be:**
  - Intraperitoneal → peritonitis (or urinary fistula if a drain has been placed).
  - Extraperitoneal → appears as an enlarging collection of urine at the site of injury. (A retroperitoneal collection can cause reflex paralytic ileus).
- Ureteric obstruction, e.g. by a ligature, either:**
  - Complete obstruction → suppression of urine production.
  - Partial obstruction → hydronephrosis.
- Anuria and acute renal failure:**
  - May complicate bilateral injuries or those affecting the only functioning kidney.

**Clinical Picture**

- History of trauma or surgery.
  - Nausea, vomiting and loin pain.
  - Urinary leakage or fistula.
  - Renal tenderness and/or renal mass (hydronephrosis).
  - Fever: possibly with pyonephrosis secondary to obstruction.
- **In Bilateral cases:** Oliguria or anuria, (acute renal failure develops in neglected cases).

**Complications**

- Stricture formation with hydronephrosis.
- Ureteric urinary fistula.

**Investigations**

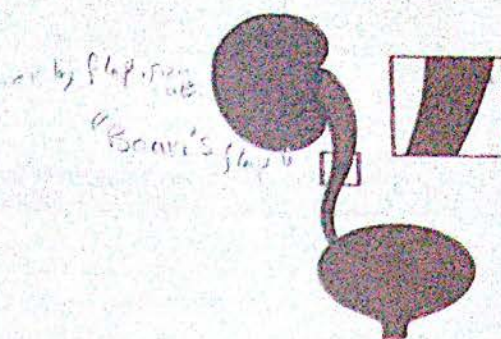
↑ creatinine ← لوفيه creatinine يترى بول  
حالات اللى فيها drain ← لوفيه creatinine يترى بول

- U/S** → distension of the pelvicalyceal system in patients with ureteric obstruction.
- Excretion Urography** → distension of pelvicalyceal system, delayed secretion or extravasation.
- Ureteric catheterization and retrograde pyelography** → obstruction or extravasation. CT scan with contrast → extravasation of the dye.

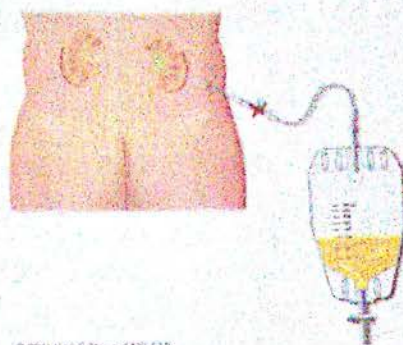


**Treatment****I- If Early diagnosis:** (within the first week)

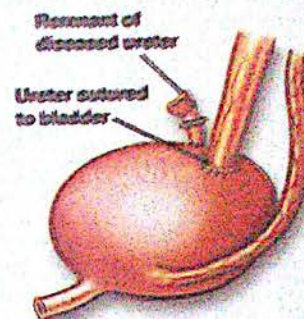
- **Fair patient condition** → Explore the ureter  
→ repair injury by end-to-end anastomosis or by reimplantation of the lower end of ureter into the bladder.



- **Poor patient condition** → Urinary diversion by a percutaneous nephrostomy → delayed repair of the ureter.

**II- If Delayed diagnosis:**

- Temporary nephrostomy → delayed repair (when the edema subsides).

**III- Ureteric catheterization and stenting may be successful in some cases.**



# C- Injuries of the bladder

## Types

1. Intra-peritoneal rupture of the bladder.
2. Extra-peritoneal rupture of the bladder (DD → intra-pelvic rupture of membranous urethra).

Intra-peritoneal rupture (20%)		Extra-peritoneal rupture (80%)	
Causes	<ul style="list-style-type: none"> <li>- Occurs in <u>males</u> &gt; females. <i>أكثر دموع حروق</i></li> <li>- <u>Full bladder</u> &amp; <u>direct trauma</u> applied to <u>supra-pubic region</u>. <i>بعد الخلع بقرع حرق</i></li> <li>- Surgical injury, e.g. hernia repair with sliding bladder or hysterectomy.</li> </ul>		<ul style="list-style-type: none"> <li>- More in <u>males</u>.</li> <li>- Bladder is injured <u>2<sup>nd</sup></u> to <u>fracture pelvis</u>.</li> <li>- Surgical injury is rare. <i>Comment</i></li> </ul>
	<ul style="list-style-type: none"> <li>- During cystoscopic procedures as TURP.</li> <li>- Open injuries caused by stabs or bullets.</li> </ul>		
Pathology	<ul style="list-style-type: none"> <li>- Sterile urine escapes into <u>peritoneal cavity</u> → <u>peritonism</u> → <u>delayed peritonitis</u>. → <i>G-Peritonitis</i></li> <li>- Rupture usually occurs between the <u>roof</u> and <u>post wall</u> of the bladder. <i>دول الى متدخين بالمتدخين</i></li> </ul>		<ul style="list-style-type: none"> <li>- Urine extravasates into the peri-vesical &amp; peri-prostatic spaces, <u>retro-pubic space</u> (<u>cave of Retzius</u>) and then ascends up between peritoneum &amp; fascia transversalis. <i>Ant. wall inj</i></li> </ul>
Symptoms	<ul style="list-style-type: none"> <li>▪ History of <u>trauma</u>.</li> <li>▪ <u>Supra-pubic agonizing pain</u> (in <u>intra-peritoneal type</u>: This pain is later replaced by a dull aching pain spreading <u>all over</u> the abdomen).</li> <li>▪ <u>Urine retention</u> with <u>NO</u> desire to micturation in <u>intra-peritoneal type</u>, but the desire is <u>preserved</u> in <u>extra-peritoneal type</u> (the collected urine cause intense desire).</li> <li>▪ <u>Haematuria</u>.</li> </ul>		
Signs	<ul style="list-style-type: none"> <li>▪ <b>General:</b> shock.</li> <li>▪ <b>Local:</b> <ul style="list-style-type: none"> <li><b>Inspection:</b> bruises, ecchymosis &amp; rigidity.</li> <li><b>Palpation:</b> guarding, rebound tenderness.</li> <li><b>Percussion:</b> shifting dullness.</li> <li><b>Auscultation:</b> diminished intestinal sounds.</li> <li><b>DRE:</b> fullness in recto-vesical pouch.</li> </ul> </li> </ul> <p>→ Catheter can be passed easily &amp; no urine is obtained (only blood).</p>	<ul style="list-style-type: none"> <li>▪ <b>General:</b> shock. → <i>Neurogenic</i></li> <li>▪ <b>Local:</b> <ul style="list-style-type: none"> <li><b>Inspection:</b> bruises, ecchymosis &amp; rigidity in supra-pubic region due to fracture pelvis.</li> <li><b>Palpation:</b> a boggy swelling with guarding, rebound tenderness in supra-pubic region.</li> <li><b>Percussion:</b> no shifting dullness.</li> <li><b>DRE:</b> a- empty recto-vesical pouch.</li> <li>b- prostate in its normal position (to differentiate it from intra-pelvic rupture of the urethra).</li> </ul> </li> </ul> <p>→ Catheter can be passed easily &amp; blood + small amount of urine.</p>	
Complications	<ul style="list-style-type: none"> <li>• Pelvic abscess from infection of hematoma or urine collected.</li> <li>• Delayed peritonitis.</li> <li>• Partial incontinence if bladder neck is injured.</li> <li>• In extra-peritoneal type, if not treated → chemical irritation of the anterior abdominal wall → Necrotizing Phlegmon.</li> </ul>		



Investigations	Ground glass appearance (due to urine in the lower part of the abdomen).	1-X-ray	Fracture pelvis.
	Free fluid in peritoneum → peritoneal tap may be of value	2-U/S & CT scan:	
	3- Ascending cystography or IVU		
Treatment	Leaking of the dye from the urinary bladder, excludes other urinary injuries.		
	<ul style="list-style-type: none"> <li>• If the patient is poly-traumatized → ABCDE + secondary survey.</li> <li>• Treatment of shock: Ryle, IV line, I.V fluids or blood).</li> <li>• Treatment of associated injuries if present.</li> <li>• <u>Treatment of ruptured bladder:</u> <ul style="list-style-type: none"> <li>→ <u>Small extra-peritoneal rupture with minimal extravasation on cystogram may be treated with Foley catheter drainage for two weeks till healing occurs.</u></li> <li>→ <u>Large extra-peritoneal rupture and intra-peritoneal rupture need repair:</u> <ul style="list-style-type: none"> <li>- Through a <b>midline</b> supra-pubic incision.</li> <li>- The extravasated urine is evacuated (open the peritoneum in intra-peritoneal type).</li> <li>- The bladder tear is exposed → edges are trimmed → the defect is closed in two layers with Polygalactin (Vicryl) or chromic catgut.</li> <li>- Placement of a supra-pubic drain, retro-pubic drain and urethral catheter.</li> <li>- Antibiotic prophylaxis.</li> </ul> </li> </ul> </li> </ul> <p><b>N.B.</b> Surgical bladder injury → immediate repair + urethral drainage for 7 days.</p> <p><b>N.B.</b> The fractured pelvis should <b>NOT</b> be treated by internal fixation in the presence of urine extravasation for fear of osteomyelitis.</p>		

## D- Injuries of the urethra

### Incidence

More common in males and rare in females.

### Types

#### According to site

1. **Extra-pelvic** (Anterior = bulbous and penile urethra).
  2. **Intra-pelvic** (Posterior = membranous and prostatic urethra)
- DD: extra-peritoneal rupture of bladder.

#### According to injury

1. **Complete or incomplete:** according to its extent on the circumference.
2. **Total or partial:** according to its depth in the wall.



Cause	Extra-pelvic rupture (most common)		Intra-pelvic rupture	
	<p>Trauma to perineum (Falling astride or kick).</p> <p>Bulbous urethral injury &gt; Penile urethra.</p> <p>Injury may be:</p> <ol style="list-style-type: none"> <li>1. Contusion.</li> <li>2. Laceration: (involving part or the whole circumference).</li> </ol> <p>The urine collects under Camper's, Scarpa's &amp; Colle's fasciae at the penis, perineum, scrotum, anterior abdominal wall &amp; then descends down to the upper part of the thigh.</p>		<p>Iatrogenic by catheterization</p> <p>2<sup>nd</sup> to fracture pelvis → urethral inj &gt; bladder inj</p> <p>Membranous urethral injury &gt; Prostatic part.</p> <p>Injury may be:</p> <ol style="list-style-type: none"> <li>1. Mucosal tear (usually by faulty catheterization).</li> <li>2. Laceration of a part of the circumference.</li> <li>3. Complete circumferential laceration.</li> <li>4. Complete circumferential laceration with torn pubo-prostatic ligament → floating urinary bladder and prostate.</li> </ol> <p>Extravasation of urine (in the cave of Retzius).</p>	
Pathology	<p>Severe pain in perineum.</p> <p>History of trauma.</p> <p>Urine retention with desire to micturation.</p> <p>Urethral bleeding.</p> <p>→ The (triad) of urethral hemorrhage, perineal hematoma and retention of urine is diagnostic of extra-pelvic rupture.</p>		<p>Severe pain in hypogastrium.</p>	
Symptoms	<p>General: Shock.</p> <p>Local:</p> <ul style="list-style-type: none"> <li>- Perineal hematoma</li> <li>- Bleeding per urethra.</li> <li>- Bladder is full.</li> <li>- Catheter is <u>never</u> used if urethral injury suspected.</li> <li>- Urine collection ↑ on straining</li> </ul>		<p>General: Shock.</p> <p>Local:</p> <ul style="list-style-type: none"> <li>- Fracture pelvis</li> <li>- Bleeding per urethra (drops of blood at the external meatus).</li> <li>- Bladder is full.</li> <li>- Catheter is <u>never</u> used if urethral injury is suspected.</li> <li>- PR: prostate → higher than normal floating prostate.</li> <li>- Distended urinary bladder excludes extra-peritoneal rupture bladder.</li> </ul>	
Signs	<p>1. Subcutaneous extravasation in complete rupture.</p> <p>2. Stricture of urethra.</p> <p>3. Urethral fistula.</p> <p>4. Infection: in neglected cases.</p> <p>5. Peri-urethral abscess.</p>		<p>1. Blood loss → hemorrhagic shock.</p> <p>2. Deep extravasation of urine in the extraperitoneal space.</p> <p>3. Injury of external sphincter (sphincter urethrae).</p> <p>→ If the internal sphincter (sphincter vesicae) is damaged → Incontinence.</p> <p>4. Impotence: injury of nerves to corpora cavernosa near membranous urethra.</p> <p>5. Urethral stricture.</p>	
Complications	<p>Plain X-ray</p> <p>-ve</p> <p>Fracture pelvis</p> <p>Ascending Urethrogram</p> <p>Show the extravasation.</p>		<p>shows site of extravasation at prostate-membranous junction.</p> <p>Urgent IVU: to Detect:</p> <ul style="list-style-type: none"> <li>- Associated urinary tract injuries.</li> <li>- The position of the urinary bladder.</li> </ul>	
Investigations				



## Treatment

1. If the patient is poly-traumatized (mainly in intra-pelvic type): ABCD + 2<sup>nd</sup> survey + treatment of life threatening injuries.
2. Treatment of shock (Ryle, IV lines, IV fluids or blood + analgesics).
3. Treatment of associated injuries if present.
4. If there is no clinical extravasation → diagnosis of type of injury by an urgent ascending Urethrogram.
5. Catheterization should be avoided and instruct the patient to avoid passing urine.
6. Supra-pubic percutaneous cystostomy for drainage until the urethra heals.
7. Prophylactic antibiotics.
8. Later on (after 3 weeks): → Investigate for strictures by micturating cysto-urethrogram.
  - If normal urethra → Remove the suprapubic tube.
  - If stricture develops → Endoscopic urethrotomy followed by repeated dilatation.
  - For tight and long strictures → Surgical correction may be required.

suprapubic  
Put Catheter

## N.B.: Important notes on Urological injuries:

1. Treatment of renal injuries is mainly conservative.
2. Most ureteric injuries are iatrogenic following difficult surgical and endoscopic procedures.
3. Bilateral ureteric ligation will lead to anuria.
4. The best way to avoid intra-operative ureteric injuries is to do preliminary exposure of the ureters.
5. Bladder or urethral injuries should be suspected in patients with pelvic fractures.
6. Extra-pelvic injury of the urethra is diagnosed by the triad of: retention of urine, few drops of blood at the external meatus and perineal swelling.
7. Catheterization is contraindicated in patients suspected of having rupture of the urethra  
→ The proper treatment is to do suprapubic cystostomy.



## Points to remember (injuries)

### Injuries of the Kidney

- ▶ **Trauma:** Blunt (commonest): direct or indirect, Penetrating, Iatrogenic
- ▶ **Path:** - bruising and ecchymosis (common).  
- subcapsular hematoma.  
- laceration (superficial, deep).  
- vascular injury. - associated injuries.
- ▶ **Symp.:** Pain, hematuria, meteorism, oliguria.
- ▶ **Signs:** Shock + tender swollen loin, shifting dullness, ↓ intest. sounds, fullness in recto-vesical pouch.
- ▶ **Comp.:** 4osis + abscess + cyst + HTN.
- ▶ **Invest.:** U/S + CT\* + IVP + renal scan + KFT.
- ▶ **TTT:** Conservative: rest, analgesic, fluid, ABs.  
Surgery: in persistent S/S, vascular inj.

### Injuries of the Bladder

- ▶ **Intra-peritoneal rupture:**
  - More males, trauma on full bladder, surgical.
  - **Symp.:** supra-pubic pain, retention with NO desire, hematuria.
  - **Signs:** surgical Abd. + full recto-vesical pouch, catheter → blood, no urine.
- ▶ **Extra-peritoneal rupture:**
  - more males, 2ry to fracture pelvis.
  - **Symp.:** supra-pubic pain, retention with preserved desire, hematuria.
  - **Signs:** surgical abd., but no shifting dullness + full recto-vesical pouch + prostate in its position, catheter → blood + urine.
- ▶ **Comp.:** abscess, peritonitis, incontinence.
- ▶ **Invest.:** cystography, IVU, X-ray, CT, U/S.
- ▶ **TTT:** ABCD, incision → evacuate urine → repair injury → drains → prophylactic ABs.

### Injuries of the Ureter

- ▶ Mostly iatrogenic during pelvic surgery
- ▶ **C/P:** a. unilateral (loin pain, swelling, silent atrophy the worst presentation)  
b. Bilateral (anuria, oliguria)
- ▶ **Comp.:** stricture, fistula.
- ▶ **Inv:** U/S, CT with contrast, excretion urography, retrograde pyelography.
- ▶ **TTT:** 1- Early diagnosis:
  - a- fair condition: repair, anastomosis, reimplant.
  - b- bad condition: nephrostomy, delayed repair.
- 2- Delayed diagnosis: nephrostomy, delayed repair
- 3- ureteric catheter + stenting.

### Injuries of the Urethra

- ▶ **Extra-pelvic rupture:**
  - trauma to perineum (falling astride, kick).
  - **Symp.:** pain in perineum, retention with desire, urethral bleeding.
  - **Signs:** shock, hematoma, full bladder, bleeding per urethra, NEVER use catheter.
  - **Comp.:** extravasation, stricture, fistula, infection
- ▶ **Intra-pelvic rupture:**
  - iatrogenic, 2ry to fracture pelvis.
  - **Symp.:** pain in hypogastrium, retention with desire, urethral bleeding.
  - **Signs:** same + floating prostate.
  - **Comp.:** shock, deep extravasations, incontinence, impotence, stricture.
- ▶ **Invest.:** ascending urethrogram, IVU, X-ray.
- ▶ **TTT:** ABCD, cystostomy, prophylactic antibiotics → urethral healing → deal with strictures formed (dilatation, surgical).



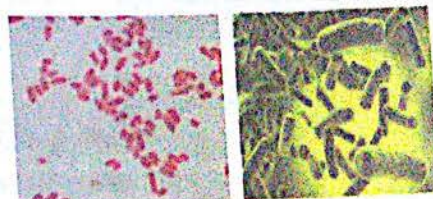
# Urinary Tract Infections

## A- Pyelonephritis

- Infection of the renal parenchyma and pelvis.
- May be acute or chronic.
- More in females particularly during pregnancy.

### Etiology

- *E. coli* is the usual organism but *Proteus* may be found.
- Infection is usually ascending, and less commonly haematogenous.



### Clinical Picture

#### Symptoms

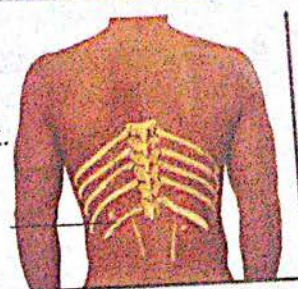
- ▶ **General:** Fever, rigors and vomiting.
- ▶ **Local:** 1. Sudden severe loin pain.  
2. Frequency, burning micturation & dysuria may be present.

#### Signs

1. Fever up to 39-40°C
2. Tenderness in the renal angle, and may be muscular rigidity.
3. Bilateral pyelonephritis may give features of uremia.

#### ➤ In severe cases:

→ The patient looks very ill and if not treated → Septicemic shock.



### Complications

- ▶ **General:** Septicemia and septic shock.
- ▶ **Local:**
  1. Pyonephrosis.
  2. Renal damage: (obstruction + infection → damages the kidney).
  3. Perinephric abscess.
  4. Chronic pyelonephritis → Scarring of the kidney leads to:
    - a) Renal hypertension.
    - b) Chronic renal failure if the disease affects both kidneys.

### Investigations

#### A. Laboratory:

1. Mid stream urine sample (MSU):  
→ for routine analysis with culture and sensitivity testing.
2. Blood urea and serum creatinine.
3. Blood sugar and electrolytes.

#### B. Radiological:

1. Plain X-ray & IVU → may show calcifications and kidney dilatation.
2. U/S → detect obstructed cases with dilatation of the pelvis and calyces.





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**DD**

1. Basal pneumonia and pleurisy.
2. Acute cholecystitis: Ultrasound can differentiate.
3. Acute appendicitis: The initial pain in appendicitis is around the umbilicus.
4. Acute pancreatitis.
5. Perinephric abscess.

## Treatment

### 1) Non-obstructed acute pyelonephritis

#### A- General measures:

- a. Rest in bed.
- b. Adequate hydration by drinking a large amount of fluids.  
→ If there is vomiting IV fluids and antiemetics are given.
- c. Analgesics and antipyretics as NSAID.
- d. Alkalinization of urine → to relief dysuria and inhibit growth of organisms.

#### B- Specific measures:

- a. Antibiotics effective against Gram-negative bacilli:  
→ Started until the culture and sensitivity result is available.  
→ Treatment should continue for 3 weeks.
- b. Urological investigations are done to exclude underlying abnormality.
- c. Repeated urine cultures should be done to ensure cure.

### 2) Obstructed acute pyelonephritis

- The same measures as the non-obstructed cases.
- Urgent drainage by ultrasound-guided percutaneous nephrostomy until the patient improves, then treat the cause of obstruction.
- Cystoscopy and ureteric catheterization to drain the kidney may be done.

## B- Pyelonephritis in Children

### Etiology

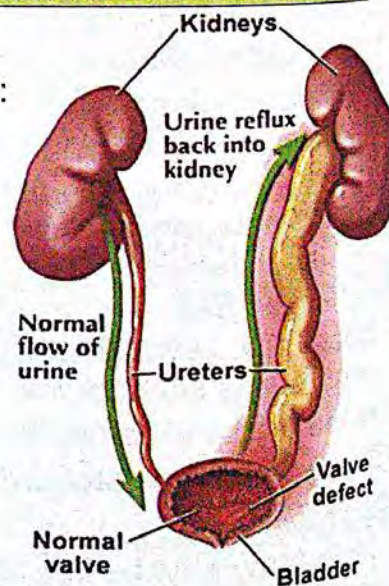
► **Vesico-ureteric reflux (VUR)** is the usual cause, it may be:

1. Idiopathic (primary) VUR: delay of maturation of uretero-vesical junction.
2. Secondary VUR: occurs on top of an intra-Vesical obstruction, e.g. posterior urethral valves, neuropathic bladder associated with spina bifida, or stones.

### Pathophysiology

- Normally during voiding no urine passes upwards to the ureters or kidneys because bladder muscle contraction occludes the lower ends of both ureters.
- Failure of this mechanism produces VUR.

### Clinical Picture





1. **In most cases:**

- Reflux is limited to the lower ureters → self-correctable as the child grows up.

2. **In few cases:**

- Refluxing urine reaches the kidneys.
- High pressure by bladder contraction + infected urine → renal damage.  
→ Repeated attacks of acute pyelonephritis cause scarring of the kidneys (chronic pyelonephritis), and probably renal failure.

**Treatment**

- Uretero-vesical reimplantation with an antireflux technique may be required in some cases.

**C- Peri-Nephric Abscess**

- A perinephric abscess is suppuration of perinephric fat & fascia.

**Etiology**

- A perinephric abscess usually affects adults, more on the right side.
- It occurs in two forms :

1. **Primary perinephric abscess:**

- Rare.
- The infection is blood borne from a distant septic focus, such as a boil or carbuncle.

2. **Secondary perinephric abscess:**

- Is more frequent due to extension of infection from the kidney or a neighbouring structure, e.g. spine, pleura or pelvic organs.

**Pathology**

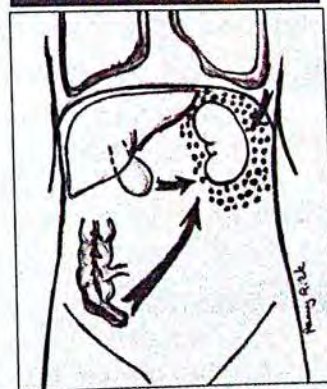
- The infecting organisms are staphylococci, less commonly streptococci & E.coli.
- Pus collects between the kidney & perinephric fascia & may extend downwards into the pelvis along the course of the ureters, or may burst through the perinephric fascia to reach the loin.
- The abscess may be unilocular or multilocular.
- A neglected abscess may be complicated by septicemia & septic shock.

**Clinical features****Symptoms**

- **Loin pain** → Pain increases by movement, respiration & coughing.
- Hectic fever.

**Signs**

- Fever
- Loin fullness, tenderness & rigidity.
- Swelling is ill-defined & doesn't move with respiration.
- Oedema & redness of skin may be present if the abscess extends superficially.
- Slight eversion & flexion of hip joint from spasm of psoas muscle.





**Investigations**

1. Urine analysis is usually sterile.
2. Blood picture shows polymorphonuclear leucocytosis.
3. Ultrasound or CT scan is diagnostic (pus around kidney).
4. Plain X-ray may show scoliosis with the concavity towards the abscess side, together with obliteration of the psoas shadow & elevation & fixation of the diaphragm.

**D.D.**

- Is similar to that of acute pyelonephritis.

**Treatment**

1. As for any abscess in the body treatment is by **Drainage of pus**.
  - Adequate lumbar incision under general anaesthesia.
  - All pockets are thoroughly opened.
  - A wide drain inserted
2. Antibiotics.

## D- Pyonephrosis

**Definition**

- Retention of infected urine and pus in the kidney due to obstructing agent.

**Etiology**

(Obstruction & infection)

- **Organism:** E.coli.
- **Route of infection:** usually ascending infection.
- **Predisposing factors:** obstruction and ↓ immunity.

⇒ It may be:

1. **Primary pyonephrosis** → Infection then obstruction or occurs simultaneously.
2. **Secondary pyonephrosis** → Infection of pre-existing hydronephrosis  
(Obstruction occurs at first → hydronephrosis → followed by infection)

**Pathology**

☒ **Pyonephrosis is usually unilateral.**

→ The pelvi-calyceal system is transformed into a multilocular cavity filled with pus and lined with necrotic renal parenchymal tissue.

**A. Primary pyonephrosis**

- The kidney is not very much enlarged.
- Pelvis is inflamed → inner lining is irregular.
- Parenchyma of the kidney is extensively destroyed.
- Perinephritis → extensive adhesions and fibro-fatty proliferation around the kidney.
- 2ry Phosphate stone is common.

**B. Secondary pyonephrosis**

- The kidney is hugely enlarged.
- The cavities are filled with thick pus.



**Clinical picture****A- Closed type (complete obstruction)**

(No pus comes out with urine due to the obstructing agent, toxemia is severe)

▪ **General:** Hectic fever, rigors, anorexia, headache, malaise...etc.

▪ **Local:**

1. Loin pain: throbbing, worse at night.
2. Tenderness (pus under tension).
3. Renal swelling: usually small (large in 2<sup>nd</sup> pyonephrosis).

**B- Open type (partial obstruction)**

(The pus comes out in large amount so toxemia is less severe)

- Presents with triad of anemia, fever & renal swelling (large).
- Renal colic may occur with passage of pus or stone down the ureter.
- With or without secondary cystitis (pyuria, frequency, burning micturation).

▪ Pyuria is absent if it is closed type.

**Complications****General**

- Septicemia and septic shock in closed type.
- Pyemia.

**Local**

- Permanent renal scarring.
- Peri-nephric abscess.
- Renal failure.

**DD**

- Acute pyelonephritis.
- Basal pneumonia & pleurisy.
- Perinephric abscess.

- Acute appendicitis.
- Acute pancreatitis.
- Acute cholecystitis..

**Investigations****For diagnosis:**

- **CBC, ESR & CRP** → elevated TLC, high ESR & CRP.
- **Urine analysis, C&S:** pyuria in open type, no pyuria in closed type.
- **U/S:** dilatation of the renal pelvis and calyces with pus inside ± renal damage.
- **IVU:** (if KFTs within normal) after resolution of the acute attack → poor renal function and hydronephrosis on the affected side.
- **Cystoscopy & ascending pyelography:**
  - 1- In open type: shows signs of chronic cystitis and purulent efflux from one ureteric orifice.
  - 2- In closed type: ureteric catheter may be arrested at the site of obstruction, or may enter the pelvis and gives exit to purulent urine with marked relief of pain.

**For cause**

- **Plain X-ray:** may show stone.

**For complications**

- **KFTs.**



**Treatment****Treatment of pyonephrosis****1- An obstructed infected kidney should be treated urgently:**

- Antibiotics & kidney drainage by inserting a large percutaneous nephrostomy tube or ureteric catheter. Any cause of obstruction as a stone or stricture should be corrected.

**2- Open type:**

- If the kidney is functioning: treatment of the cause.
- If the kidney is not functioning (detected by radioisotope renal scan): preliminary nephrostomy is done.
- If the kidney still not functioning: nephrectomy is done provided that the other kidney is normal.

**E- Bilharziasis of U.B.****Etiology**

- Due to *Schistosoma Hematobium* (96%) or *Mansoni* (4%).
- The worms migrate from the liver to the mesenteric veins → reach the urinary bladder through the anastomotic channels between the haemorrhoidal and vesico-prostatic plexuses.

**Incidence**

- Adolescents and middle aged male (10 – 30 years old).
- Male : Female = (4 : 1).
- More in occupations with exposure to water canals especially of small streams, such as farmers and fishermen.

**Pathology****Site**

- The urinary bladder is the commonest site of Bilharzial infection.
- The lesions affect the mucosa, muscle layer or peri-vesical tissue.

**Macroscopically (cystoscopy)** (Depending on duration, one or more can be seen)**1. Patchy hyperaemia:** over the Trigone.**2. Bilharzial sandy patches:**

- Aggregations of calcified dead ova in the submucosa.
- Appear through the mucous membrane like sand under water.
- Form a barrier to the passage of ova → normal urine does not mean a cure of the disease.

**3. Bilharzial tubercles:**

- Larger, more numerous and more yellow than those of tuberculosis.
- Consist of small bilharziomata, each the size of a pin's head and surrounded with a narrow ring of congestion.
- May undergo resolution, calcification or ulceration.

**4. Bilharzial nodules:**

- Spherical bodies, larger and more prominent than the tubercles.
- Grayish in color, may be discrete or aggregated.
- Consist of crypt-like invaginations of hyperplastic epithelium, having a pseudo-glandular or cystic appearance (Cystitis glandularis and Cystitis cystica).



5. **Bilharzial papillomata:**
  - Polypoid projections of the mucous membrane due to irritation and hyperplasia of the epithelium.
  - Vary in size from a pea size to an almond, also in number and distribution.
  - Lie commonly near the ureteric orifices, trigone and base of the bladder.
  - With heavy infection → necrosis, ulceration and encrustation with phosphates crystals.
  - May obstruct the flow of urine from the ureter or bladder.
  - Rarely become malignant.
6. **Bilharzial granulomata:**
  - Submucous masses of bilharzial granulation tissue.
  - Form smooth tumour-like swellings projecting into the bladder.
7. **Bilharzial ulcers:**
  - Usually single, small and on the posterior wall of the bladder.
  - with clean-cut edges and superficial pale yellowish floor covered with scanty granulation tissue.
  - Surrounded by congestion and sandy patches.
  - Tend to heal under treatment.

### Microscopically

- Leukoplakia, cystitis glandularis, cystitis cystica → predispose to UB carcinoma.

### Clinical picture

- Swimmer's or bather's itch due to penetration of cercaria through the skin may be followed 4- 12 weeks later by fever, urticaria & asthma.
- Such symptoms usually pass unnoticed until ova invade the bladder within 6 months after cercarial penetration.

### Symptoms

- 1- **Hematuria:**
  - Is the cardinal symptom.
  - It is usually slight (few drops) & terminal.
- 2- **Pain:**
  - Some urethral burning may be felt, but with the occurrence of ulceration, stone formation & malignancy.
  - The pain is markedly increased.
- 3- **Frequency:**
  - From congestion of trigone but later on severe frequency follows secondary cystitis & other complications.
- 4- **Difficulty in micturition:**
  - At first there may be a slight difficulty in voiding, together with a feeling of discomfort & heaviness in the perineum at the end of the act.
  - In late cases, severe difficulty may occur from bladder neck obstruction.

### Signs

- No signs are elicited until complications occur.

### Complications

- 1- **Secondary infection is very common:** acute or chronic cystitis.
- 2- **Stone formation:** from stasis, changing pH and deposition of debris and blood.
- 3- **Ureteric obstruction:** usually bilateral and affects the intramural portion.
- 4- **Bladder neck obstruction:** - Due to fibrosis around the internal meatus.  
- Aggravated by infiltration of the detrusor with atrophy of the muscle fibers.
- 5- **Spread of infection:** to seminal vesicles, prostate, urethra and scrotum.



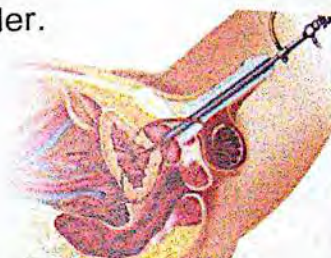
6- **Peri-cystitis:** extension from the bladder, ureters, prostate and seminal vesicles.

- 7- **Malignancy:**
- Bilharzial cancer bladder is a common malignant tumor in Egypt.
  - It occurs on top of patches of leukoplakia or alkaline encrusting cystitis.
  - Cystitis cystica, cystitis glandularis, ulcers and papillomata are rarely precancerous.
  - Alkaline sepsis with ammoniacal decomposition is the most important factor.

## Investigations

### For diagnosis

- **Urine analysis:**
  - Last few milliliters of early morning urine are taken for several consecutive days.
  - In the acute congestive stage → urine looks smoky and contains living bilharzial ova and red cells.
  - With secondary infection → it becomes alkaline and turbid with blood, pus, phosphates, epithelial debris and dead ova.
  - Negative results don't exclude bilharziasis.
- **Cystography:** to study the shape and the size of the bladder.
- **Cystoscopy:** to study the macroscopic pathology in the bladder wall + biopsy.
- **Antibody detection by ELISA.**



### For complications

- **Plain x-ray:** shows bilharzial calcification of bladder, terminal ureters, seminal vesicles (honey comb pattern), calcified papilloma or calculi.
- **IVU:** shows strictures of the ureters, hydronephrosis or bladder neck obstruction.

## Treatment

### Medical treatment

- Anti-bilharzial drugs → Praziquantel single dose 60mg/kg (max. 400mg).
- If secondary cystitis is present → Same + Urinary antiseptics (Antimony).



### Surgical treatment

- ➔ **Depends on the individual lesion:**
- **Cystitis cystica, cystitis glandularis and Bilharzial papillomata:**
  - No treatment unless they are bulky and causing obstruction.
  - ➔ Cystoscopic fulguration or excision biopsy.
- **Superficial bladder ulcers:** cystoscopic excision.
  - ➔ Deep ulcers may need Partial cystectomy.
- **Bladder neck obstruction:** cystoscopic incision or resection.
- **Lower ureteric stricture:** urethro-scopic balloon dilatation, or uretero-vesical implantation.



## F- Cystitis

## Etiology

## Causative organism

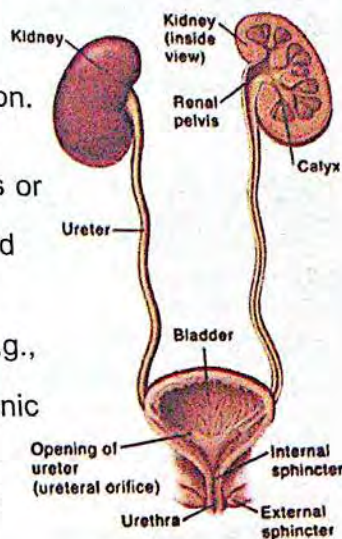
- **Non-specific** → **E. coli** is the commonest organism.
- May occur in single or mixed infections.
- Others include: proteus, Streptococcus faecalis and Pseudomonas.
- **Specific** → TB, Bilharziasis.

## Route of infection

1. **Ascending (commonest):** from the urethra, prostate and vulva or during instrumentation.
2. **Descending:** from the kidney.
3. **Direct:** through a vesico-vaginal or vesico-intestinal fistula.
4. **Lymphatic:** from the cervix uteri, prostate, seminal vesicles or bowel.
5. **Blood:** from distant foci, e.g. boils, carbuncles and infected tonsils.

## Predisposing factors

1. Incomplete emptying of the bladder → residual urine. e.g., prostatic obstruction, urethral stricture, pregnancy and neurogenic bladder.
2. Constant reinfection from the upper or lower urinary tract or from neighboring structures such as the prostate, colon and cervix (e.g., contraceptive device).
3. Low General resistance, e.g., diabetes.
4. Devitalization of the bladder by instrumentation, calculi and foreign bodies.



## Clinical picture

## Symptoms

## ➤ General:

- FAHM: (fever rarely occurs in acute cases and rarely reaches 38°C).

## ➤ Local:

1. Frequency (both diurnal and nocturnal) → The chief symptom.
2. Suprapubic and perineal pain.  
→ Severe pain is present at the end of micturition and is referred to the glans penis or labia majora.
3. Pyuria: Urine is cloudy and a feathery deposits may appear on standing.
4. Haematuria: (terminal haematuria).  
→ In severe cases: the whole specimen may be blood-stained.

## Signs

- Tenderness over the bladder on abdominal, rectal or vaginal examination.
- Urethral discharge.
- Tender prostate (prostatitis).
- Chronic cervicitis or erosion may be detected.

## Investigation

## ▪ Urine analysis:

- Mid-stream sample for analysis with culture and antibiotic sensitivity tests.
- In acute stage: Instrumentations are contraindicated.



- **Cystoscopy:**  
In chronic cases → show the specific pathological lesions and local predisposing factors in the bladder, urethra or prostate e.g. bladder ulcer.
- **Others:**
  - Measurement of urinary flow rates and post-void residual urine.
  - Difficult cases may require urodynamic investigation.

### Treatment

- 1- Rest.
  - 2- Ample of fluids.
  - 3- **Antibiotics:** Trimethoprim, Amoxicillin or Quinolones (or according to culture/sensitivity).
- ⇒ Failure to respond indicates the necessity for further investigation to exclude predisposing factors

## G- Gonococcal Urethritis

### Pathology

- ▶ **Causative agent:**
  - Neisseria gonorrhea: Gram negative diplococci located within the neutrophils.
  - Concurrent infections with Chlamydia and other organisms are common.
- ▶ **Route:** sexually transmitted disease.
- ▶ **Site:** The urethra is a common site of infection



### Clinical Picture

#### Symptoms

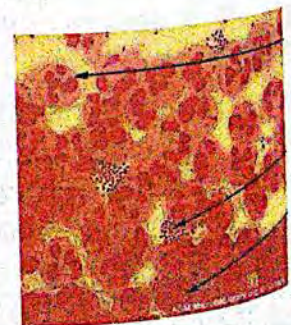
- The usual incubation period is 3-10 days.
- May be asymptomatic
- In males → urethral itching, urethral discharge and dysuria.
- Without treatment:
  - urethritis will stay for 3-7 weeks.
  - 95% of men become asymptomatic after 3 months.
- Complications such as involvement of the prostate → frequency, urgency, and nocturia.
- Spread down the vas deferens to the epididymis → acute epididymitis.

#### Signs

- Urethral discharge is yellowish or brown.
- There may be meatal oedema and erythema.

### Investigations

- Gram-stained smear:** (the usual method of diagnosis):
  - considered positive if Gram-negative diplococci are seen within PNL.
- Cultures** are not necessary for diagnosis, but may help to determine antibiotic sensitivities.





iii. **Alternative diagnostic methods:**

→ based on detection of the Gonococcal enzymes, antigens, DNA, liposaccharides.

**DD**

- Non-gonococcal urethritis → the discharge is more scant and clear.

**Complications**

1. Peri-urethritis → abscess formation → urethral fibrosis → urethral stricture.
2. Prostatitis may develop → perineal pain and low backache.
3. Epididymitis may occur → infertility or testicular atrophy.
4. Teno-synovitis and arthritis may occur.

**Prevention**

→ Condoms, if properly used, will prevent the spread of N. gonorrhea.

**Treatment**

- 1- Antibiotic treatment.
- 2- Treatment of the sexual partner is imperative.
- 3- Sexual intercourse should be avoided until cure has been established.

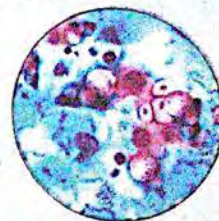
**H- Non-Gonococcal Urethritis****Incidence**

- Accounts for 50% of urethritis.

**Etiology**

- **Organism:** Chlamydia Trachomatis: small obligate intracellular bacterium of columnar or pseudo columnar epithelium.
- Post Gonococcal urethritis occurs in those who get gonorrhea and chlamydial infection simultaneously.

Chlamydia Trachomatis Bacteria

**Clinical Picture**

- The incubation period is 7-21 day.
- Dysuria and mild scanty whitish or clear urethral discharge.
- Discharge may be absent, and patient only complain of urethral itching.
- Asymptomatic infection occurs in contacts of women with known cervical chlamydial infection.

**Treatment**

- Tetracycline for patient and sexual partner.



## Points to remember (inflammation)

### Pyelonephritis

- ▶ **Etiology:** E.coli.
- ▶ **Symp.:** FAHM, loin pain, frequency, dysuria.
- ▶ **Signs:** fever, tenderness, (bilat. → uremia).
- ▶ **Comp.:** septicemia, pyonephrosis, renal damage, perinephric abscess, chronic → HTN, chronic renal failure.
- ▶ **Invest.:** urine analysis (MSU), KFTs, electrolytes, X-ray, IVU, U/S.
- ▶ **TTT:** Non-obstructed: - General (rest, fluids, NSAIDs, alkalization of urine).  
- Specific (antibiotics).  
Obstructed: the same + drainage.

### Pyonephrosis

- ▶ **Org.:** E. coli mainly
- ▶ **Path.:** 1ry, 2ry
- ▶ **C/P:** Closed: hectic fever, loin pain, swelling (large in 2ry), Open: renal colic ± cystitis.
- ▶ **Comp.:** G. (sepsis), L. (abscess, failure).
- ▶ **Invest.:** CBC, ESR, urine C/S, U/S, IVU, cystoscopy, KFTs, X-ray.
- ▶ **TTT:** Closed: antibiotics + nephrostomy or ureteric catheter.  
Open: TTT of the cause, nephrostomy, nephrectomy.

### Cystitis

- ▶ **Etiology:** E. coli, ascending infection,
- ▶ **C/P:** FAHM, frequency, suprapubic pain, pyuria, hematuria, urethral discharge, tender prostate.
- ▶ **Invest.:** urine analysis & C/S, cystoscopy.
- ▶ **TTT:** rest, fluids, antibiotics.

### Peri-Nephric abscess

- ▶ **Etiology:** 1ry, 2ry
- ▶ **Org.:** Staph. mainly, strept., E.coli
- ▶ **C/P:** fever, pain, swelling, spasm of psoas ms
- ▶ **Invest.:** urine analysis, CBC, U/S, CT, X-ray.
- ▶ **TTT:** drainage, antibiotics

### Bilharziasis of UB

- ▶ Schistosoma (hematopbium 96% > mansoni 4%)
- ▶ **Middle aged male.**
- ▶ **Pathology:** hyperemia, sandy patch, tubercles, nodules, papilloma, granuloma, ulcer.
- ▶ **C/P:** hematuria\*, pain, frequency, difficulty.
- ▶ **Comp.:** 2ry infection, stone, obstruction, spread peri-cystitis, malignancy.
- ▶ **Invest.:** urine analysis, cystoscopy, Abs detection, IVU, X-ray.
- ▶ **TTT:** praziquantel, excision or fulguration acc. to the type of lesion.

### Gonococcal Urethritis

- ▶ **Etiology:** Neisseria Gonorrhea, STD.
- ▶ **C/P:** IP(3-10 days), urethral itching, discharge (yellowish or brown), dysuria.
- ▶ **Comp.:** prostatitis, epididymitis, peri-urethritis → fibrosis → stricture.
- ▶ **Invest.:** gram stained smear, detection of the Gonococcal enzymes, antigens, DNA, liposaccharides.
- ▶ **TTT:** antibiotics, TTT of partner, avoid intercourse till cure.

### Non Gonococcal Urethritis

- ▶ 50% of urethritis.
- ▶ **Etiology:** Chlamydia Trachomatis, STD.
- ▶ **C/P:** IP(7-21 days), discharge (scanty whitish clear), dysuria.
- ▶ **TTT:** tetracycline, TTT of partner.



# Urinary stones

## Incidence

- Common disease present in 10 - 20% of population.
- Males > females.
- Middle age (30 - 50) but no age is immune.
- The disease is common in Egypt due to bilharziasis and hot climate.
- Two thirds of patients have one or more recurrences within the following 8 years.

## Types

1. Calcium stones (oxalate and phosphate) → 75%.
2. Phosphate stones → 15%.
3. Urate stones → 7 - 9%.
4. Cystine stones → 1 - 3%.
5. Xanthine → very rare.

## Predisposing factors

### 1. Inadequate drainage

- Normal urine flow excretes crystals before they can coalesce and grow stones.
- Stasis (BPH and strictures): allow stones to form, Stasis also predisposes to infection.

### 2. Excess normal constituents in urine

➤ Results in precipitation of crystals which initiates stone formation.

#### a. Inadequate urine volume:

- Warm and hot climates → dehydration → concentrated urine.

#### b. Excess calcium:

- Idiopathic.
- Hyperparathyroidism.
- Prolonged immobilization → skeletal decalcification.
- Bone metastasis.
- Vitamin D intoxication.
- ↓ Urinary citrate e.g. during menses (its presence keeps insoluble  $\text{Ca}^{+2}$  phosphate).

#### c. Excess uric acid:

- Gout.
- Purine-rich food, e.g., meat, liver and kidney → increase uric acid level in urine.
- Chemotherapy for leukaemias and lymphomas.

#### d. Excess oxalates:

- Idiopathic hyperoxalluria.
- Excess intake of strawberries, green leafy vegetable and tea.
- Loss of terminal ileum, e.g., by resection or Crohn's disease.

### 3. Presence of abnormal constituents in urine

#### a. Infection:

- Produces epithelial desquamation upon which calculi may deposit.
- Infection with urea-splitting organisms → alkalinization of urine → phosphate stones.

#### b. Foreign bodies:

- Non-absorbable sutures placed at operation, ureteric stents or fragments of broken catheters → nidus for stone formation.



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c. **Vitamin A deficiency:**

- Rare but cause hyperkeratosis of urothelium → epithelial debris → nidus for stone formation.

d. **Cystinuria:**

- Inborn error of metabolism → excess cystine excretion → cystine stone formation.

**Pathology (Types of stones)**

Types	Oxalate	Cystine	Phosphate	Urate
Surface	Spiky	Smooth	Smooth	Smooth
Consistency	Hard	Very hard	Hard	Hard
1 <sup>ry</sup> , 2 <sup>ry</sup>	1 <sup>ry</sup>	1 <sup>ry</sup>	2 <sup>ry</sup>	1 <sup>ry</sup>
Radiological	Opaque	Opaque	Opaque	Lucent
Color	Brownish	Pink to yellow	Yellowish white	Golden yellow



Jagged stone



Smooth stone



Staghorn stone



Smooth stone

- **Oxalate stone:** spiky → injury → blood → brownish in color & early C/P.
- **Phosphate stone:**
  - Is formed of ammonium, magnesium & calcium salts i.e. triple phosphate (**struvite**) & is usually due to proteus infection.
  - It causes minimal symptoms so it is discovered as stag horn stone (i.e. takes the shape of the calyces).
  - The surface is laminated, every layer = an attack of infection.
- **Cystine stone:** opaque due to sulphur content.
- **Xanthine calculi:** are smooth, rounded, brick red in color and show lamellation on cross section.

**Clinical picture**

1. **Usually asymptomatic (accidentally discovered):**

if bilateral, uremia may be the first presentation.

2. **Pain (the leading symptom in 75%):**

⇒ **Renal stones:**

- Dull aching pain due to stretch of renal capsule.
- **Site** → in the flanks, **radiate to:** the back posteriorly or the hypochondrium anteriorly.
- Pain increases by movement.
- **Associated with** nausea and vomiting due to irritation of coeliac ganglion.
- **O/E** → tender renal swelling.

⇒ **Ureteric stones (ureteric colic):**

- Severe **agonizing** pain.
- **Site:** *Upper third* → in the loin → referred to groin or testicles (males) or labia majora (females).  
*Middle third* → iliac pain → simulate appendicitis.  
*Lower end of ureter* → pain at end of micturition → referred to the tip of penis.
- Sudden onset, short duration (**rarely > 8 hours**).
- **Associated with** nausea, vomiting and if intramural → strangury (painful passage of few drops of urine).

**Clinical picture:**

- 1- Asymptomatic.
- 2- Pain.
- 3- Complications (hematuria)



- Hematuria may occur with attack of ureteric colic (gross or microscopic).
- O/E → rigidity of lateral abdominal muscles (not rectus abdominis muscle).

## ⇒ Bladder stones:

- Varies from slight discomfort to severe pain.
- Site: in the supra-pubic region referred to the tip of penis or labia majora at the end of micturation (due to contraction of the bladder around the stone).
- Timing: more during day, aggravated by movement and relieved by lying down (as the stone moves away from the trigone).  
→ If cystitis develops → becomes diurnal (day) and nocturnal (night).
- Associated with:
  - **Frequency (earliest):** first diurnal then diurnal and nocturnal (after infection).
  - Difficult micturition and interruption of stream.
  - Acute retention of urine due to obstruction of bladder neck.
  - Terminal haematuria (abrasions of the trigone).

## ⇒ Urethral stones:

- **Migratory stone:** history of renal colic 2-3 days before.
- During the last micturition → sudden arrest of urine.
- Followed by acute retention.
- O/E → felt on the under surface of penis if in penile urethra.

## 3. Clinical picture of complications:

- ⇒ **Uremia:** anorexia, hiccough, asterixis, anemia, bleeding tendency, confusion, coma and pericarditis.
- ⇒ **Painful hematuria or pyuria (if infected).**
- ⇒ **Anuria:** due to retention.
- ⇒ **Severe persistent renal pain:** if complete obstruction of ureter.

## Complications (HIMOM)

### 1. Hematuria (painful) *Due to ulceration:*

- Total** → in renal, pelvic or ureteric stones.
- Terminal** → in bladder stones.
- Initial** → in prostatic urethral causes.
- Not related to micturation** → in distal urethral causes.

### 2. Infection

- **Pyelonephritis** → loin pain, fever, rigors, frequency and dysuria.
- **Pyonephrosis** → painful loin swelling with marked constitutional symptoms.
- **Cystitis** → supra-pubic pain with day and night frequency & dysuria.

### 3. Migration

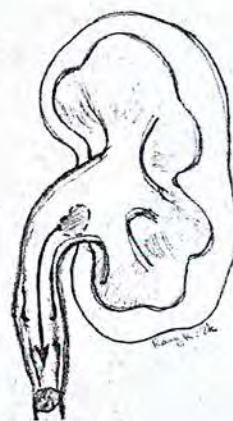
- Leading to change in the character of pain according to the site.

### 4. Obstruction

#### ⇒ Back pressure:

#### A-Above the urinary bladder:

- Partial** → ipsilateral hydroureter and hydronephrosis:
  - Stone impacted in ureter or pelvi-ureteric junction.
  - Stone impacted at neck of calyx → dilatation of this calyx (hydrocalyx).
  - Usually discovered by investigations to the 1<sup>st</sup> cause.
  - Rarely presented by loin swelling or pyonephrosis if infected.
  - Bilateral cases → renal atrophy & renal failure.





2. Complete → calculus anuria:

- If bilateral ureteric obstruction or unilateral in the only functioning kidney.
- No urine, no desire, empty bladder.

B-At bladder neck or urethra → acute retention

- Painful desire with full bladder.

### Malignancy

- Squamous cell carcinoma on top of leucoplakia.
- Exaggeration of vesical syndrome with strangury and supra-pubic mass.

### DD

#### Causes of loin to groin pain

1. Renal or ureteric calculi.
2. Infection:
  - Pyelonephritis.
  - Cystitis with ascending infection.
3. Hydronephrosis.
4. Renal cell carcinoma.
5. Carbuncle of the kidney.

*The principal difficulty on the right side is to distinguish symptoms and signs of ureteric colic from those of acute appendicitis or acute cholecystitis. In practice, the patient with acute renal colic is usually in greater pain and less systemically ill.*

## Investigations

### A- For diagnosis

#### A. Laboratory:

##### ⇒ Urine examination:

- RBCs are detected in 90% of specimens (gross or microscopic).
- Crystals:
  - Envelope-like → oxalate stone.
  - Hexagonal plate → cystine stone.

#### B. Radiology:

1. Plain x-ray (KUB film): (shows 90% of urinary stones)
  - Postero-anterior view and lateral view.
  - In descending order of radiodensity: calcium phosphate (the densest) → calcium oxalate → struvite → cystine → uric acid (considered radiolucent).
  - In lateral view, if calcification is anterior to the vertebral body = outside the urinary tract) (☆).



#### (☆) Opacities on a plain abdominal x-ray which may be confused with renal calculi:

1. Calcified mesenteric LNs (multiple, mottled, along the root of mesentery).
2. Gall stones (in 15%).
3. Phlebolith (radiolucent center), faecolith, appendicolith.
4. Ossified tip of 12<sup>th</sup> rib.
5. Calcified T.B lesion of the kidney.
6. Foreign body in the alimentary canal.
7. Calcified adrenal gland.
8. Fracture tip of transverse process of lumbar vertebra.
9. Nephrocalcinosis.
10. Calcified renal tumors.



## 2. U/S (very commonly used):

- The presence of stones either radio-opaque or radiolucent.
- Renal parenchymal thickness.
- Not reliable in visualization of uretric calculi.

## 3. CT scan with contrast (preferably spiral CT): → are now the mainstay of imaging.

## 4. IVU: (intravenous urography = descending urography)

- Done if KFTs are within normal.
- **Anatomical values:**
  - To detect radio-lucent stones (10%) → filling defect.
  - To show any back pressure.
- **Functional values:**
  - Differential kidney function.
- **Contraindications:**
  - Blood urea > 50 mg%.
  - During attacks of pain.



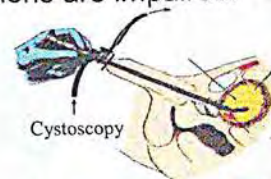
## 5. Ascending urography (retrograde urography): if renal functions are impaired.

## 6. Isotope scanning of the kidney (rarely needed):

- Static (DSMA).
- Dynamic (DTPA).

## C. Instrumental: (Cystoscopy)

- May show bladder stones.
- May show bloody efflux from the ureteric orifice on the affected side or an impacted stone.



## Sites of impaction of ureteric stone

- Pelvi-ureteric junction.
- Site of crossing of iliac arteries.
- At the site of crossing of the broad ligament in females or at the site of crossing of the vas in males.
- At the site of entry into the bladder wall.
- At the ureteric orifice.



## B- For the cause (mainly in recurrent and bilateral cases)

1. Serum calcium, phosphorus & parathormone → for hyperparathyroidism.
2. Stone analysis: if the stone is retrieved.
3. Uric acid in blood.
4. Calcium, uric acid, cystine in 24hours urine.

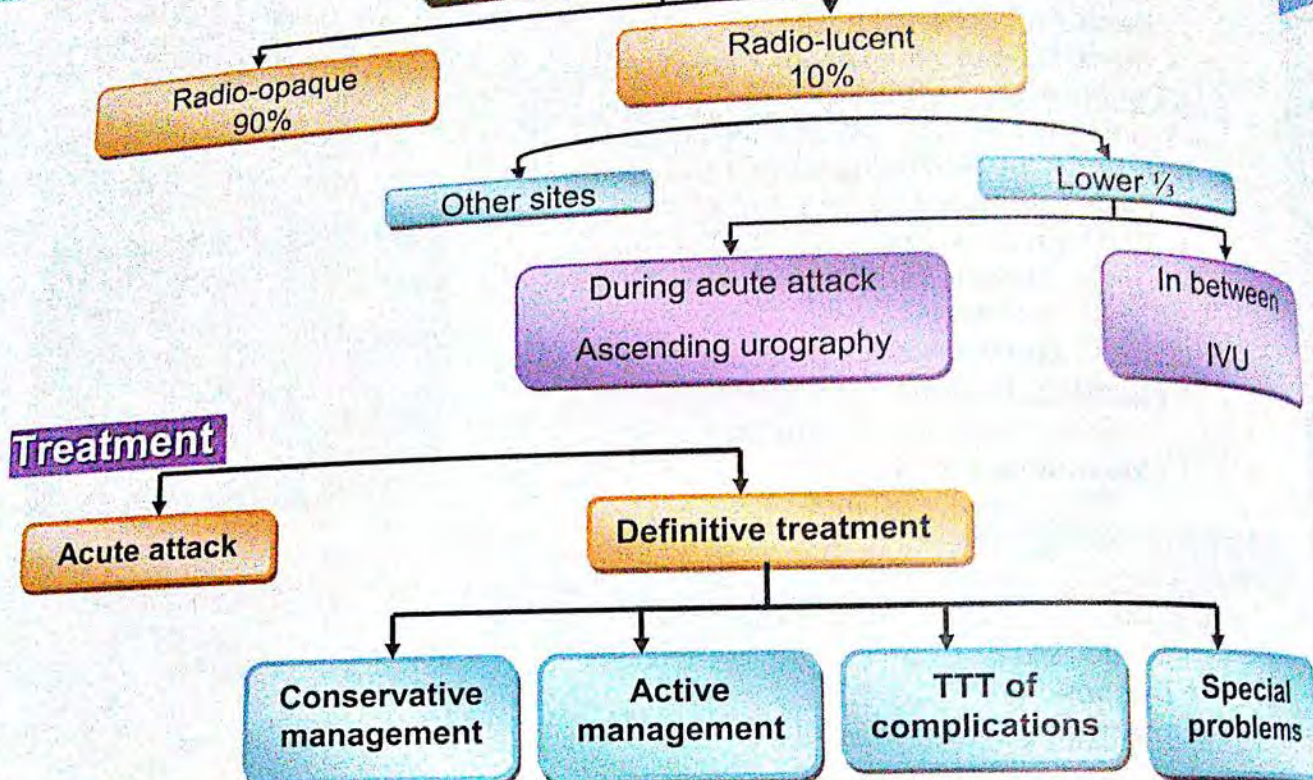
## C- For complications

- Urine analysis, KFTs.



## SPECIAL SURGERY

Plain X-ray

**I- Treatment of Renal Colic (Acute attack)**

1. Most cases are treated as outpatients.
2. Hospitalization is required for patients with severe colic specially with persistent vomiting.
3. Parenteral analgesics:
  - a. NSAID, e.g., indomethacin or diclofenac.
  - b. Narcotic analgesics: given in resistant cases.
4. Anti-emetics, e.g., metochlopramide.
5. IV fluids are given if vomiting is persistent.
  - Forcing excess fluids in acute attack of colic would help to flush out the stone but may also increase pain by increasing urine flow on an obstructed kidney.
6. Antibiotics are given only if there is suspicion of urinary tract infection.

**II- Definitive treatment**

(After resolution of the acute attack or in accidentally discovered stones)

**1. Conservative management (up to 2 weeks):**

(If small < 0.5 cm, with no complications → 90% will pass spontaneously)

⇒ Ample of fluids ± diuretics, Antispasmodics, Acidification of the urine, Antibiotics & follow up.

**2. Active management (if failed conservative, complicated or > 0.5cm):**

⇒ **Renal stone:**

**A. Instrumental:**

- If 1-2 cm → Extra-corporeal Shock Wave Lithotripsy (ESWL).
- If > 2 cm (or stag-horn) → Percutaneous nephrolithotripsy (PCNL) ± ESWL.



## B. Surgical (if failed or unavailable instrument):

- Renal stone → Nephro-lithotomy.
- Pelvic stone → Pyelo-lithotomy.
- Stag horn stone → Extended pyelo-nephro-lithotomy.

- Partial nephrectomy → if multiple stones causing cavitations in the lower calyx.
- Total nephrectomy → if the kidney is non-functioning and the other kidney is normal.

## ⇒ Ureteric stone:

### A. Upper 1/3:

- < 1 cm → push-bang technique or ESWL in situ.
- > 1 cm → Pyelo-lithotomy through lumbar or Morris incision.

- ### B. Middle 1/3:
- open surgery is the treatment of choice.  
→ uretero-lithotomy through Abernathy's incision.

### C. Lower 1/3:

- < 1 cm → extracted by ureteroscopy.
- < 2 cm → fragmented and extracted by ureteroscopy.
- > 2 cm → open surgery → ureterolithotomy, lower midline or Pfannenstiel's incision.

## ⇒ Bladder stone:

### A. Instrumental:

- If 1 – 2 cm → Cystoscopic litholapaxy.
- If failed or contraindicated → percutaneous supra-pubic litholapaxy.

### B. Surgical:

- If > 2 cm → Supra-pubic cysto-lithotomy.

## ⇒ Urethral stone:

### • Prostatic urethra:

- Push to bladder by metal bougie to be crushed by litholapaxy & evacuate fragments.
- If failed → Supra-pubic cysto-lithotomy.

### • Stone in membranous and bulbous urethra:

- Removed by urethral forceps or wire basket through a urethro-cystoscope.
- If failed → open surgery is performed through a perineal incision → wound is then closed on a urethral catheter.

### • Stone in penile urethra:

- Gentle trials to milk the stone out of the meatus helped by injecting a lubricant gel, or by use of forceps.
- Never try to open on a stone in penile urethra to avoid penile urinary fistula (no muscle support of this part of the urethra).

### • Stone in fossa navicularis or at meatus

- Trial to milk out the stone → if failed → meatotomy (cutting external meatus) is done to allow stone extraction.



### 3. TTT of complications:

⇒ If UTI → preoperative antibiotics.

⇒ Hydronephrosis:

- If the kidneys are still functioning → removal of the stone.

- If the kidneys are not functioning:

- If unilateral & the other kidney is functioning → nephrectomy.

- If bilateral → nephrostomy tube, then treatment of the better functioning kidney; if still not functioning → dialysis then transplantation.

⇒ Pyonephrosis: as before but add parenteral antibiotics.

⇒ Acute retention of urine: relief of retention by catheterization or supra-pubic cystostomy, to be prepared for definitive treatment.

⇒ Calculus anuria:

- Relieve by ureteric catheter with trial of endoscopic extraction.
- If failed → nephrostomy tube then uretero-lithotomy.

### 4. Special problems:

⇒ Recurrence: avoided by:

1. Excess water intake is the most valuable prophylaxis against stone formation.
2. Chemical analysis of the stone, and restriction of diet containing high amount of its composition.

3. Metabolic work-up to know the etiology of stone:

- Serum calcium and phosphorus (for hyperparathyroidism).
- 24-hour urine collection for detection of excess crystals.

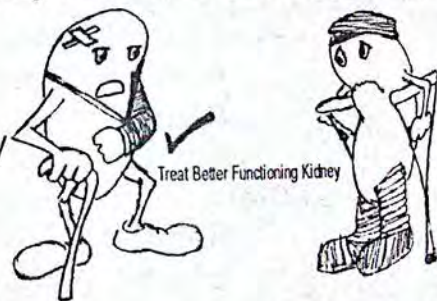
4. Treatment of infections and other causes of calculi e.g. hyperparathyroidism.

5. Follow up of patients that had previous stones to detect early recurrence.

⇒ Bilateral stones: start by the better functioning kidney then treat the other one after 2 - 3 months with exception:

1. Painful side first if pain persists.
2. Pyonephrosis first to save life.

⇒ Multiple stones: start by urethra, ureter, kidney then bladder.





**SUMMARY OF TREATMENT OF RENAL STONES****Renal colic = Analgesia + IVU or spiral CT****Stone demonstrated**

&lt; 0.5 cm

Should pass spontaneously  
→ conservative TTT up to 2 weeks

&gt; 0.5 cm

**No obstruction****Obstruction**

Renal failure/sepsis/solitary kidney/ continuing obstruction

No

Yes

Nephrostomy

**Where is the stone?****Renal pelvis**

- ESWL 1<sup>st</sup> line
- PCNL if stagehorn or large stone

**Upper 1/3 ureter**

Push-Bang or ESWL in situ

**Middle 1/3 ureter**

- Push-Bang 1<sup>st</sup> line or ESWL in situ (difficult)
- If not consider open surgery

**Lower 1/3 ureter**

Dormia basket or JJ stent



## More details about treatment of stones

### 1. Conservative:

#### ▪ Indications:

1. Small (less than 0.5 cm), with no complications.
2. Patient is unfit for surgery.
3. Prophylaxis against recurrence of stones after instrumental or surgical treatment.

#### ▪ Methods:

1. **Avoid foods** which cause crystalluria, e.g.
  - i. Oxalate in spinach, tomato, berries.
  - ii. Uric acid in liver, brain, kidney, ducks, goose & red meat.
  - iii. Cystine in high sulphur containing proteins e.g. eggs, meat and fish.
2. **Ample amount of fluids** or diuretics; the best is osmotic diuresis.
3. **Antibiotics** e.g. sulfa, quinolones.
4. **Acidify** the urine by ammonium chloride or vitamin C in phosphate stone.
5. **Analgesic & antispasmodic** during the attack of colic.
6. **Agenda: Follow up by radiography** every 6-8 weeks & if no detectable descent is noted, the stone should be removed by instrumental or surgical treatment.

### 2. Instrumental:

#### ▪ Indications:

1. Stone larger than 1 cm.
2. Complications.
3. Stone not moving (ureteric stones).

#### ▪ Methods:

##### 1. Extracorporeal Shock Wave Lithotripsy (ESWL)

⇒ **Indicated in** all radio-opaque stones less than 2 cm whether calyceal or pelvic.

##### ⇒ Principle:

- 1- This method depends on high-energy electric-generated shock waves.
- 2- They are focused from outside the body on the stone visualized using X-ray or ultrasonic imaging.
- 3- The stone is fragmented to minute particles → pass through urinary tract.
- 4- High fluid intake is maintained to facilitate passage of gravels.
- 5- The procedure is performed without anesthesia, except in children.

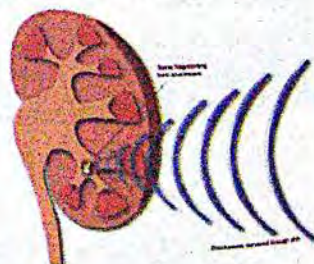
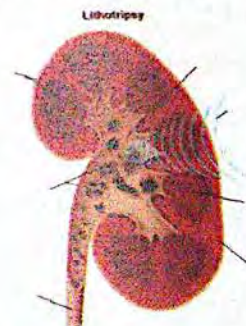
##### ⇒ Advantages:

1. Painless, non invasive technique which can be done as an outpatient procedure.
2. Suitable for risky patients.
3. Successful for most radio-opaque urinary calculi, → Uric acid calculi are radiolucent and may cause some difficulty.

##### ⇒ Contraindications:

##### A. Urological:

1. Distal obstruction.
2. Large stones except after decreasing the size of the stone by PCNL.





3. Renal insufficiency.
4. Single kidney.
5. Acute pyelonephritis.

#### B. Non-urological:

1. Pregnancy and bleeding tendency.
2. Spine abnormalities (as location of the stone is difficult).

#### ⇒ Complications:

1. Infection: the principle complication as the stones contain bacteria → released when the stone is broken (**give prophylactic antibiotics**).
2. Transient attacks of haematuria (passage of gravels through the ureter).
3. Ureteric colic during the passage of fragments (**give analgesics**).
4. Failure to disintegrate the stone.
5. Acute obstruction by fragments (**put self-retaining ureteric catheter**).

### 2. Percutaneous nephrolithotomy

⇒ Endoscopic technique to fragment and remove renal stones.

#### ⇒ Indications:

1. Stone > 2 cm (especially hard cystine stone).
2. ESWL failure.
3. Cystine stones (very hard for ESWL).
4. Urinary obstructive lesions.

#### ⇒ Method:

1. Establish a track for percutaneous endoscopy.
2. A nephroscope is introduced at the location of the stone.
3. Small stone → extracted with forceps.
4. Large stone → fragmented by lithotripsy.
5. Insertion of a nephrostomy tube for 48 hours for drainage.

#### ⇒ Advantages:

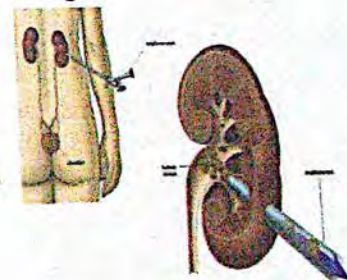
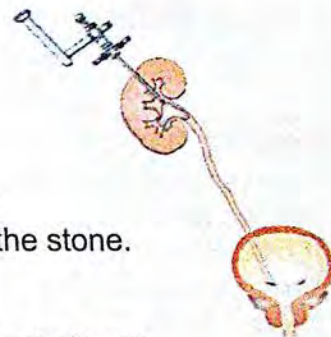
1. Very small endoscopic incisions (1 cm).
2. Short hospital stay (3 days).
3. Can be done by local anesthesia.
4. Minimal operative and post-operative side effects.

#### ⇒ Complications:

1. Hemorrhage.
2. Residual stones.
3. Injury:
  - Renal or other organs injury e.g. colon, pleura.
  - Bleeding ± urine extravasations.
  - A-V fistula formation.
  - Subcutaneous fistula.

#### ⇒ Contraindications:

1. Bleeding tendency.
2. Congenital renal anomalies, e.g., horseshoe or ectopic kidney (has abnormal vessels).
3. Pregnancy and spine deformities.





**3. Cystoscopic Litholapaxy**

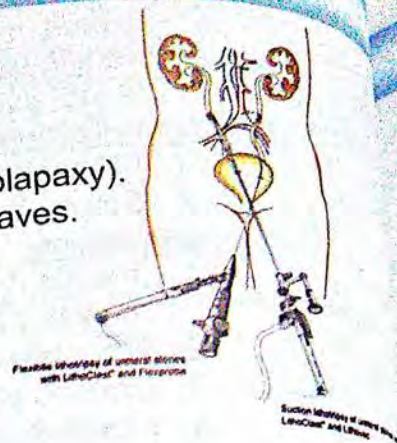
⇒ **Indications:** Stones less than 2 cm.

⇒ **Method:**

1. Using cystoscopy → stone is crushed, either:
  - a- Mechanically by lithotrite (technique is called litholapaxy).
  - b- By ultrasonic waves or electro-hydraulic shock waves.
2. Fragments are then lavaged through cystoscopy to outside the bladder by Ellik's evacuator.

⇒ **Complications:**

- Bleeding, injury to the bladder or urethra, and failure to crush the stone.

**3. Surgical:**

⇒ **Indications:**

1. Failure of instrumental treatment.
2. Instrumental treatment not available or contraindicated.

⇒ **Methods:** according to the site of the stone.

**Renal stone****1- Pyelo-lithotomy**

- Means opening the renal pelvis and removal of the stone.
- Always tried first especially with extra-renal pelvis.
- It can to be done in intra-renal pelvis by the use of Gil Vernet retractor.
- Done by exposing the posterior surface of the kidney → reach the renal pelvis (most posterior) → remove the stone.
- **Closure:**
  - If no sepsis → interrupted absorbable suture.
  - If gross sepsis → leave a tube for drainage.

⇒ **Advantages:**

- Minimal bleeding.
- No damage for renal parenchyma.
- Rapid healing.

**2- Nephro-lithotomy**

⇒ **Means incision through renal parenchyma to remove a stone.**

⇒ **Indicated in:**

- Difficulty in exposing the renal pelvis.
- Stone large and palpable through thin renal parenchyma.

**3- Pyelo-nephro-lithotomy**

- Removal of the stone through an incision in the renal pelvis & the kidney substance.

⇒ **Indications:**

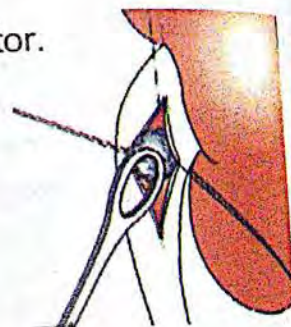
- Multiple stones in the renal pelvis.
- Stag horn stone.

**4- Partial nephrectomy**

- Indicated for a stone impacted in a hugely dilated non functioning lower calyx with narrowing of its neck.

**5- Total nephrectomy**

- If the kidney is non-functioning provided that the other kidney is normal.

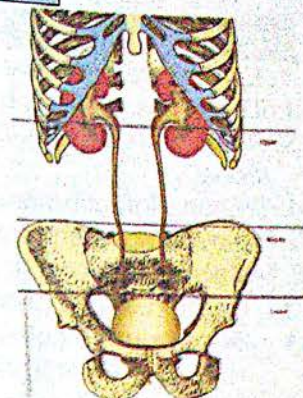




## Open surgery (uretrolithotomy)

### ⇒ Indications:

1. Stones >1 cm in upper ureter.
2. Stones >2cm in lower ureter.
3. Stones in middle ureter.
4. Associated ureteric stricture.
5. Failed URS or ESWL.
6. Contraindication to URS or ESWL.



### Stone in the upper 1/3

- Can be removed by **pyelolithotomy** through Morris incision.

### Stone in the middle 1/3

- Can be removed by **ureterolithotomy** through Abernathy incision.

### Stone in the lower 1/3

- If above the ischial spine: removed by ureterolithotomy through Abernathy incision.
- If below the ischial spine: removed by ureterolithotomy through mid-line supra-pubic incision or Pfannenstiel incision.



#### 1- Morris (lumbar) incision:

From above the renal angle to about 1" above the ASIS (passing downwards & forwards).

#### 2- Abernathy incision:

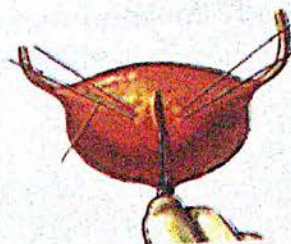
1" above the ASIS and passes downwards & medially to mid-inguinal point (muscle cutting).

# Bladder stone

## Supra-pubic cysto-lithotomy

### ⇒ Indications:

1. Stone larger than 2 cm.
2. Multiple stones.
3. Stone in a diverticulum (has thin wall, so easy to perforate).
4. Very hard stones.
5. Presence of another pathology needing surgery.
6. In children (weak vulnerable urethra).
7. Failure of crushing or disintegration.





## Prevention of Urinary Stones Recurrence

### General measures

1. Excess water intake (especially in hot weather).
2. The stone should be chemically analyzed.
3. Restriction of diet containing high crystals according to chemical composition of the stone.
4. Treating infection and other causes of stone formation.
5. Follow up of stone formers to detect early recurrence.
6. Metabolic work-up to know etiology of the stone.
  - Serum Ca and phosphorus to exclude hyperparathyroidism.
  - 24-hour urine collection for the following whose normal values are:
    - Ca <300 mg.
    - Uric acid <800 mg.
    - Oxalates <40 mg.
    - Citrates 300-900 mg.

### Calcium oxalate stones

1. Avoid diet rich in oxalates.
2. Hydrochlorothiazide 50 mg/d aids in the dissolution of Ca oxalate stones.
3. Citrates 5 mg bid inhibits crystallization of oxalates.

### Uric acid stones

1. Avoid diet rich in purines.
2. Rule out myeloproliferative or neoplastic diseases.
3. Urine should be kept alkaline, e.g. by  $\text{NaHCO}_3$  1 gm tds.
4. Allopurinol (Xyioric) 300 mg/day is indicated in patients with hyperuricemia.  
→ It inhibits the formation of uric acid.

### Ammonium magnesium phosphate (struvite)

1. Aluminum hydroxide orally restricts phosphate absorption.
2. Long term antibiotics to eradicate UTI.
3. Avoid indwelling catheters.
4. Increase urine acidity by oral administration of 1 gm vitamin C daily.



# Obstructive Uropathy

## Definition

- Obstruction anywhere in the urinary tract associated with changes in the urinary system proximal to the obstruction.

## Classifications

1. Acute or chronic obstruction.
2. Partial or complete obstruction.
3. Unilateral or bilateral obstruction.
4. Congenital or acquired obstruction.
5. Extrinsic or intrinsic obstruction.

## Etiology

### I. Unilateral

#### A. Kidney and pelvis:

##### • Congenital:

1. Horse-shoe kidney.
2. Aberrant renal vessels crossing the pelvis.
3. PUJ obstruction.

##### • Acquired:

1. Stones.
2. Tumors of the kidney or pelvis.
3. Renal TB.

#### B. Ureteric obstruction:

##### • From outside:

1. Pressure from adjacent structures e.g. cancer cervix, rectum...etc.
2. Idiopathic retro-peritoneal fibrosis.
3. Retro-caval ureter.

##### • In the wall:

1. Congenital stenosis.
2. Ureterocele.
3. Inflammatory stricture after repair of damaged ureter, calculus or ureteric TB.
4. Neoplasm of ureter or bladder cancer involving the ureteric orifice.

##### • In the lumen:

1. Stone (commonest).
2. Clot retention.

### II. Bilateral (lower urinary tract obstruction)

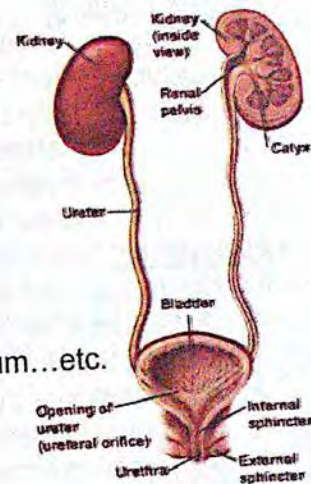
#### A. Urinary bladder causes:

1. Tumors involving uretero-vesical junction, whether primary or secondary.
2. Neurogenic bladder dysfunction.

#### B. Bladder neck causes:

1. Congenital bladder neck obstruction.
2. Bilharzias bladder neck obstruction.
3. Bladder neck tumors from the urinary bladder or local extension from prostate or cervix.

- The commonest cause for unilateral obstruction is stone.
- The commonest cause for bilateral obstruction is BPH





**C. Prostate causes:**

1. Benign prostatic hyperplasia (BPH).
2. Carcinoma of the prostate.

**D. Urethral causes:**

1. Congenital causes as meatal stenosis and posterior urethral valves.
2. Stricture of the urethra.

**Pathological changes****A. Urethra**

- Dilatation.

**B. Urinary bladder**

- Early → Muscle hypertrophy and trabeculation  
→ Acquired false pulsion diverticulae and saccules.
- Late → bladder dilatation and atony → retention of urine.

**C. Ureter**

- Early → muscle hypertrophy.
- Late → atony and dilatation (hydro-ureter).

**D. kidney****• Morphological:**

- Early → pelvic hypertrophy.
- Calyces → lost normal concavity (cupping) → flattening → clubbing → ballooning.
- Late → pelvic atony and dilatation (hydronephrosis).  
→ Parenchymal thinning and atrophy.  
→ Finally, kidney is completely destroyed → thin-walled sac filled with clear fluid or, if infected with pus.

- **Functional:** Normally, the pressure within the renal pelvis is close to Zero.  
Increased intra-pelvic pressure → urine excretion stops → ↓ GFR

- If unilateral → contralateral hypertrophy and ↑ function.
- If bilateral → renal failure.
- Pyelo-venous, pyelo-lymphatic, and pyelo-tubular back flow occur → Urine leaking into the interstitial tissues → absorbed by the renal lymphatics.
- Renal concentrating power is gradually lost.

**Factors affecting morphological & functional changes:****1. Level of obstruction:**

- Lesions at or below the bladder neck → Bilateral effect.
- Lesions in the ureter or pelvi-ureteric junction → Unilateral effect.

**2. Degree of obstruction:** Severe obstruction leads to more damage to the kidney.**3. Duration of obstruction:**

- Long-standing partial or intermittent obstruction → significant proximal dilatation.
- Acute obstruction → mild dilatation but more rapid deterioration of function.

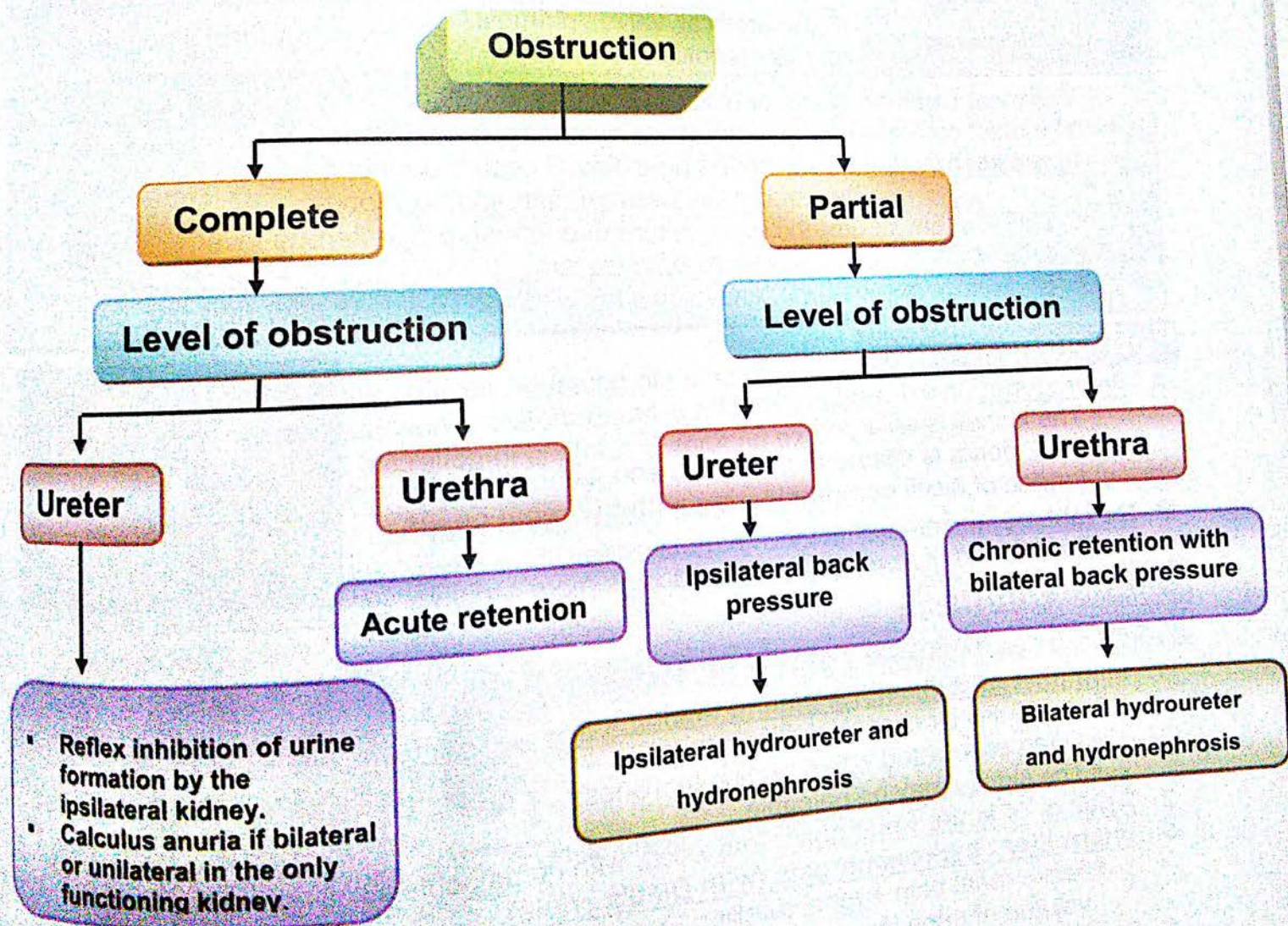
**4. Development of infection** on top of obstruction causes very serious deterioration of function of the affected kidney.



- N.B.:**
- Acute obstructive conditions that need urgent interventions are:
    1. Acute retention of urine.
    2. Calcular anuria.
    3. Ligation of both ureters during a surgical procedure
  - Bilateral obstructions or infra-vesical obstructions are serious because they affect both sides of urinary tract with resulting uraemia.
  - Obstructive uropathy consequences are reversible when treated early.
  - A combination of urinary obstruction and infection leads to rapid deterioration of kidney function.

## Sequalae of obstructive uropathy

- Hydronephrosis.
- Retention of urine.
- Calcular anuria.





# Hydronephrosis

## Definition

- Aseptic distention of the pelvi-calyceal system due to chronic or intermittent obstruction.

## Causes

		Congenital		Acquired	
		Unilateral	Bilateral	Unilateral	Bilateral
Unilateral	Renal	Horse-shoe kidney, aberrant renal vessels crossing the pelvis, PUJ obstruction		Stones, tumors, renal TB, Bilharziasis, iatrogenic injury	
	Ureteric	Ureteric reflux, ureterocele, stenosis, retrocaval ureter		Stones, tumors, TB, pregnancy, pressure from outside (as cancer cervix)	
Bilateral	Urinary bladder	Congenital contracture of the bladder neck		Stones, BNO, tumors, T.B, neurogenic bladder	
	Prostatic			Stones, BPH, cancer prostate	
	Urethral	Post. urethral valve, phimosis, meatal stenosis		Stones, urethral stricture	

- The most common cause of bilateral hydronephrosis is SEP.
- The most common cause of unilateral hydronephrosis is stone.
- In pregnancy:**
  - a- Usually on the right side, it occurs during the first few weeks, reaches maximum between fifth and six months.
  - b- Due to atony of ureteric musculature due to high progesterone level.
  - c- Also, the fetal head may press both ureters.
  - d- Hydronephrosis of pregnancy subsides within 2-12 weeks after delivery.

## Pathology (2 types)

### A. Pelvic type: (in extra-renal pelvis)

- The kidney is enlarged.
- First, pelvis is dilated then calyces and, later, the kidney is formed of loculi **communicating with the renal pelvis**.

### B. Renal type: (in intra-renal pelvis)

- Destruction of renal parenchyma occurs more rapidly.



## Clinical picture

### A. Presentations of hydronephrosis

#### 1. Mild pain or dull aching pain in the loin:

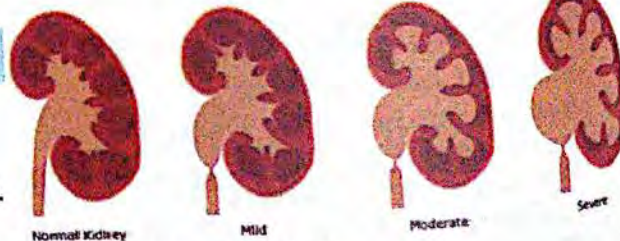
- Increases by excessive fluid intake.
- Often associated with dragging heaviness.
- The kidney may be palpable.

#### 2. Attacks of acute renal colic: may occur with no palpable swelling.

#### 3. Intermittent hydronephrosis (with Dietl's crisis)

- Acute renal pain + renal swelling → some hours later → no pain or swelling but large volume of urine is passed.

#### 4. In late stages → a cystic swelling filling the renal angle can be palpated.





**B. C/P of the cause**

- Stone → colic, painful hematuria.
- BPH → prostatism (LUTs).
- TB → constitutional symptoms, frequency.

**C. C/P of the complications**

- e.g. Hypertension, fever (in infections) and in late cases → renal failure.

**Complications****General**

- Renal hypertension.
- Renal failure (if bilateral hydronephrosis or unilateral in the only functioning kidney).

**Local****⇒ As any cyst:**

- a) Infection → pyonephrosis (2<sup>ry</sup>).
- b) Pressure atrophy.
- c) Others: calcification – rarely hemorrhage or rupture (more liable to trauma).

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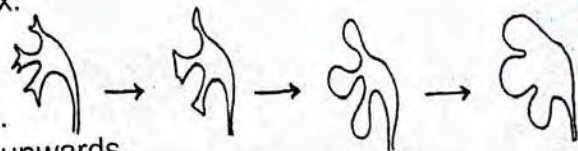
- Of loin mass (polycystic kidney, hypernephroma, liver swellings on the right side, splenomegaly on the left side).

**Investigations****A- For diagnosis**

- **U/S:** detects the **size** of the kidney and the **thickness** of the renal cortex.

**▪ IVU:**

- Dilatation of renal pelvis which become biconvex.
- Flattening of calyces.
- Clubbing.
- Ballooning of the calyces, widening of the waist.
- Pelvi-ureteric junction is distorted and is raised upwards.
- Later, delayed excretion of contrast → then no excretion occurs.

**▪ Ascending (retrograde) pyelography:**

- Indicated if IVU is contraindicated due to renal failure.
- It helps to visualize the pelvi-calyceal system → confirm site of obstruction.

**▪ Renal isotope scan:** to show the remaining functioning parenchyma.**▪ Plain X-ray:**

- Abnormal psoas shadow.
- Stone, calcifications.

**▪ Descending (antegrade) pyelography:** done if a nephrostomy tube is present.**B- For complications**

- **KFTs:** for renal failure.
- **Urine analysis:** polyuria of low specific gravity, also for RBCs, WBCs and crystals.
- **CBC & ESR:** to exclude infection.

**C- For the cause**

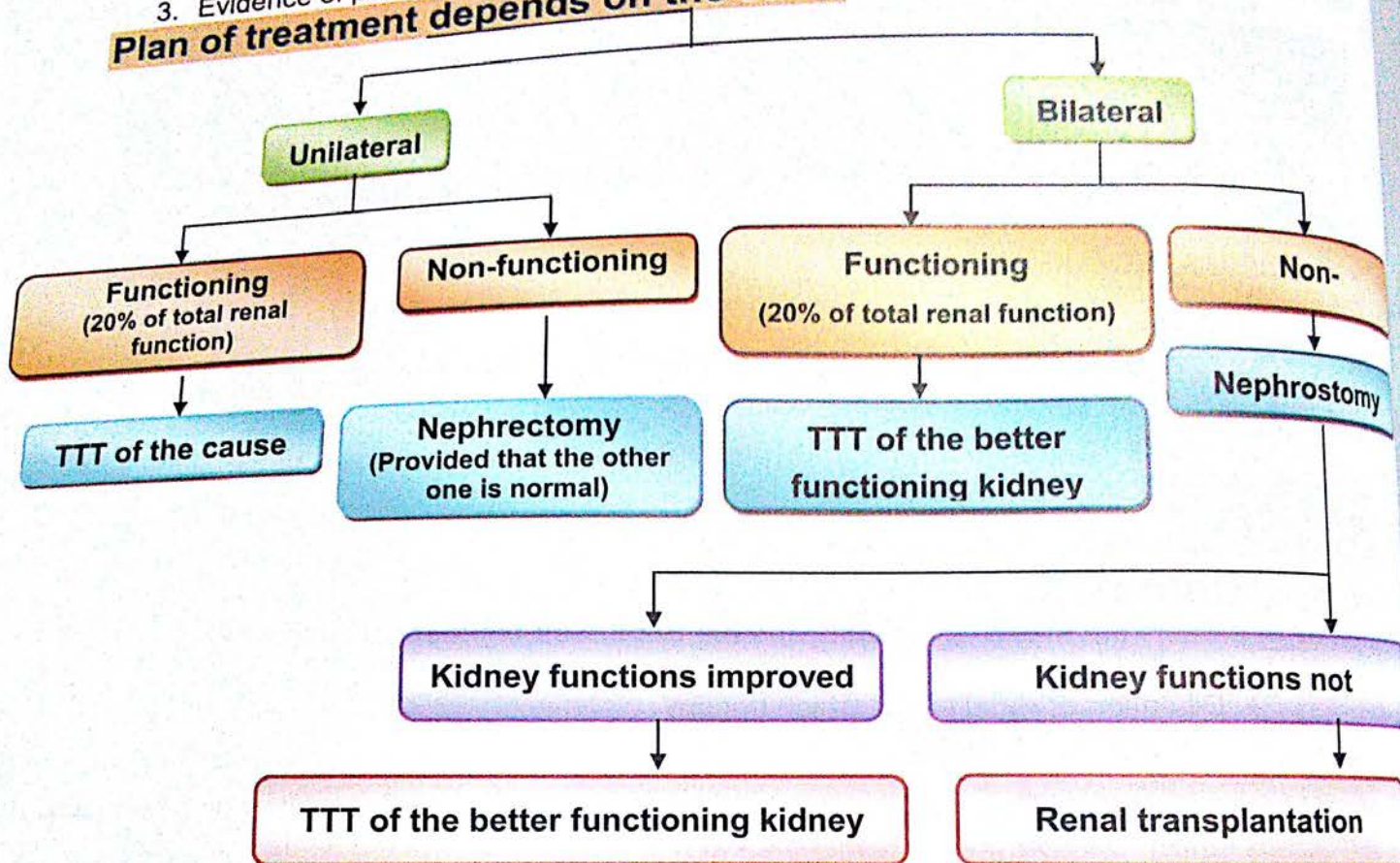
- **Trans-rectal U/S** → for SEP.
- **Cystoscopy** → bladder lesions (bilharziasis or tumor).



**Treatment****Indications of surgical treatment**

1. Bouts of renal pain.
3. Evidence of parenchymal damage.

2. Increasing hydronephrosis.
4. Infection.

**Plan of treatment depends on the case**

▪ **Nephrectomy is done with the following criteria:**

- The kidney is non functioning with infusion urography.
- U/S showed very thin parenchyma.
- Renal scan shows zero function.
- The opposite kidney is normal.

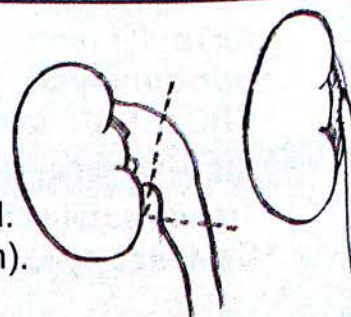
- In advanced cases: plastic reconstruction of the dilated renal pelvis (Anderson-Hynes operation) is performed to reduce the size of the dilated pelvis and to provide adequate drainage of the lowest part of the pelvis.
- **Recently:** endoscopic pyelolysis is done.

**Treatment of the cause**

→ Whether congenital or acquired.

**Treatment of complications**

- **Renal hypertension:** ACE inhibitors, Nephrectomy of the affected kidney provided that the other kidney is normal.
- **Renal failure:** replacement therapy (dialysis or transplantation).
- **Pyonephrosis:** drainage and parenteral antibiotics.





# Retention of urine

## Definition

- Failure of bladder evacuation with functioning kidneys.

## Types

- Acute retention:**
  - Sudden complete failure to pass urine, **Painful**.
- Chronic retention:**
  - The patient can pass urine but some urine always remains in the bladder (residual urine increases), **Painless**.
- Retention with overflow (false incontinence):**
  - Micturation is replaced by a continuous dribbling of urine from an over-distended bladder on top of neglected chronic retention, **Painless**.

## 1. Acute retention of urine

## Etiology

### 1. Mechanical lower urinary tract obstruction:

- Urethra:** rupture, stones, blood clot, stricture.
- Prostate:** SEP, acute prostatitis.
- Bladder:** stone.
- Pelvic mass:** incarcerated gravid uterus.
- Fecal impaction.**

### 2. Paralytic:

- Acute stage of spinal cord injury.
- Multiple sclerosis.
- Surgical denervation of bladder.
- Spinal anesthesia.
- Drug induced: e.g. tranquilizers (e.g. TCA) or anticholinergics (e.g. propantheline).

### > The most common causes are:

- Senile enlargement of prostate.
- Stone (in urethra).
- Trauma.
- Postoperative.

### 3. Hysterical.

### 4. Reflex: postoperative, especially after anorectal operations (due to anal pain e.g. post-hemorrhoidectomy).

## Clinical picture

## Symptoms

### 1. Symptoms of acute retention:

- Supra-pubic cramp like pain.
- Severe **desire** to micturate.
- Inability** to pass urine in spite of desire.

### 2. Symptoms of the cause:

#### 1- Stone:

- UB → supra-pubic pain referred to the tip of penis & terminal hematuria.
- Urethra → urethral pain referred to the tip of penis & initial hematuria.

#### 2- SEP → prostatism (LUTs):

- Dysuria, night frequency, hesitancy, weak stream, post-micturation dribbling, double micturation and attacks of retention.

#### 3- History of trauma or operation few days before.



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**Signs (locally)**▪ **Urinary bladder:**

- Bladder may be felt as a tender median pyriform swelling above the symphysis pubis → dull on percussion.

▪ **Kidney:** may be loin swelling due to back pressure.▪ **Urethra:** palpate the urethra for stone▪ **DRE:** may show the cause e.g.

- BPH → soft, symmetrical, smooth, preserved sulcus, mobile rectal mucosa.
- Cancer prostate → hard, asymmetrical, nodular, obliterated sulcus, fixed rectal mucosa.

**DD**

- Acute retention from calculi anuria → (see calculi anuria).

**Investigations****For diagnosis**

- Diagnosed clinically.
- Pelvic U/S → shows full bladder.

**For the cause**

- X-ray → stone, or carcinoma.
- Trans-rectal U/S → SEP, cancer prostate.

**Management****Treatment of retention****A. Reflex retention** → never rush to catheter.

- You are a doctor not a plumber → don't be catheter-minded.
- Neurological causes should be excluded by checking perianal sensations and LL reflexes.

⇒ **Conservative:**

1. Strong analgesics for pain.
2. Encourage the patient to get out of bed.
3. Warm applications on the lower abdomen & perineum.
4. Running tap in front of the patient.
5. If the above measures failed → catheterization:

⇒ **Complications of catheterization:**

1. Neurogenic shock.
2. False passage → hemorrhage & extravasations of urine.
3. Catheter fever, may be due to:
  - Urethritis.
  - Ascending cystitis or pyelonephritis.
  - Descending epididymo-orchitis.
  - Pyrogenic reaction.

**B. Mechanical obstruction:**

- Catheterization using Nelaton's catheter (removed after drainage of urine).
- If recurrent retention → Indwelling Foley's catheter & prepare patient for surgery.
- If failed → Supra-pubic catheter (Cystofix ®) under local anesthesia.



**Treatment of the cause****1- Urethral stone:****a- Prostatic urethral stone:**

- Push to bladder to be crushed by litholapaxy & evacuate fragments.
- If failed → supra-pubic cysto-lithotomy.

**b- Penile urethral stone:**

- Local anesthetic gel & try forceps extraction

**2- Urethral stricture:**

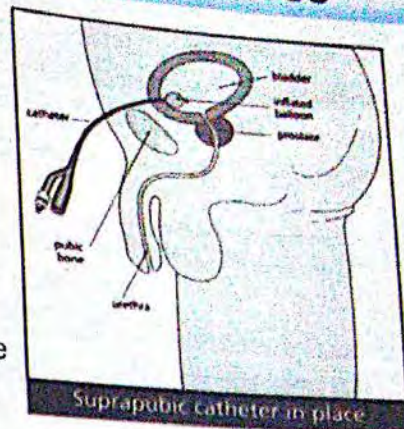
- Dilate the stricture.
- Urethroscopy → divide stricture by urethrotome under vision → put urethral catheter.

**3- Bladder stone:**

- If < 2 cm → cystoscopic litholapaxy.
- If > 2 cm → cysto-lithotomy.

**4- BPH:**

- a- Medical treatment may be used if it's the 1<sup>st</sup> attack of retention:
  - 5-alpha reductase inhibitor (Proscar<sup>®</sup>)
  - α-blockers.
- b- Surgical:
  - Trans-Urethral Resection of Prostate (TURP).
  - Open surgery (trans-vesical or retro-pubic prostatectomy).

**2. Chronic retention of urine****Causes**

- Urethra: stricture.
- Prostate: BPH, carcinoma.
- Bladder: BNO, carcinoma.
- Pelvic mass: fibroid, ovarian or cervical tumors.

**Clinical picture****Symptoms**

- Supra-pubic discomfort.
- Painless urinary bladder swelling.
- First, frequency especially nocturnal then bed wetting later on.
- Symptoms of the cause (BPH) → see before.
- Symptoms of complications (hydronephrosis) → loin pain + swelling.

**Signs**

- Bladder is **full** (may reach to the level of umbilicus) & **not tender**.
- Signs of the cause (DRE → BPH, see above).
- Signs of complications (hydronephrosis → tender loin mass).

**Investigations**

- A. For diagnosis: Like acute retention + urine analysis.
- B. For the cause: e.g. trans-rectal U/S → BPH.
- C. For complications: IVU to assess back pressure.



**Treatment****Treatment of chronic retention**

- Foley's catheter or condom catheter.



If urea  $>100$  mg%  $\rightarrow$  evacuate the bladder gradually:

- To avoid reactive hyperemia of renal tissue  $\rightarrow$  may cause hematuria or renal shutdown.
- Follow up to avoid post-obstructive diuresis which should be replaced by intravenous saline.

**Treatment of the cause**

- BPH (medical or surgical).
- Carcinomas  $\rightarrow$  according to its stage.
- Urethral stricture  $\rightarrow$  dilatation, internal urethrotomy or urethroplasty.

**Treatment of complications**

- Hydronephrosis.

## Retroperitoneal fibrosis

- Bilateral Compression of ureters by retroperitoneal fibrosis leads to obstruction.

**Types****A) Primary (idiopathic) Retroperitoneal Fibrosis**

- Unknown etiology but may be drug-induced, e.g., methysergide that is used for prophylaxis against migraine.

**Clinical picture**

- The patient may present acutely with anuria:  
 $\rightarrow$  need urgent ureteric catheterization to relieve obstruction  $\rightarrow$  the catheters pass up to the kidneys easily (Unlike calculi anuria).

**Investigations**

- 1) ESR, urea and creatinine  $\rightarrow$  usually elevated.
- 2) IVU and/or ascending pyelography  $\rightarrow$  both ureters are pulled medially towards the midline.
- 3) CT scan:
  - Shows a retroperitoneal fibrous plaque in which both ureters and great abdominal vessels (aorta and IVC) are embedded.
  - Both kidneys show hydronephrotic changes.

**Treatment** (Surgical ureterolysis)

- A. Release of ureters from fibrous tissue  $\rightarrow$  wrapping them in pedicled omentum inside the peritoneal cavity to avoid re-obstruction.
- B. Postoperative corticosteroid reduce the possibility of recurrence.

**B) Secondary Retroperitoneal Fibrosis**

- Occurs due to:
  - Diffuse infiltrating retroperitoneal malignancy
  - Previous leakage of an aortic aneurysm.



# Calcular anuria

## Definitions

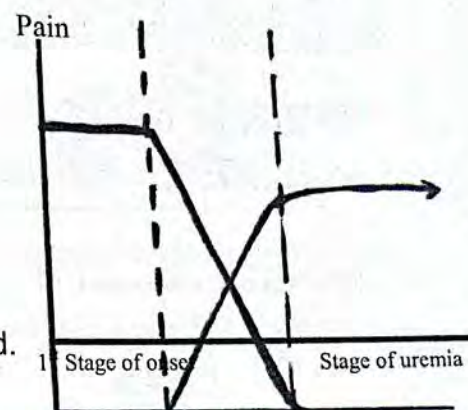
- Arrest of urine flow (anuria) secondary to calcular obstruction of the ureter.
- **Anuria** → no urine excretion for 12 hours.
- **Oliguria** → urine excretion less than 300 ml in 24 hours.

## Etiology

- Bilateral complete ureteric obstruction by stones.
- Unilateral complete ureteric obstruction by stone if the other kidney is:
  - Congenitally absent.
  - Surgically removed.
  - Rare, reno-renal shut down.

## Clinical picture

- There may be history of urinary stones.
- **Stage of onset:**
  - Sudden onset of severe ureteric colic (describe).
  - No urine, no desire, empty bladder.
  - Sometimes the colic may be absent.
- **Stage of tolerance (3-8 days):**
  - Pain gradually disappears.
  - Still no urine output.
  - Blood urea & creatinine progressively rises.
- **Stage of uremia:** After few days, uremia is established.



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	Calculus anuria	Acute retention of urine
History	ureteric colic	severe supra pubic pain
Examination	bladder is empty	bladder is distended
Catheterization	catheter is passed → no urine	catheter is passed → brings urine

## Investigations

### For diagnosis

1. Plain x-ray:
  - May detect radio-opaque stone.
  - Of no help in (small or radiolucent stones, patient has gaseous distention).
2. Ultrasonography:
  - Is very important.
  - It reveals a distended pelvi-calyceal system on the affected side.
  - Large hydronephrotic kidney is usually not the side of acute obstruction as it is often nonfunctioning.
3. Ascending pyelography: diagnostic and therapeutic (see below).
4. Cystoscopy:
  - Impacted stone at the ureteric orifice.
  - Helps to pass ureteric catheters.
5. Urethral catheter: to exclude retention.

**IVU is contraindicated in anuria.**

### For complications

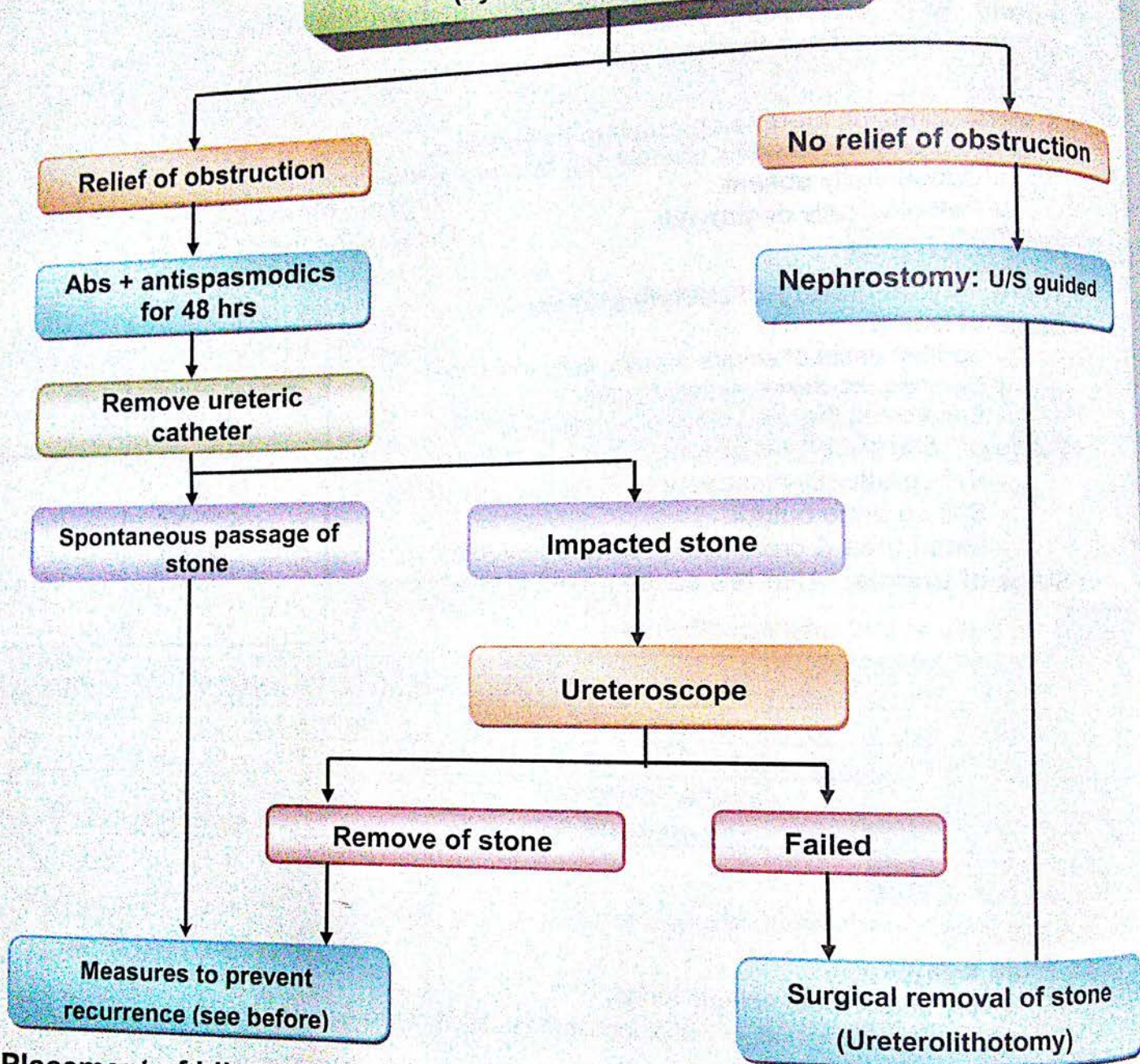
- Blood urea, creatinine & electrolytes → elevated to variable degrees according to the time of presentation.



**Treatment**

It is a surgical emergency → urgent relief of obstruction

Cystography + ascending pyelography  
(by ureteric catheter)

**Placement of bilateral ureteric catheters:**

- 1- If obstruction relieved → antibiotics and antispasmodics for 48 hours, then remove the ureteric catheters:
  - ⇒ If the stone passed spontaneously → measures to avoid recurrence (e.g. ample amounts of fluids, antibiotics).
  - ⇒ If the stone is impacted → ureteroscopy and removal of stone:
    - If removed → measures to avoid recurrence.
    - If failed → surgical removal of the stone (ureterolithotomy).
- 2- If obstruction is not relieved → nephrostomy, then removal of the stone surgically (ureterolithotomy) later on.



## Important Notes on Treatment

- A trial of forced diuresis during the investigations period is carried out by giving 40 mg frusimide in 100 ml Saline over 2 hours.
- If the side of obstruction is not exactly known, both ureters should be catheterized.
- Following the relief of obstruction, the patient may have severe diuresis (pass several liters of urine per day).
  - This is due to: a- the tubular defect caused by the obstructive process.
  - b- the diuretic effect of high blood urea.
- This diuretic phase should be monitored and treated properly.
- The lost large amounts of fluid and electrolytes should be properly replaced.

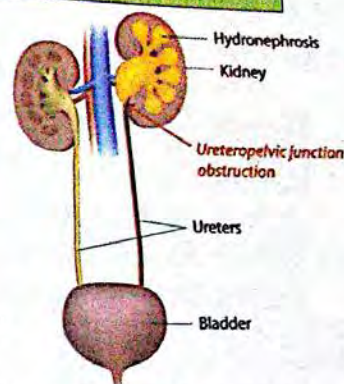


## Ureteric stricture

- Narrowing of the ureter that impede urine flow

### Etiology

- Congenital:** pelvi-ureteric junction obstruction (PUJO) or uretero-vesical junction (pin-hole meatus).
- Traumatic:** Follow open or closed injuries of the ureter particularly operative or instrumental injuries.
- Inflammatory:**
  - 1) Bilharzial stricture: commonly intramural and lower part, may be bilateral.
  - 2) Tuberculous stricture: the whole ureter and is usually multiple and bilateral.
- Long standing stones** may lead to stricture.
- Neoplastic:** Carcinoma of the ureter or more often, invasion of ureter by a malignant growth as carcinoma of the uterus, colon, or rectum.



### Clinical picture

- 1) Renal aching pain due to distension of the renal pelvis.
- 2) Progressive hydronephrosis.
- 3) Recurrent attacks of pyelonephritis.
- 4) In Egypt, bilateral hydronephrosis is a common sequel of bilateral Bilharzial ureteric stricture. These patients may present by chronic renal failure

### Investigations

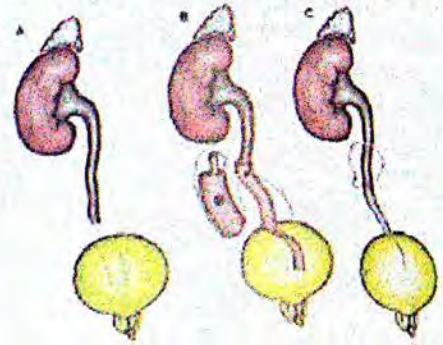
1. Blood urea, serum creatinine and serum electrolytes.
2. U/S: shows hydronephrosis.
3. IVU: detect the site of stricture and functional capacity of both kidneys.
4. Retrograde and antegrade pyelography.



**Treatment** (Mainly surgical)

1) Stricture of upper two thirds of ureter (above the level of ischial spine):  
- Excision and end to end anastomosis is done for localized strictures.

2) Stricture of lower third of ureter:  
a. Uretero-vesical implantation is done for localized stricture involving the lower end of the ureter as commonly occurs in Bilharziasis.  
b. Bladder (Boari's) flap is done for a long stricture of lower part of ureter when direct uretero-vesical anastomosis is not possible:  
- A flap prepared from wall of the bladder → transformed to a tube → anastomosed to ureter.

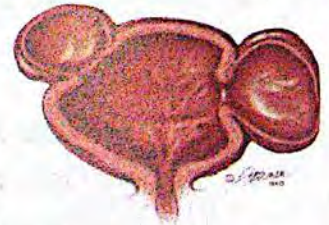


3) Stricture of long segment of ureter: (ileal loop replacement)

- The ureter can be replaced by a segment of ileum that retains its blood supply → one side is anastomosed to renal pelvis and the other side to the bladder.

## Bladder Diverticulae

- A flask shaped pouch of bladder wall.
- Usually acquired due to distal obstruction to bladder or urethra (infravesical obstruction).

**Clinical features**

- There are no specific symptoms that indicate the presence of a diverticulum.
- Symptoms are those of the obstructive lesions.
- Double micturition occurs with large diverticulae.
- Complicated diverticula give rise to frequency, pain, and haematuria.

**Complications**

- Rarely, it may obstruct the ureter.
- Stones may be formed inside.

**Investigations**

- Diagnosis of diverticula should be accompanied by diagnosis of their cause.
- IVU, ascending cystography, and cystoscopy are all helpful.

**Treatment**

- Treatment of the cause is mandatory.
- Diverticula are not excised unless complicated.

→ The operation is usually done in the course of surgery for distal obstructive lesion, e.g., with prostatectomy.



**Etiology**

→ Most common causes are post-traumatic strictures and gonococcal urethritis.

**A. Congenital**

1. Posterior urethral valve.
2. Meatal stenosis.
3. May be associated with hypospadias.

**B. Inflammatory**

1. Following STDs especially gonorrhea (commonly affecting bulbar urethra, 70%).
2. Prolonged urethral catheterization.

**C. Traumatic**

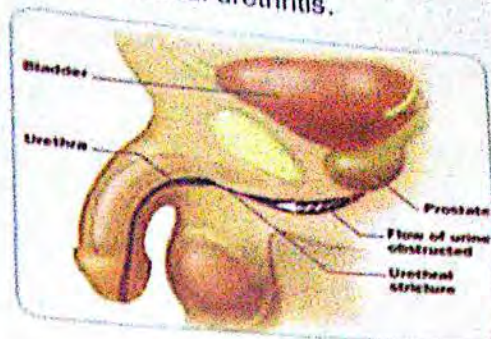
1. Rupture of urethra.
2. Iatrogenic injuries due to prolonged indwelling urethral catheters, transurethral surgical or diagnostic procedures.
3. Post-operative urethral stricture following prostatectomy or amputation of the penis.

**D. Neoplastic**

Urethral polyps - Venereal warts - Carcinoma of the urethra.

**N.B.:**

- A posterior urethral valve is not a true stricture as a catheter passes easily up to the bladder.
- Traumatic stricture >> gonococcal.

**Pathology****Types:**

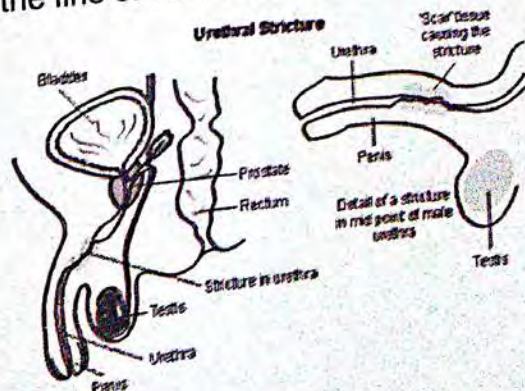
1. Passable strictures → allow passage of urine and instruments.
2. Permeable strictures → allow passage of urine but no instruments can pass.
3. Impermeable strictures → neither urine nor instruments can pass.

**Clinical picture (as BPH)**

- Difficulty in micturation:
  - The patient has to strain to pass urine (in contrast to BPH where the patient has to relax).
  - The stream is thin and weak.
  - There is terminal dribbling of urine trickling from the dilated urethra.
- Occasional passage of urethral discharge due to infection or desquamated epithelium.
- Frequency of micturation due to incomplete evacuation of the bladder or due to cystitis.
- Retention of urine: this may occur as acute or chronic retention.
- It may be possible to palpate the scarring along the line of the urethra.

**Complications**

1. Prostatitis and epididymo-orchitis.
2. Secondary infection with periurethral abscess formation.
3. Urethral urinary fistula following spontaneous rupture or drainage of a periurethral abscess.



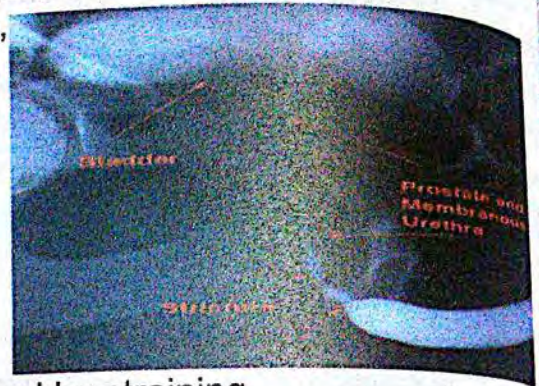


4. Infertility from the trauma, surgery or obstructed semen flow.
5. Complications of obstructive uropathy (back pressure changes, infection, stone formation, and renal failure).

## Investigations

### For diagnosis

1. Ascending urethro-cystography: (using a water-miscible gel containing contrast medium) → detects the site, length, degree and shape of stricture.
2. Ultrasonography: assess the upper urinary tract.
3. IVU: assess the renal function, back pressure changes.
4. Urethrocystoscopy: see the stricture, assess its possible treatment.



### For complications

1. **Uroflowmetry:** reveals obstructed flow characterized by straining.
2. Urine analysis: pyuria.
3. KFTs.

### For the cause

- Urine analysis: bilharzial ova.

## Treatment

There is a danger to pass a urethral catheter as it will result in a false passage

### A. Urethral dilation

- Under absolute sterile condition and after instillation of a local anesthetic in the urethra.
- Dilatation is performed very gently.
- Dilatation usually starts with gum elastic bougies or even filiform bougies in very narrow stricture. Metal bougies can be used later.
- If a filiform bougie can't be passed on three successful occasions, the stricture is considered to be impassable.

### B. Endoscopic visual Internal Urethrotomy

- Through the urethroscope and under direct vision, the stricture is incised with sharp knife blade, followed by regular dilatation.

### C. Surgical Urethroplasty

- This procedure is applicable for strictures of bulbar and penile urethra if previous measures failed.
- The principle is to excise the fibrous tissue of the stricture and then do end to end anastomosis.
- If the stricture is long → a tube or a flap is constructed from penile skin, scrotum, or perineum and is used to replace the strictured segment.



## Points to remember (obstructive uropathy)

### Renal Stones

- ▶ 10% - 20%, Middle aged males.
- ▶  $\text{Ca}^{++}$  stones mainly (75%)
- ▶ **Etiology:** inadequate drainage, excess normal constituent, abnormal constituent,
- ▶ **Path.:** oxalate (spiky), cystine (very hard), phosphate (2ry, struvite), urate (lucent).
- ▶ **C/P:** asymptomatic, pain, hematuria.
- ▶ **Comp.:** HEMOM
- ▶ **Invest.:** urine analysis (crystals), X-ray, U/S, CT, IVU, cystoscopy, KFTs.
- ▶ **TTT:** acc. to the site & size of stone:
  - Conservative, instrumental, surgical.

### Acute Retention of Urine

- ▶ **Etiology:** mechanical, paralytic, hysterical, reflex.
- ▶ **Symp.:** Pain, severe desire, inability, full tender bladder, the cause.
- ▶ **Invest.:** pelvic U/S, X-ray.
- ▶ **TTT:** conservative, catheterization, cause.

### Calcular Anuria

- ▶ Unilateral mainly.
- ▶ **C/P:** 3 stages (onset, tolerance, uremia).
- ▶ **Invest.:** Ascending pyelography, U/S, X-ray, cystoscopy.
- ▶ **TTT:** ureteric catheter → ureteric catheter:
  - if relieve obstruction → ABs + fluids for 48 hrs then treat the cause.
  - if not relieved → nephrostomy.
  - (stone by: uretroscopy → uretrolithotomy).

### Bladder Diverticulae

- ▶ **Eti.:** infra-vesical obstruction.
- ▶ **C/P:** of obstruction, if complicated → frequency, pain, hematuria.
- ▶ **Invest.:** IVU, asc. cystography, cystoscopy.
- ▶ **TTT:** not excised unless complicated, of the cause.

### Hydronephrosis

- ▶ **Causes:** - Cong., acquired.
  - (unilat. → stone, bilat. → SEP).
- ▶ **Path.:** Pelvic, renal.
- ▶ **C/P:** Dietl's crisis, pain, late → cystic swelling.
- ▶ **Comp.:** renal HTN, renal failure, as cyst.
- ▶ **Invest.:** U/S, IVU, asc. pyelography, renal scan, for comp. & for cause.
- ▶ **TTT:** TTT of the cause + nephrectomy or nephrostomy acc. to (unilat. or bilat.), (functioning or non-functioning kidney).

### Chronic Retention of Urine

- ▶ **Eti.:** PBH, malignancy, stricture, pelvic mass.
- ▶ **Symp.:** Swelling, discomfort
  - + cause + comp.
- ▶ **Signs:** full bladder + cause + comp.
- ▶ **Invest.:** U/S + cause + comp.
- ▶ **TTT:** foley's catheter + cause + comp.

### Ureteric Stricture

- ▶ **Eti.:** cong., trauma., inflamm., stone, tumors.
- ▶ **C/P:** pain, S/S of hydronephrosis, pyelonephritis.
- ▶ **Invest.:** U/S, IVU, KFTs, electro., pyelography.
- ▶ **TTT:** - upper 2/3 → excision + anastomosis.
  - lower 1/3 → reimplantation or bladder flap.
  - long segment → ileal loop replacement.

### Retro-peritoneal Fibrosis

- ▶ **Primary (idiopathic):**
  - Anuria → urgent ureteric catheterization.
  - **Invest.:** KFTs, U/S, CT, pyelography.
  - **TTT:** surgical ureterolysis.
- ▶ **Secondary: due to:**
  - Diffuse infiltrating retroperitoneal malignancy.
  - Previous leakage of an aortic aneurysm.

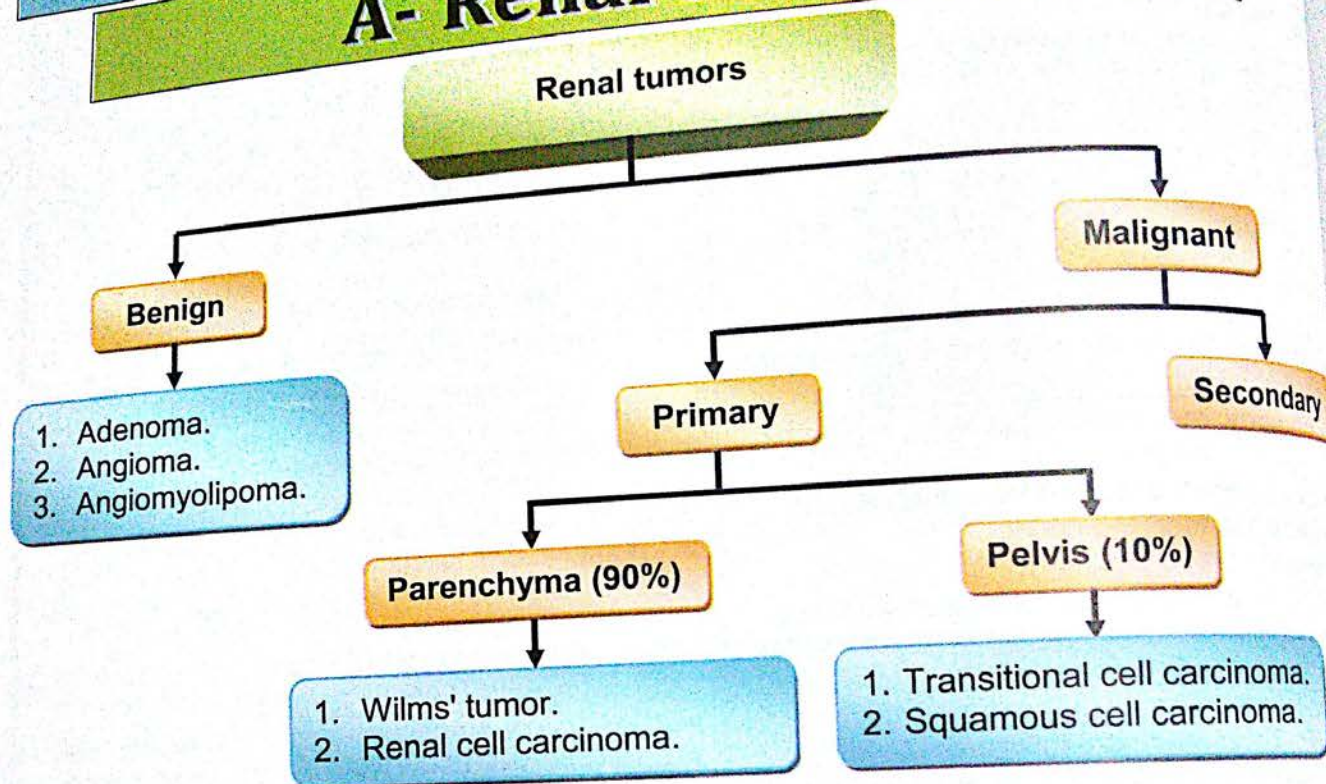
### Urethral Stricture

- ▶ **Eti.:** post-traumatic, Gonococcal urethritis.
- ▶ **Types:** passable, permeable, impermeable.
- ▶ **C/P:** difficulty, frequency, discharge, retention.
- ▶ **Comp.:** Prostatitis, epididymo-orchitis, 2ry infection, fistula, infertility.
- ▶ **Invest.:** U/S, IVU, asc cystography, KFTs urethro-cystoscopy, uroflowmetry.
- ▶ **TTT:** urethral dilatation, endoscopic urethrotomy, surgical urethroplasty.



# Tumors of urinary tract

## A- Renal tumors



## Wilms' tumor (Nephroblastoma)

### Incidence

- It represents about 10% of childhood malignant tumors. *10% bilat. Malign*
- 80% of all genitourinary cancers in children under 15 years of age.
- **Age:** usually below 5 years (peak incidence = 3-4 years). 90% of cases occur below 7 years old.
- It is the 4<sup>th</sup> malignancy in children following leukemia, CNS malignancy & lymphoma.
- **Sex:** almost equal in both sexes.
- It may be familial in 1 – 2% of cases.

### Pathology

*Wagars*

### Site

- May be bilateral in 5 – 10%. *unilat*

### Origin

- Embryonic *totipotent cell* nephrogenic tissue containing both epithelial cells from primitive glomeruli & connective tissue.

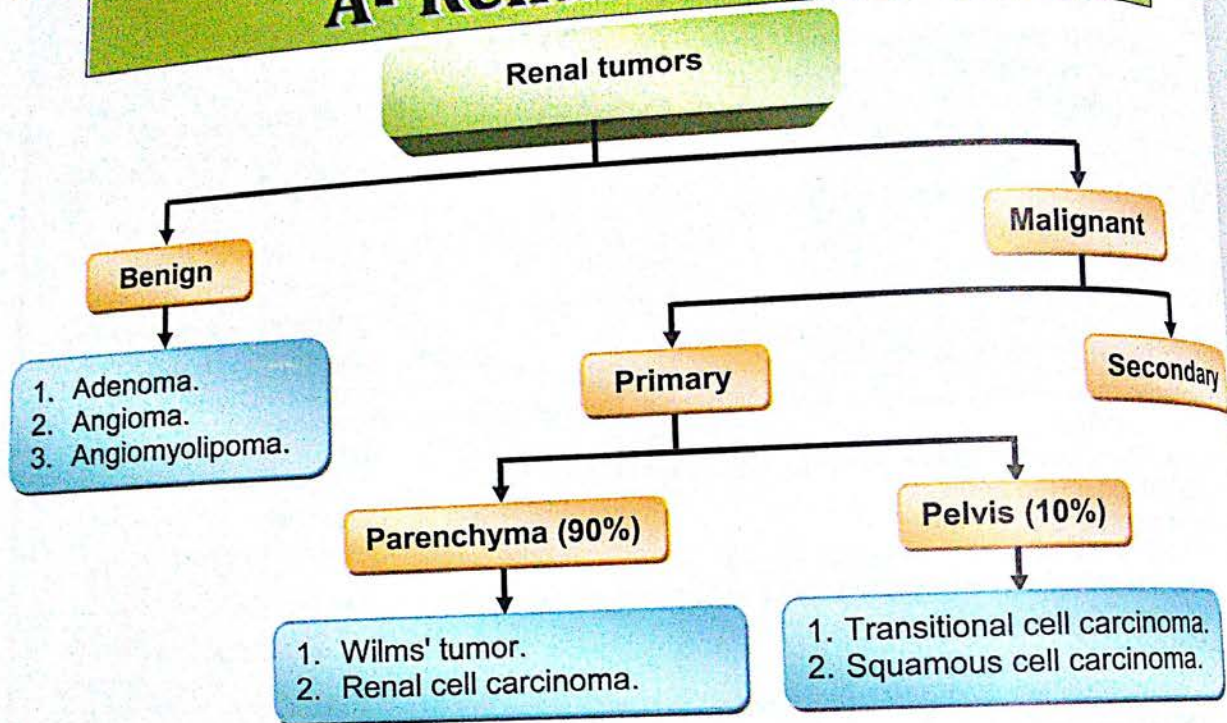
### Commonest childhood malignancy:

1. Leukemia (acute lymphoblastic).
2. CNS tumors.
3. Lymphoma.
4. Wilms' tumor and neuroblastoma.



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Macroscopic

- Solitary
- hemolytic
- the color

Microscopic

- Mixed
- (some)

- It's
- Or

Spread

- Direct
- Blood
- Lymph

Staging

- I-
- II-
- III-
- IV-
- V-

Clinical

- 1- Tumor
- 2- Cystic
- 3- 8
- 4- H
- 5-

DE

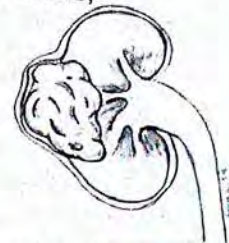


**Macroscopic picture**

- Solitary sharply demarcated encapsulated mass, areas of hemorrhage & necrosis + grayish or pinkish white + early invasion of the capsule, while invasion of the pelvis is late.

**Microscopic picture**

- **Mixed tumor** contains both epithelial and connective tissues elements (some components are less sensitive to radiotherapy than the others):
  1. Epithelial cells may form primitive glomeruli or tubules.
  2. Connective tissue elements: fibroblasts, fibrous tissue, muscle fibers, cartilage, bone.
  3. Spindle cells, round cells.
- It's differentiated in 80% of cases (of good prognosis). *Favourable*
- Or anaplastic in 20% of cases (of bad prognosis). *unfavourable*

**Spread**

- **Direct spread**: to capsule early, pelvis late.
- **Blood spread**: early to lungs (cannon ball metastasis), & Liver
- **Lymphatic spread (uncommon)**: to para-aortic LNs. *Virchow's Triad*

**Staging**

- I- Confined to the kidney.
- II- Extends beyond the kidney but is completely excised.
- III- Residual non-hematogenous tumor confined to the abdomen.
- IV- Hematogenous metastasis.
- V- Bilateral renal involvement at diagnosis. 10% of cases

**Clinical picture**

- 1- The main presentation (90%) is an abdominal mass which is smooth, firm & is confined to one side of the abdomen.
- 2- One third of patients present with vague abdominal pain, often associated minor trauma & hemorrhage within the tumor.
- 3- **Microscopic hematuria** occurs in 50% of cases.
- 4- **Hypertension** is present in up to 60% of cases. It results from encroachment on the blood supply producing renal ischemia & excess renin production. (Paraneoplastic)
- 5- **Associated syndromes in familial type.** *WAGR*

**♦ Anomalies that may be associated with Wilms' tumor**

- Aniridia in 2% of cases. *WAGR*
- Hemihypertrophy in 3% of cases.
- Macroglossia.
- Neurofibromatosis.
- Genito-urinary anomalies in 4.4% of cases.

**DD**

1. **Neuroblastoma** (childhood supra-renal tumor with bone secondaries, usually form irregular tumor which may cross the midline, enolase +ve, VMA in urine +ve and HVA → useful more in follow up *or from Sympathetic chain*)  
treated as Wilms' tumor). *u/s → extra renal mass* *NSE*
2. Hepatoblastoma.
3. Renal swellings: (Hydronephrosis, infantile type of polycystic kidney).

- best prognosis 4<sup>th</sup> grade.

- Most Common intra abd. tumor at 1st year.

- Gross: hard, friable

- Microscope: malign cells...

- Worse than Wilms

- Rosett shape

- Stroma rich tumor better than net.

- Metastasis → Bone M. & Liver & Skin

HTN d.t. Catecholamine release



## Investigations

### For diagnosis

1. U/S (pelvi-abdominal) → Distinguish solid renal masses from hydronephrosis and renal cystic disease.  
→ Can detect small tumors and liver metastases.  
→ ± Percutaneous needle biopsy.
2. CT scan (spiral) → Differentiate cystic from solid masses.  
→ Detect involvement of adjacent structures or the other kidney.  
→ Can assess tumor response to chemo and radiotherapy.
3. Plain urinary tract (PUT) → soft tissue shadow with crescentic calcification.  
→ Can assess tumor response to chemo and radiotherapy.
4. IVU → enlarged kidney, the pelvicalyceal system is attenuated and distorted, the kidney may be non-functioning.
5. Ascending pyelogram to diagnose early changes in the pelvis.
6. Renal angiography to differentiate cysts from solid swelling (now replaced by CT).
7. Urine analysis → hematuria.
8. Catecholamines are within normal.

### For staging

→ CXR, Bone scan, Pelvi-abdominal U/S.

### For preoperative preparation

1. (CBC → anemia), high ESR, KFTS, LFTS, FBS, CXR, ECG.

## Treatment

### A- Surgical treatment:

- Surgical excision remains the cornerstone of therapy in all children with Wilm's tumor.

#### 1. For operable tumor:

- The affected kidney is radically resected as for renal cell carcinoma.

#### 2. For large unresectable lesions

- A course of preoperative chemotherapy usually shrinks the tumor, which can then be removed.
- Remaining tumor in nodes or adjacent tissues should be marked with surgical clips to facilitate direction of radiation therapy.

### B- Post-operative treatment:

- If there is no residual tumor → adjuvant chemotherapy, using actinomycin D, vincristine & adriamycin is given.
- If there is residual tumor → radiotherapy is added for local control.

## Prognosis

- Chemo & radiotherapy have improved the overall prognosis to 80% 5-year survival. Early cases are usually cured.

Recurrences usually occur within a year, so a child surviving for 18 months or more is probably cured.



Grades

I → in Capsule → chemo.

II → Local → Radical neph + Chemo

III → L.N

IV → Distant

V → bibt

} chemo → Radical neph → Radio (under staging)



# Renal cell carcinoma

(Hypernephroma) (Grawitz's tumor)

## Incidence

- 75% of renal tumors, the most common tumor of the renal parenchyma.
- Age: usually between 50-70 years.
- Sex: more in males (M:F = 2:1).
- Bilateral tumors are synchronous or metachronous and occur in 1-2% of cases.

## Etiology

- Loss of short arm of chromosome 3.
- Smoking increase incidence by 2 folds.
- Von-Hippel Lindau disease:** Renal and pancreatic cysts, cerebellar haemangioblastomas, retinal angiomas and pheochromocytoma.  
→ In these patients RCC may be multiple and bilateral.

## Pathology

### Site

- Usually unilateral <sup>esp. mainly not only</sup> mainly from one pole of the kidney.

### Origin

- Epithelium of proximal convoluted tubules.

Hypernephroma is a misnomer as it was thought to arise from supra-renal remnants

## Macroscopic picture

- Mass that ranges in size from a few centimeters to lesions filling the abdomen, with infiltrating edge.
- Area of hemorrhage & necrosis → giving the tumor a mosaic appearance.
- The tumor is golden yellow color (or dull white) due to high lipid content.
- There is an apparent false capsule surrounding the lesion but the tumour actually invades the adjacent tissues beyond it.
- Usually invades the pelvis early, capsule late.



## Microscopic picture

### Adenocarcinoma:

#### a. Cells:

- Form acini or sheets with signs of mitosis and loss of polarity.
- The cells may be **Clear** (due to lipid, cholesterol and glycogen content which is dissolved during preparation) or **Granular** (due to increased mitochondria in the cytoplasm).

#### b. Vascular CT.





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## Spread

- **Direct spread:** early to the pelvis (explains early hematuria), late to the capsule.
- **Lymphatic spread:** to lymph nodes along the hilum of the kidney, then to para-aortic LNs, Virchow's LNs (by retrograde lymphatic spread).
- **Blood spread:**
  1. Lung (cannon ball in the X-ray).
  2. Liver, bone, brain.
  - ③ Within the renal vein & IVC like **finger in gloves** → **2ry varicocele**. → in old male → RCC till prove other cause



## Staging

- Stage I → Tumor confined to the kidney.
- Stage II → Tumor confined to Gerota's fascia and involves the perinephric fat.
- Stage III → Tumor involves the renal vein and/or regional L.Ns.
- Stage IV → Distant metastases.

## Clinical picture

♂ - 60y

- 1- **Hematuria:**
  - Is present in 50% of cases with painless, <sup>intermittent</sup> recurrent, profuse & total hematuria.
  - Sometimes, the blood passes as tubular clots taking the shape of ureter.
- 2- **Pain:**
  - Is present in 40% of patients. It may be due to:
    - Stretch of the renal capsule by the neoplasm.
    - Passage of blood clots causing ureteric colic.
    - Infiltration of adjacent lumbar nerves causing referred pain.
- 3- **Renal mass:**
  - Irregular, hard, renal swelling in 30% of cases.
  - The classic triad of hematuria, pain & renal mass is present in 10% of cases and usually indicates an advanced disease.
  - Other uncommon presentation
- 4- **Metastasis.** May be the first presentation, e.g., Pulmonary or skull deposits.
- 5- **Non specific symptoms** as fever, night sweats, weight loss & anemia.
- 6- **Secondary varicocele:** rapidly enlarging varicocele which does not empty on elevation of the scrotum.
- 7- **Systemic syndromes** Para malign. \$
  - Hypercalcemia occurs in 5% of cases due to secretion of parathormone like substance by the tumor or due to presence of bone metastasis.
  - Polycythemia.
  - Amyloidosis.  $\alpha$ AcTH  $\alpha$ HTN  $\alpha$ D.M.

↓  
↓  
stone

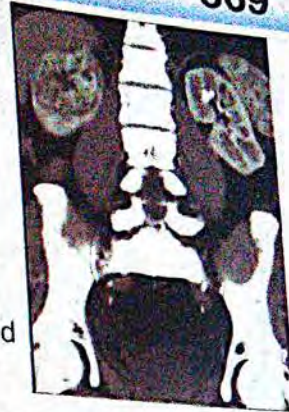
## DD

1. Hydronephrosis.
2. Polycystic kidney.
3. Liver swellings (on the right side) or splenic swellings (on the left side).



## Investigations

- **CT scan (spiral)**: very accurate in detecting:
  - a. The exact site, size and consistency of the lesion.
  - b. Invasion of the renal capsule or any surrounding tissues.
  - c. Lymph node enlargement and invasion of the renal vein or inferior vena cava.
- **US (abdomino-pelvic)** → shows the tumor as a solid mass → Biopsy → for diagnosis and staging.
- **Plain urinary tract (PUT)** → obliterated psoas shadow, mottled central calcification.
- **IVU** → a- Enlargement of the kidney.  
 b- pelvi-calyceal system is Dilated, Enlarged Amputated & Distorted (DEAD) → (Irregular spider leg deformity).  
 c- Displacement of the renal pelvis.  
 d- Rarely, a non functioning kidney.
- **Ascending pyelogram** to diagnose early changes in the pelvis.
- **Renal angiography** differentiates benign from malignant swellings (now replaced by CT).
- **Urine analysis** → hematuria.



hypovascular      hypervascular

## For staging

- CT scan, bone scan.
- CXR: cannon ball metastasis.

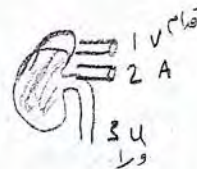
## For preoperative preparation

- CBC → anemia, polycythemia (4%), high ESR.
- KFTs, LFTs, FBS, ECG & CXR.

## Treatment

### 1. For early operable cases (stages I & II):

- ⇒ Surgery offers the only hope for cure.
- ⇒ **Radical nephrectomy** is done. It entails removal of the kidney within its sheath of Gerota's fascia together with the ipsilateral adrenal gland.
- ⇒ It is recommended to expose & ligate the vascular pedicle as a first step of the operation for:
  - So Trans peritoneal
  - Prevention of dissemination of malignant cells during manipulation of the tumor.
  - To have good control on a very vascular tumor.
  - To be able to remove a malignant thrombus from the inferior vena cava, if present.



### 2. Advanced disease

- ⇒ Patients who have metastatic disease may receive symptomatic treatment e.g. analgesics, irradiation & immunotherapy using alpha or gamma interferons & IL-2.

## Prognosis

- Removal of even the largest neoplasm may cure the patient.
- In operable cases 70% of patients are well after 3 years and 60 % after 5 years.
- Worse prognosis with:
  - Macroscopic involvement of the renal vein or its tributaries.
  - Tumor invasion beyond the capsule.
  - Lymph node involvement.



	WILM'S	RCC
<b>Incidence</b>	- 10% of childhood malign.	- 75% of renal tumors
	- 3 – 4 yrs old	- 50 – 70 yrs old
	- ♂ = ♀	- More in ♂
<b>Pathology</b>	- Bilat 5 – 10 %	- Mainly unilateral 2 %
	- Embryonic tissues	- PCT
	- Early capsule & Late pelvis infiltr.	- Early pelvis & Late capsule
	- Mixed tumor	- Adenocarcinoma
<b>C/P</b>	- Main present: abd. Mass	- Main present: hematuria
	- Associated \$: familial types	- Associated \$: paramalignant
	- pain, hematuria, HTN.	- pain, mass, 2ry varicocele
<b>Investigations</b>	- IVP: displaced pelvi-calyceal system (rarely invaded)	- IVP: DEAD
	U/S + CT + Ascending pyelogram + PUT + Staging + Preoperative.....→	
<b>Treatment</b>	- <b>Operable:</b> Radical resection	- Radical nephrectomy.
	- <b>Inoperable:</b> chemotherapy then resection + radiotherapy for malignant LN	- In advanced tumors: symptomatic TTT
	→ Post-op.: chemotherapy or radiotherapy	
<b>Prognosis</b>	80 % 5 year survival	- 60 % 5 year survival - 70% 3 year survival

## B- Tumors of the renal pelvis

### I- Transitional cell Carcinoma

→ Accounts for 7% of renal tumors

#### Predisposing factors

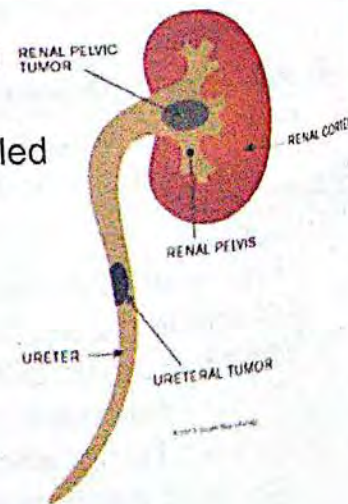
1. Tobacco use → 4 folds increase in the risk of TCC of the upper urinary tract.
2. Phenacetin abuse → Long-term, high dosage intake increases the risk.

#### Pathology

1. TCCs are collectively called urothelial tumors as the epithelium that lines the renal pelvis, ureter, and the urinary bladder.
2. TCCs vary from low-grade malignancy (which was formerly called papilloma) to highly anaplastic tumors.
3. Same lesion can develop in the ureter, the bladder or even the contralateral renal pelvis.

This is explained by either:

- a) Multicentricity of this neoplasm → the whole urothelium is predisposed to malignancy by a certain carcinogen.
- b) Trans-luminal spread of shed malignant cells.



#### Clinical

1. Gross or
2. Obstruct

#### Investig

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### Clinical features

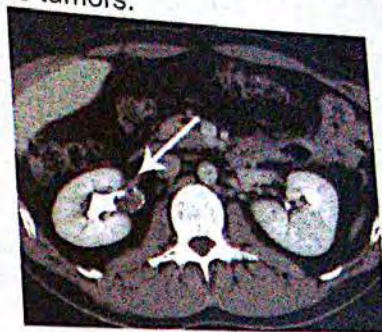
1. Gross or microscopic haematuria is present in 90% of cases.
2. Obstruction causes renal pain and/or renal swelling (hydronephrosis).

### Investigations

1. Intravenous urography (IVU) → shows a fixed irregular radiolucent defect or non-visualization of part or all of the collecting system.  
→ It can visualize lymph node deposits.
2. CT scan → differentiates renal Parenchymal from renal pelvic tumors.  
→ It can visualize lymph node deposits.
3. Cytology (microscopic examination of urine) → for malignant cells
4. Flexible uretero-pyeloscopy → inspect the whole upper tract → any lesion is visualized and biopsied.

### Treatment

- The classic therapy is **Nephro-ureterectomy** with excision of an adjacent cuff from the bladder.
- If a ureteral stump is preserved → 50% chance for stump recurrence (difficult to monitor).



## 11- Squamous Cell Carcinoma

- Occurs on top of leukoplakia.
- Often associated with infection and calculi disease.
- It forms a nodular ulcerated mass → invades the renal pelvis and parenchyma → spreads to the neighboring structures (but surface implantation does not occur).
- **Clinically:** there is haematuria.
- **In late cases** → extra-renal spread causes severe pain.
- The tumor has a bad prognosis.



# C- Urinary Bladder Tumors

## Tumors of the UB

### Benign

1. Epithelial polyp.
2. Fibroma.
3. Myoma.
4. Angioma.

### Malignant

#### Primary

1. Transitional cell carcinoma.
2. Squamous cell carcinoma.
3. Others.

#### Secondary

not rare, from neighboring organs.

### <sup>Egypt</sup> A- In areas endemic for *Schistosoma hematobium*:

- 55 % transitional cell carcinoma (TCC).
- 40 % squamous cell carcinoma (SCC).
- 5 % others including adenocarcinoma (on top of cystitis glandularis).

B- In other areas: transitional cell carcinoma is 95%.

➡ U.B carcinoma is the most common urological malignancy in Egypt



# Squamous cell versus Transitional cell carcinoma

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Pathology	Microscopic	Macroscopic	Site	Predisposing Factors	Sex	Age	SCC	TCC
							20 - 40 Male : Female 4 : 1	> 60 Male : Female 3 : 1
							<p><b>a. Chronic irritation:</b></p> <ul style="list-style-type: none"> <li>- long-standing Bilharzial cystitis.</li> <li>- <u>Mechanical</u>: by ova or stones.</li> <li>- <u>Chemical</u>: by metabolites (N-Nitrose compound, tryptophan, serotonin).</li> <li>- Increased level of B-glucuronidase enzyme in patients with Bilharzial cystitis.</li> </ul> <p><b>b. Chronic infection:</b> especially with ammonia-producing organisms.</p> <p><b>c. Abnormalities of tryptophan metabolism.</b></p> <p><b>d. Precancerous lesions:</b></p> <ul style="list-style-type: none"> <li>- Brunn's nests.</li> <li>- Cystitis cystica, glandularis.</li> <li>- Leucoplakia &amp; squamous metaplasia.</li> </ul>	<p><b>a. Chronic irritation:</b></p> <ul style="list-style-type: none"> <li>- <u>Chemical</u>: <ul style="list-style-type: none"> <li>▪ Smoking ↑ the risk by 2-4 folds.</li> <li>▪ Industrial carcinogens <ul style="list-style-type: none"> <li>a- Aniline dye, petrol and leather industries.</li> <li>b- Aromatic amines in Rubber and textile industries.</li> </ul> </li> <li>▪ Chemotherapy (cyclophosphamide) ↑ the risk 9 folds.</li> <li>▪ Prolonged intake of large doses of phenacetin.</li> </ul> </li> <li>- <u>Physical</u>: pelvic irradiation.</li> </ul> <p><b>b. Genetic:</b></p> <ul style="list-style-type: none"> <li>- Activation of oncogenes e.g. RAS &amp; Cerb B-2.</li> <li>- Inactivation of tumor suppressor genes e.g. P-53 (Li Fraumeni).</li> </ul>
							<ul style="list-style-type: none"> <li>▪ Usually at the posterior &amp; lateral walls</li> <li>▪ <u>Not</u> at trigone</li> </ul>	<ul style="list-style-type: none"> <li>▪ Usually at the base and around ureteric orifices.</li> <li>▪ At the trigone</li> </ul>
							<p><u>Fungating</u> mass (common) Malignant <u>ulcer</u> <u>Papillary</u> mass (rare) Cauliflower</p>	<p><u>Papillary</u> mass or papillae, <u>Ulcer</u>. <u>Nodule</u>. Localized erythematous patches. → They are often multiple.</p>
							<p><u>SCC</u> → Cell nests if well differentiated = B type</p>	<p><b>TCC is classified into:</b></p> <ol style="list-style-type: none"> <li>1. <u>Superficial</u> TCC (75%): commonly papillary type.</li> <li>2. <u>Muscle invasive</u> type (25%).</li> <li>3. Carcinoma in situ (CIS) (associated in 5% of the cases).</li> </ol>
							See below	

Grades low well diff.



## Staging SCC of UB

- **Wallace staging system for SCC is based on bimanual clinical examination**
- T0 → No palpable mass.
  - T1 → Palpable mobile mass with no induration of bladder wall.
  - T2 → Palpable mass with induration of the bladder wall.
  - T3 → Palpable mobile wall with extravascular spread.
  - T4 → Fixed bladder mass.

### Histological grading:

1. Low grade (well differentiated cells).
2. Medium grade (moderately differentiated cells).
3. High grade (poorly differentiated cells).

## Complications

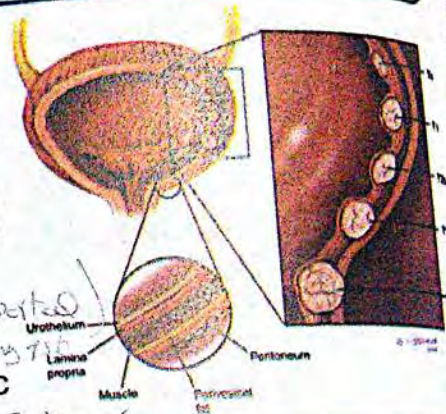
### Spread (especially with muscle invasive type)

- ⇒ **Direct spread to the surroundings:** prostate & seminal vesicles in males, vagina & uterus in females, pubic bone, abdominal wall, bowel & omentum, pelvic wall, sacral plexus & iliac vessels, pelvic fascia and rectum.

- ⇒ **Blood spread:** to the lungs, liver & bones.

- ⇒ **Lymphatic spread:** (15% in SCC)

- Perivesical LNs → internal iliac LNs → common iliac LNs → para-aortic LNs → thoracic duct → Virchow's.



Lymphatic spread in SCC on top of bilharziasis is delayed due to fibrosis & calcification in the bladder & peri-vesical tissue & local LNs

### Others (in order of frequency)

- Ulceration.
- Hemorrhage.
- Infection.
- Fistula formation.
- Urinary tract obstruction.

## Clinical picture

### Symptoms

➤ The patient usually presents with **exacerbation of symptoms of cystitis**.

#### 1- Hematuria: (terminal)

- Does not attract the attention of patient in cases of SCC on top of bilharziasis & th
- hematuria is **painless** in cases of TCC.
- It is **painful** in SCC.

#### 2- Necroturia: passage of pieces of whitish tissue (fish odor).

#### 3- Frequency and dysuria:

- Commonly occur with muscle invasion.
- With CIS, symptoms may be very severe (malignant cystitis).

#### 4- Pain (late):

- Deep seated pelvic or supra-pubic pain (usually with muscle invasion).
- Sciatica (with pelvic wall invasion). Sacral plexus invasion
- Loin pain due to ureteric obstruction → hydronephrosis or pyonephrosis.



## 5- Abnormal presentations:

- Cachexia, anemia, metastasis, repeated attacks of lower UTI, retention of urine by a pedunculated tumor or a clot, late → uremia.

Symptoms of Bilharziasis of the UB and UB cancer are overlapping → so if a patient is known to have urinary Bilharziasis and complains of aggravation of symptoms, the possibility of UB cancer should be excluded

## Signs

### a. General:

- Manifestations of complications.
- Cachexia, anemia, metastasis, fever if infected, late uremia.

### b. Local

Bimanual examination under general anesthesia.

- o To differentiated T<sub>2</sub> and T<sub>3</sub> (a palpable mass = T<sub>3</sub>)
- o To assess local spread (prostate or vagina in T<sub>4a</sub>)



## DD

- Urinary bladder stone.
- Cystitis.

## Investigations

### For diagnosis

1. **Cysto-urethroscopy + multiple biopsies:** from the tumor base & adjacent mucosa).  
 In TCC trans-urethral resection of visible tumor with biopsy of underlying muscle+ multiple random biopsies to diagnose carcinoma in situ.
2. **IVU:** descending  
 o Shows irregular filling defect or just irregularity in the bladder wall.  
 o May show manifestations of back pressure (hydronephrosis, hydroureter).
3. **Ascending cystography:** if IVU is contraindicated e.g. uremia.
4. **CT:** assess the extent of the tumor and any pelvic node deposits.
5. **U/S:** assess the kidney size and the bladder mass.
6. **Urine analysis:**
  - o Cytology (shows Bilharzial ova, RBCs >5 /HPF, malignant cells).
  - o Hematuria, necroturia, pyuria.
  - o Culture & sensitivity.

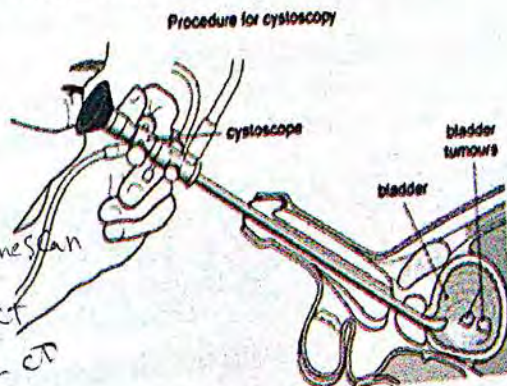
## For staging

1. CXR.
2. Bone scan.

## For preoperative preparation

1. CBC → anemia and increased ESR.
2. K.F.Ts → uremia (in late cases).
3. LFTs → elevated ALP in metastasis.
4. FBS, CXR, ECG.

For follow up → cystoscopy





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**Treatment (according to type)****I. SCC:**

- Unfortunately in Egypt the diagnosis of SCC is made when the case is too advanced.
- SCC is chemo and radio resistant.
- The best chance is to treat it by **radical cystectomy**, but urethra is not removed.
- It includes removal of: → In males → the whole bladder with its peri-vesical fat, the prostate, the seminal vesicles and the lower ends of both ureters.  
→ In females → urinary bladder, the uterus, the tubes and the anterior vaginal wall.
- Block dissection of the internal and external iliac and obturator LNs. is performed.
- **Prognosis:**
  - The 5-year survival rate following radical cystectomy is 32%.

**II. TCC:****A. Superficial bladder cancer:**➤ **Transurethral resection (TUR):**

- Excision of the tumor with the underlying muscle plus multiple random biopsies to detect carcinoma in situ.
- Laser ablation may be used in place of TUR.
- Indications for Intra-vesical chemotherapy (Adriamycin) or immunotherapy (BCG vaccine): (Used after TUR to prevent recurrence).

++ all mediate  
immunity  
good prog

1. Grade II and III tumors.
2. Carcinoma in situ.

▪ **Prognosis**

- Regular follow up for 5 years is indicated to detect recurrence.

▪ **Indications for radical cystectomy in this patient:**

1. Multiple recurrences.
2. Persistent carcinoma in situ.

**B. Muscle invasive:**➤ **Radical cystectomy.** in no enlarged LN

- This operation differs from that prescribed for SCC in only one step; the urethra has to be removed because of the tendency of TCC to spread along the urethra.

➤ **Radiotherapy:**

- The results are inferior to surgery.

➤ **Chemotherapy:** → +ve L.N

- For metastatic disease or when the surgical margins are not free. Best combination is methotrexate, vinblastine, adriamycin and cis-platin (MVAC).

# Urinary diversion

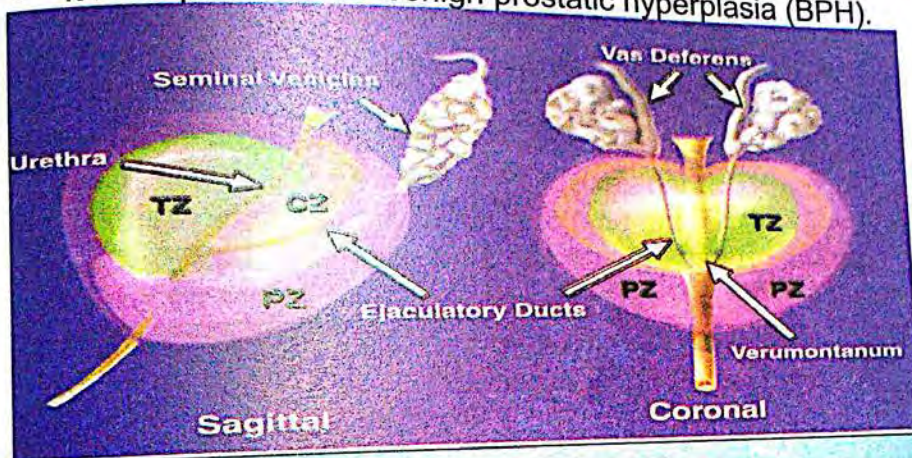
- See differential diagnosis.



# Anatomy of the prostate

## Surgical anatomy

- The prostate is divided into 3 zones + anterior fibro-muscular stroma:
- **Peripheral zone (PZ)**
    - It is the subcapsular portion of posterior aspect of the prostatic gland which surrounds the distal urethra.
    - More than 70% of prostatic cancers originate from it.
  - **Central zone (CZ)**
    - It surrounds the ejaculatory ducts as they pass through the prostate.
    - CZ tumors account for more than 25% of all prostate cancers.
  - **The peri-urethral transitional zone (TZ)**
    - It surrounds the proximal urethra.
    - It is responsible for benign prostatic hyperplasia (BPH).



## Enlargement of the prostate

### 1. Benign Prostatic Hyperplasia (BPH)

BPH is a normal aging process that affects most males → therefore, called senile prostatic enlargement.

#### Incidence

- Starts at age of 40 years.
- By the age of 50 years, about 50% of males have BPH.

#### Etiology

- The exact cause is unknown.
- Mostly, a sort of hormonal imbalance between androgens and estrogens, probably due to aging → stimulates transition-zone prostatic cells to undergo hyperplasia.
- Development of BPH is dependent on the presence of a functioning testis with adequate testosterone production.
- Secretion of intermediate peptide growth factors may play role in development of BPH.

Androg & Estrog relative





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## Pathology

### Site

- Most commonly arises from submucous group of glands in transitional zone (peri-urethral) → lateral lobes.
- If arising from CZ sub-cervical glands → middle lobe. ) *central zone (peri-urethral)* *Cancer*

### Macroscopic

#### A- Changes in the prostate:

- BPH is formed of nodular tissue that is termed "adenoma".
- It starts by developing nodules that enlarge → compress urethra and rest of the prostate.
- These nodules form the main bulk of BPH tissue.
- The remaining compressed prostatic tissue forms prostatic surgical capsule.
- If hyperplasia is more on both sides of the urethra → enlargement of lateral lobes.
- If hyperplasia is central (grows up elevating the trigone) → middle lobe enlargement.
- In some cases enlargement may be trilobar. *No gritty sensation*

#### B- Changes in the urethra:

- The adenoma compresses the urethra producing:
  - 1<sup>st</sup>, urethral elongation.
  - Urethral narrowing as it is stretched and compressed from side to side. This narrowing interferes with bladder emptying.
  - Exaggeration of the normal posterior curve of the urethra.
- The urinary bladder, ureters and kidney show changes as in obstructive uropathy.

### Microscopic

- Hyperplasia of acini (fibro-myo-adenoma).
- Dried prostatic secretion → corpora amylacea.

## Clinical picture

### Type of patient

- Men over 50 years of age.

- There is no relation between the size of the prostate and degree of symptoms.
- Severity of symptoms depends on the degree of urethral and bladder neck obstruction.



Normal prostate



Benign prostatic hypertrophy (BPH)

## Symptoms (STAGES)

### a) Asymptomatic.

### b) Symptomatic: 15% only.

#### I. Urinary symptoms:

##### 1- Frequency and Urgency of micturation:

- Usually the earliest complaint.
- At first nocturnal, later on day & night.

##### ⇒ Causes:

- Congestion of the trigone.
- Detrusor muscle hyper-reflexia increases frequency.
- Elongation of sensitive posterior urethra exposes its mucosa to urine in the U.B.



- 4) Increased residual urine.
- 5) Stretch of internal sphincter allows a few drops of urine to escape in the posterior urethra.
- 6) **Complications:** cystitis, stones & trigonal irritation.

## 2- Hesitancy and Difficulty:

- a. To start: straining increase the obstruction due to congestion and projection of middle lobe, so the patient learns to relax
- b. To maintain (abnormal stream): weak, interrupted, forked, deviated stream.
- c. To finish: in the form of dribbling of urine (residual urine).

## 3- Retention of urine:

- a. **Acute retention** of urine is sometimes the 1<sup>st</sup> presentation of BPH. Retention is precipitated by excess fluid intake, alcohol, cold weather, cystitis, constipation, unrelieved sexual excitement, drugs (diuretics, antispasmodics, antitussives). Acute retention is very painful and needs urgent intervention.
- b. **Chronic retention** with overflow incontinence, As obstruction progresses → more residual urine → over-distended bladder (up to 1 liter of urine) → bladder turn atonic → when intravesical pressure > intraurethral → involuntary passage of few drops. The condition is painless and the actual complaint of the patient is incontinence.

- 4- **Hematuria:** enlarged prostate → compress the prostatic venous plexus → congestion of veins at base of the bladder. Gross hematuria may occur due to rupture of one of the prostatic veins.

## II. Sexual symptoms:

- Increased libido at the start, later on impotence is the rule.

## III. Symptoms of complications.

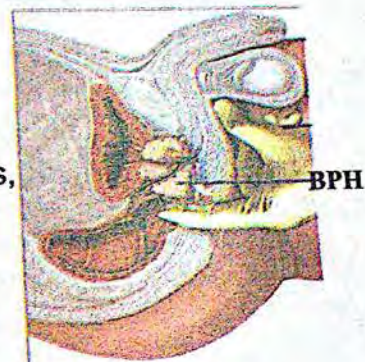
### Signs

#### 1. General:

- Exclude complications (uremia, fever).
- Exclude DD (cystitis, cancer prostate with metastasis, neurological examination for DM and Parkinsonism).

#### 2. Local:

- Mass or tenderness in the renal angle (hydronephrosis).
- Supra-pubic palpable bladder (retention).
- DRE → the prostate is benignly enlarged.



### Criteria of benign enlargement of the prostate

1. **Soft or firm.**
2. **Smooth.**
3. **Symmetrical.**
4. **Median sulcus preserved.**
5. **Notch between it & seminal vesicle is preserved.**
6. **Mucosa of rectum mobile over prostate**

Residual urine may be felt as a fluctuating swelling above the prostate (if there is considerable amount of residual urine, it pushes the prostate downwards making it appears larger than it is).



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## Complications

### General

- Renal failure from prolonged back pressure
- Psychological distress

### Local

- Hematuria** due to rupture of vesical varices.
- Back pressure** which leads:
  - Retention of urine. Acute or Ch.
  - Detrusor irritability → overactive bladder.
  - Muscle hypertrophy and ↑ trabeculation of UB.
  - Detrusor failure → residual urine (chronic retention).
  - Bilateral hydronephrosis.
  - Bilateral hydroureter.
  - Diverticulum formation. From open of blood vessels → Acute or Chronic
  - Bladder stone.
  - Cystitis.

### DD

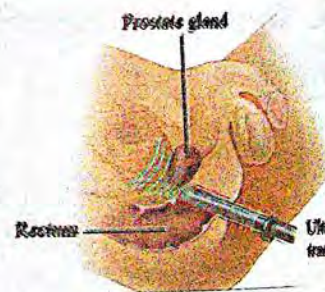
1. R.F.

- Cancer prostate.
- Other lower urinary tract diseases.
- Generalized disorders affecting the urinary tract (ex. DM, Parkinson's disease).

## Investigations

### For diagnosis

- Trans-rectal U/S (TRUS)** (very accurate and non-invasive).
  - To uncover non-palpable malignancy in peripheral zone.
  - To assess size of enlargement and its pattern, i.e., middle lobe, bilobar, or trilobar.
  - U/S guided biopsy can be taken. S.E → inj. of fascia of Denonvilliers
- PSA (prostatic specific antigen):**
  - More specific than acid phosphatase.
  - To exclude associated prostate cancer.
  - Normally 0 – 4 ng / ml.
  - If > 30 ng / ml → metastatic prostatic carcinoma.
  - If < 15 ng / ml → prostatic carcinoma confined to prostate or BPH.



- IVU:**
  - Smooth basal filling defect in the bladder.
  - Hooking of the ureters on entering the bladder (fish-hook sign)
  - Trabeculations, sacculations and diverticulae.
  - Post voiding film → residual urine.
  - Exclude gross pathology of the urinary tract.



- Cysto-urethroscopy + biopsy:** It is indicated in patients presenting by hematuria to exclude bladder pathology.

Flowmetry → < 15 ml/sec.



**For complications**▪ **Laboratory:**

1. Urine analysis: hematuria, C & S.
2. KFTs, CBC, electrolytes.

▪ **Imaging:**

- Abdominal U/S → to visualize kidney changes, measure amount of post-voiding residual urine in the bladder and to diagnose any bladder pathology.
- Plain X-ray (KUB) → May show bladder or prostatic stones.

▪ **Instrumental:**

- **Uroflowmetry** → maximum flow rate less than 15 ml/sec means bladder neck obstruction.

**N.B.:**

- BPH is a normal aging process and not a disease by itself unless an obstruction starts to develop → its treatment when complicated is by TURP in most of the cases.
- BPH and prostate cancer can be present in the same patient.
- PSA measurement is mandatory in all men above the age of 50 for early detection of prostate cancer.

**Treatment****A- Medical treatment and watchful waiting:**

↳ For patients with minimal symptoms and No complications.

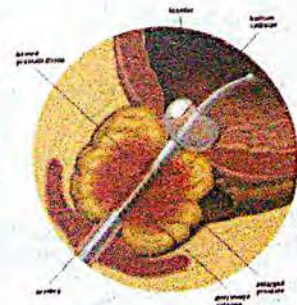
- Prostatic decongestant suppositories.
- **Phytotherapy:** A group of drugs of plant origin may improve symptoms.
- Alpha blocker e.g. Prazosin, Trasocine → relax smooth muscles of the capsule → relieve urethral obstruction. It improves frequency and flow rates.
- 5-alpha reductase inhibitor (Proscar®). In those who improve on this treatment, this drug is continued for life.
- Advise the patient to avoid diuresis, constipation, wine, unrelieved sexual excitement and withholding micturition for long periods.
- Close follow-up with periodic flowmetry and symptoms score.

**B- Minimally invasive procedures:**

➤ The aim of these procedures is temporary relief of BPH when definitive treatment is contraindicated in high risk patients.

↳ **Methods:**

- **Thermotherapy:** Microwave heat therapy, applied by special probes per urethra or per rectum.
- Endoscopic transurethral **cryo-ablation** of the prostate.
- Endoscopic transurethral **prostatic stents**.

**C- Surgical treatment:**

↳ **The idea is:** to remove adenomatous gland enlargement from inside its false capsule of compressed prostatic tissue, which is left unremoved.

↳ **Indications:**

1. Obstructed uroflowmetry curves.
2. Acute retention of urine. *repeated attacks*
3. Chronic retention with residual urine more than 200 ml.



4. Hematuria.
5. Complications as stones, bladder diverticulae.
6. Back pressure changes.
7. Distressing frequency.

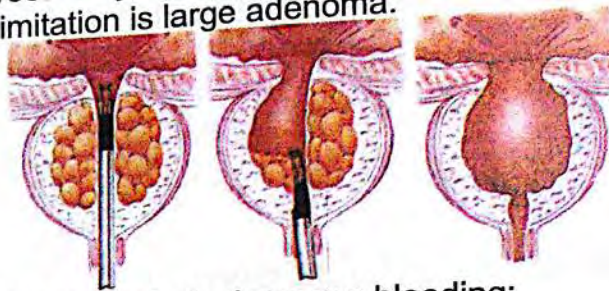
**Methods:**

- **Pre-operative:**
  - o Treatment of acute complications (e.g. UTI, Acute retention).
  - o Antibiotics.

- **Operative:**

**1. Endoscopic surgery:**

- o TURP (trans-urethral resection of the prostate).
  - It is the standard technique using cystoresectoscope.
  - The adenoma is removed trans-urethrally piece by piece, using an electrocautery.
  - The limitation is large adenoma.



- o Recent methods to decrease bleeding:
  - VLAP (Visual LASER Ablation of Prostate by Holmium laser).
  - Transurethral heat prostatic vaporization.

**TURP Syndrome**

- **Etiology:** occurs only with endoscopic resection → over absorption of the irrigating hypotonic fluid used during endoscopic resection of the prostate.
- **Effects:** hypervolemia, dilutional hyponatremia & intravascular hemolysis. Brain edema.
- **Prophylaxis:** use of Glycine (isotonic solution) for irrigation.

**2. Open surgery:**

- o Needed for exceptionally large adenomas.
- o Trans-vesical prostatectomy (Fryer). Indicated when there is an associated bladder pathology that requires surgery.
- o Retro-pubic prostatectomy (Millin).
- o Perineal (Young) → not done now.



Trans-vesical



Retro-pubic



☒ **Complications:** *→ TURP*

1. Bleeding is the main problem. It may be 1ry, 2ry or reactionary, clot retention may occur.
2. Retrograde ejaculation (more than 90%): due to injury of internal sphincter.
3. Incontinence, Rare, if the external sphincter mechanism is damaged, (Temporary urge & stress incontinence for a few days are common).
4. Impotence (5%) due to injury of pudendal nerve.
5. Infection → urethritis, cystitis or epididymo-orchitis.
6. Bladder neck obstruction.
7. Urethral stricture.
8. TURP syndrome. *→ Brain Edema d.t. washing blood & saline*

## 2. Carcinoma of prostate

### Incidence

- The most common cancer in ♂ > 65 years (androgen sensitive).

### Predisposing Factors

- +ve Family history.
- Fatty meals.
- Blacks have the highest incidence.
- Native Asian have the lowest incidence.
- Age: constant rise starting at the age of 50 years old.



### Pathology

#### Site

- Outer zone of the posterior lobes (peripheral zone 75%).

### Macroscopic

- Gritty sensation on cutting.
- Hard infiltrating pale nodule.
- Mass with infiltrating edge + areas of hemorrhage & necrosis.
- Grayish in color.

### Microscopic

- Usually adenocarcinoma (95%) → derived from the acinar epithelium.
- Scirrhou carcinoma.
- Rarely → anaplastic.
- There is a grading system of prostatic cancer (Gleason's grade) based on glandular differentiation and growth pattern. Grade 2 is the least malignant while grade 10 is the highest malignant.

### Spread

- See below.

### Staging

#### TNM

- T0 → no clinical abnormality.
- T1 → Nodule in one lobe.



- T2 → Diffuse disease.
- T3 → Extension to the seminal vesicles.
- T4 → Lesion is fixed to other tissues.
- N0 → No evidence of involvement of LNs.
- N1 → Involvement of one regional node.
- N2 → Involvement of several regional nodes.
- N3 → Fixed mass of regional LNs.
- N4 → Involvement of common iliac or para-aortic LNs.
- M0 → No evidence of distant metastases.
- M1 → Distant metastases.

### Clinical picture

- Early cancer prostate is asymptomatic but it may be found:
  - Incidentally following TURP (t1).
  - As a nodule on rectal examination (t2).
- **Pathological Surprise** → diagnosis may be reached only after routine histopathological examination of a prostate removed with a preoperative diagnosis of BPH.

### Symptoms

Only advanced cases give rise to symptoms but even advanced cases may be asymptomatic

1. **Prostatism** (LUTs) (disturbance of function).  
→ Short history of these symptoms in a male above 65 years is suggestive.
2. **Pain, which is:**
  1. Perineal.
  2. Supra-pubic, referred to the penis.
3. **Occult presentation:** due to metastasis e.g. pathological fracture, sciatica, oedema of the lower limb or paraplegia.
4. **Symptoms of complications:** see later.

*Back Pain*

### Signs

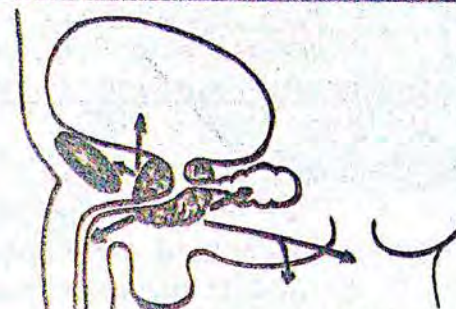
1. **General:** cachexia, uremia.
2. **Local:**
  - Mass or tenderness in the renal angle.
  - Supra-pubic palpable bladder.
  - **DRE** (A normal DRE does not exclude carcinoma):
    - Hard.
    - Asymmetrical.
    - Median sulcus not preserved.
    - Notch between it & seminal vesicle is not preserved.
    - Mucosa of rectum: early mobile, late not mobile over the prostate (due to delayed invasion of the rectum).



## Complications

### Spread

There is delayed spread to the rectum due to presence of fascia of Denonvilliers (remnants of urorectal septum)



#### 1- Direct:

- Urethra.
- Seminal vesicles.
- Bladder.
- Ureteric obstruction occurs in 20% of cases.
- Perineum.
- Pubic bone.
- Sacral plexus.
- Iliac vessels.

#### 2- Lymphatic:

- Internal iliac and external iliac LNs → common iliac LNs → para aortic LNs → thoracic duct → Virchow's LNs. The obturator LN may be involved.

#### 3- Blood spread:

- 90 % of blood-born metastases occur in bone especially the lower vertebrae, neck of femur, pelvic bones and ribs (& even BM invasion → anemia and pancytopenia).
- This is due to reversal of blood flow from prostatic plexus (veins of Santorini) to the axial skeleton through valveless veins of Batson (emissary veins of pelvic bones).
- It is usually osteoblastic.
- Rarely, metastases develop in lungs or liver.

Skeletal metastasis most commonly arises from malignancies in the prostate, breast, kidney, bronchi and thyroid gland

## Others

- 1) Hematuria which is less common.
- 2) Retention of urine might occur late.
- 3) Renal failure.
- 4) Back pressure: 1- Hydronephrosis. 2- Hydroureter.

## Investigations

### For diagnosis

#### 1. Trans-rectal U/S (TRUS):

- **Advantages:**
  - Accurate.
  - Non-invasive.
  - Best method for local staging.
  - Can be used in early detection of tumors in screening programs.

- Biopsy can be taken

- Must be done to any patient with abnormal DRE and / or elevated PSA.

#### 2. IVU: shows irregular filling defect at the base of UB and may show back pressure effects.

#### 3. Tumor markers:

⇒ PSA:

- The most useful marker in the diagnosis and follow-up.
- More specific than acid phosphatase.
- Raised level (>15 ng /ml) → suggestive for prostatic carcinoma.
- >20 ng /ml → diagnostic of advanced prostate cancer (disseminated disease)



- (PSA may be -ve in 20% therefore it is mainly used for follow up).
- The serum level is not affected by DRE, but it may be mildly raised in non malignant conditions as in prostatitis or BPH.
- ⇒ Acid phosphatase: Raised in 70% of cases with extracapsular or metastatic disease. After DRE the acid phosphatase remains elevated for 24 hours.

4. Urodynamic study for bladder neck obstruction.
5. Urine analysis → RBCs.

### For staging

1. TC99 bone scan (especially if PSA > 20 ng/ml).  
→ Scanning is not specific and the scan abnormality should be compared with the clinical examination and plain radiography.
2. X-ray spine: characteristic osteosclerotic lesions with or without pathological fractures (lesions may be osteolytic).
3. CT scan → detects pelvic lymph node deposits, but is not accurate.
4. CXR.
5. Bone marrow aspiration → presence of metastatic carcinoma cells.

### For preoperative preparation

- 1) KFTs → exclude renal failure.
- 2) Liver enzymes (ALP, gamma GT → increase if liver metastasis).
- 3) CBC, FBS, CXR & ECG.

### For screening

⇒ By PSA → controversial.

TURS together with rectal examination and measurement of PSA will detect only 30 – 50% of cancers that are known to be present o autopsy studies

## Treatment

### ⇒ Choice of treatment depends on:

- 1) Staging of the disease (local, metastases).
- 2) Life expectancy and the age of the patient.
- 3) Patient's general condition and his will.

### A. Early (operable cases) → T1 & T2:

In elderly patient with life expectancy < 10 year, watchful waiting is the treatment of choice

#### ➤ Radical prostatectomy:

- Removal of prostate, seminal vesicles and pelvic LN (obturator, internal and external iliac LNs). The bladder neck is reconstituted and anastomosed to the urethra.
- **Side effects:** impotence (high incidence 30%), severe stress incontinence (low incidence 5%).

Recent modification by preservation of neuromuscular bundle (which lies behind the prostate) led to preservation of erectile function in about 60 – 70% of cases

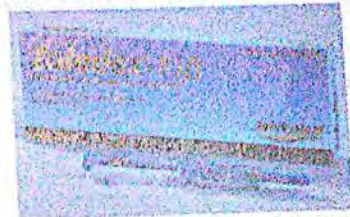
#### ➤ Radical radiotherapy: (in unfit patients)

- External beam radiation therapy is applied with a dose of 7000 cGy over 5 weeks.
- **Side effects:**
  - Bladder irritation → frequency & urgency.
  - Rectal irritation → diarrhea or bleeding per rectum.
- Useful for symptomatic bone metastases → produces dramatic relief of pain.



**B. Advanced (inoperable cases) → T3 & T4:**

- Palliative TURP.
  - ⇒ For patients with bladder outflow obstruction and not fit for major surgery
    - symptomatic relief.
- Hormonal therapy:
  - ⇒ This is the mainstay of treatment in cases of advanced or unfit or unwilling patient for surgery or radiotherapy.
  - ⇒ **Principle**: prostatic cancer is androgen sensitive; there are different methods for androgen ablation:
    - a- Bilateral **Orchidectomy** (removal of testes with tunica albuginea and epididymis) or bilateral **Orchiectomy** (removal of testes only to avoid appearance of empty scrotum).
      - Side effects: loss of libido & erectile dysfunction.
    - b- Estrogen: - phosphorylated DES (Honvan®) → still increases risk of thrombosis.
      - Ethinyl oestradiol may also be used.
    - c- LHRH agonist (Zoladex):
      - The drug causes initial rise of the level of testosterone for 4-6 weeks then drops to castrate level. - Expensive.
    - d- Anti-androgen (Nutilamide®):
      - Act by blocking testosterone receptors by competitive inhibition.
      - Used as adjuvants to castration or LHRH agonists.

**C. Treatment of metastasis:**

1. Radiotherapy (if multiple bone metastasis → IV strontium-89 which is a bone-seeking isotope to deliver effective radiotherapy to metastatic areas).
2. Internal fixation for pathological fracture.

☒ No treatment in cases of small well differentiated tumors in elderly men may be managed by watchful waiting, particularly if their life expectancy is less than 10 years.

**Prognosis**

- 1- With localized tumors to the prostate, the 10-year survival rate is 50%.
- 2- If metastasis is present, the 10-year survival rate drops to 10%.

	BPH	CANCER PROSTATE
<b>Incidence</b>	50% of ♂ above 50 yrs old	Most common cancer in ♂ > 65 yrs
<b>Etiology</b>	Unknown (Mainly growth factors)	- Black - Fatty meals - +ve F.H.
<b>Site</b>	Lateral, middle lobes	Posterior lobes
<b>Macroscopic</b>	- Yellowish - No gritty sensation - Fibrous trabeculae	- Greyish - Gritty sensation - Mass + Hge. + necrosis
<b>Microscopic</b>	- Hyperplasia of acini - Corpora amylacea	Adenocarcinoma (95%)
<b>C/P</b>	1. Prostatism { <ul style="list-style-type: none"> <li>Urinary: Frequency, Difficulty, Retention, Hematuria</li> <li>Sexual: ↑ libido → impotence</li> </ul>	



Investigations	2. Complications	2. Complications
	3. DRE: benign enlargement	3. Pain <sup>Back</sup>
Treatment	Transrectal U/S + PSA + Acid phosphatase + IVP + urodynamic studies	4. Occult (due to metastasis)
	Biopsy (staging, screening) + Comp. + Pre-op. +	3. DRE: malignant enlargement
	- <u>Medical</u> : supportive	- <u>Early</u> : Radical prostatectomy or Radical radiotherapy
	- <u>Surgical</u> : TURP	- <u>Late</u> : TURP or hormonal therapy

## Hematuria

➡ See differential diagnosis.



## Points to remember (tumors)

### Wilm's Tumor (Nephroblastoma)

- ▶ The 2nd commonest tumor affecting the kidney and the 4th malignancy affecting children.
- ▶ Bilateral in 5-10% of cases, early invades the capsule, of good prognosis.
- ▶ C/P: main presentation is an abdominal mass, vague abdominal pain, Microscopic hematuria, associated anomalies in familial type.
- ▶ Inv.: U/S, spiral CT, IVU, urine analysis.
- ▶ TTT: - Operable: surgery, pre-op. chemo.  
- Inoperable: chemotherapy.

### Transitional Cell Carcinoma of the Pelvis

- ▶ PDF: tobacco use, Phenacetin abuse.
- ▶ Can develop in the ureter, the bladder or even the contralateral renal pelvis.
- ▶ C/P: hematuria, obstruction, swelling.
- ▶ Inv.: IVU, CT, cytology.
- ▶ TTT: Nephro-ureterectomy

### Benign Prostatic Hyperplasia (BPH)

- ▶ Very common in old males.
- ▶ Mostly arise from submucous group of the gland in T.ZONE
- ▶ C/P: a. **Symptoms**: urinary symptoms (frequency, urgency, hesitancy, retention), sexual symptoms + symptoms of complications.  
b. **Signs**: On DRE criteria of BPH.
- ▶ Comp.: renal failure, psychological distress, hematuria, back pressure.
- ▶ Investigations: TRUS, PSA, IVU, Cysto-urethroscopy + biopsy, uroflowmetry.
- ▶ TTT: medical if failed surgical (TURP, open).

### Renal Cell Carcinoma

- ▶ Most common tumor of the renal parenchyma, common in male patient
- ▶ Arise from proximal convoluted tubule
- ▶ Unilateral from one pole of the kidney, early invade pelvis, bilat. in Von-Hippel Lindau dis.
- ▶ C/P: Main presentation: hematuria, pain abdominal mass, 2ry varicocele.
- ▶ Inv: CT, IVU {DEAD}, U/S, KFTs, urine ana.
- ▶ TTT: a. operable: radical nephrectomy  
b. In operable: IL2, alpha or gamma interferon, radiotherapy, analgesics.

### Urinary Bladder Tumors

- ▶ Common in male than females.
- ▶ SCC occurs in young age with TCC occurs in old age
- ▶ SCC:
  - chronic irritation & infection, N-nitrose, precancerous lesion
- ▶ TCC:
  - smoking, industrial carcinogen, chemo., phenacetin, genetic.
- ▶ C/P: Terminal hematuria, necroturia, frequency, dysuria, late pain.
- ▶ Inv.: cysto-urethroscopy+ multiple biopsies, IVU, CT, U/S, urine cytology.
- ▶ TTT: a. **SCC**: Radical cystectomy  
b. **TCC**: - non invasive: trans-urethral resection.  
- invasive: radical cystectomy, radio, chemo.

### Carcinoma of the Prostate

- ▶ The most common cancer in ♂ > 65 years (androgen sensitive).
- ▶ Common in the posterior lobes (peripheral zone 75%).
- ▶ C/P: a. **Symptoms**: Prostatism, pain (perineal, suprapubic), occult (metastases).  
b. **Signs**: criteria of cancer prostate in DRE.
- ▶ Comp.: spread, hematuria, retention, back pressure, renal failure.
- ▶ Investigations: TRUS + PSA, acid phosph., IVU, bone scan, CT, X-ray spine.
- ▶ TTT: according to stage, age, general condition, life expectancy.  
- Early: radical prostatectomy, radiotherapy.  
- Advanced: palliative TURP, hormonal.  
- Metastases: radio., int. fixation of fractures.



**Kidneys**

- Flower vase appearance in IVP is seen in horseshoe kidney.
- The cause of ureterocele is congenital atresia of ureteric orifice.
- Hematuria following trivial blunt trauma of kidneys indicates previously pathological kidneys.
- Closed renal injury is always extraperitoneal.
- Contusions are best treated with → observation until hematuria subsides.
- Lacerations 2ry to blunt trauma don't always require exploration:
  - Confined to cortex → no exploration.
  - Extending to calyceal system → requires exploration.
- Indications of IVP following abdominal trauma:
  - a. Blunt trauma to abdomen, back
  - b. With microscopic hematuria
  - c. With macroscopic hematuria.
- In renal T.B., the earliest manifestation is frequency.
- The commonest bacteria found as nidus for urinary stones are staphylococci & E. coli.
- Hyperparathyroidism is found in 5% or less of those presenting with radio-opaque stones.
- If parathyroid adenoma is found to be a cause of renal stones, it should be removed 1<sup>st</sup> before the stone.
- Open operations for renal stones are performed through extraperitoneal loin approach.
- 1% of patients with ureteric stone need open surgery.
- In case of bilateral silent staghorn stones in elderly, the patient should be managed conservatively.
- $\text{Ca}^{++}$  oxalate renal calculi doesn't get affected by change of urine pH.
- Uric acid, cystine stones are treated by alkalinization of urine.
- ESWL's most common complication is urethral obstruction 2ry to stone fragments.
- Classical triad of: pain, hematuria & mass in R.C.C. occurs in 10% of cases.
- For assessing R.C.C. CT (the most important initial assessment) shows:
  - a. Size & site of R.C.C.
  - b. L.N.
  - c. IVC, renal V. invasion.
- Transabdominal approach to kidney is advisable in tumors.
- Pretreatment to unresectable wilm's tumor is radiotherapy, chemotherapy or both.
- 6 months child with left sided abdominal mass, the investigation showed calcification near the Lt. kidney, this is → Neuroblastoma.
- Bilateral ureteric obstruction occurs in cancer [cx].
- Retroperitoneal fibrosis involves 1<sup>st</sup> the ureter.

**Urinary bladder**

- Hypertrophy of detrusor muscle causes U.B. trabeculations.
- Epithelium of trigone involves proximal ureter & urethra.
- Internal sphincter prevents retrograde ejaculation not incontinence.
- Distal urethral sphincter receives 52 – 54 fibers via pudendal nerve.
- Regarding bladder calculi → its incidence has fallen markedly.
- Carcinogens of bladder cancer includes → Benzidine, Beta-naphthylamine & Chlorinated hydrocarbons.



- The best method to assess depth of penetration of bladder cancer is contrast enhanced CT.
- Regarding bladder C.I.S.:
  - a. More in ♂.
  - b. Poorly differentiated TCC
  - c. TTT: intravesical BCG.
  - d. Higher tumor recurrence.
- Strangury is due to irritation of trigone.
- Uretero-segmoidostomy leads to hyperchloremic acidosis.

### Prostate

- Formation of prostatic middle lobe in BPH arises from central zone.
- Drug therapy in BPH gets 20% improvement in symptom score.
- TURP results in 75% improvement in symptom score.
- Assessment in prostatic cancer includes cross sectional MRI.
- Patient who had prostatectomy for BPH, can develop cancer prostate.
- 75 yrs old ♂ got TURP & discovered foci of adenocarcinoma, the next step is → No TTT.



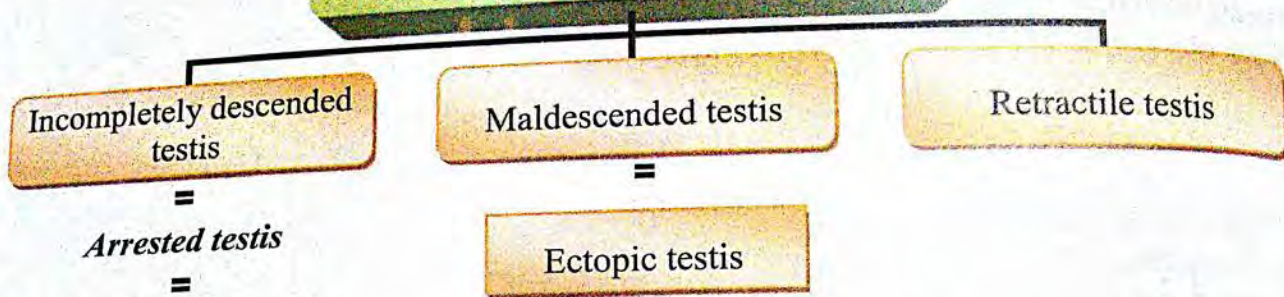
# Anatomy of the Testis

➔ See surgical anatomy book.

## A-Diseases of Testis

### Congenital Anomalies of Testis

#### 1. Imperfect descent of the testis



#### Undescended Testis

2. Testicular agenesis (Anorchia) / Hypoplasia (rare).
3. Supernumerary testis (rare).
4. Inversion of the testis means alteration of the normal position of the epididymis

#### a. Anterior inversion

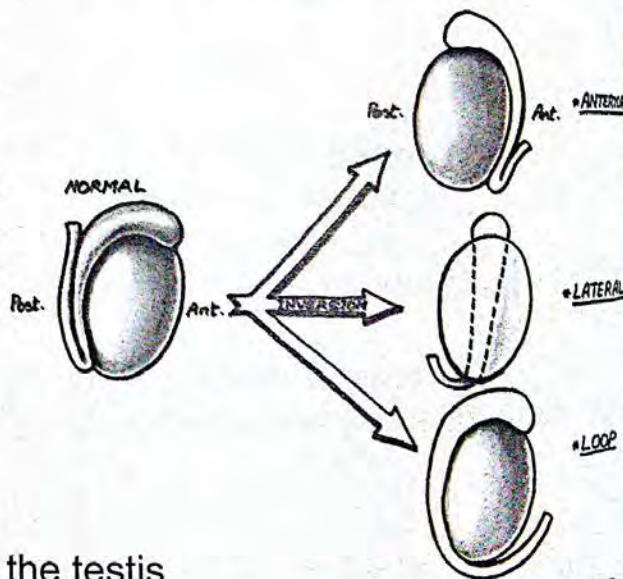
1. Epididymis is attached to the anterior border
2. Testis & tunica vaginalis lies posteriorly
3. TB sinus can open anteriorly in this case only.

#### b. Lateral inversion

The epididymis is attached to the lateral surface of the testis.

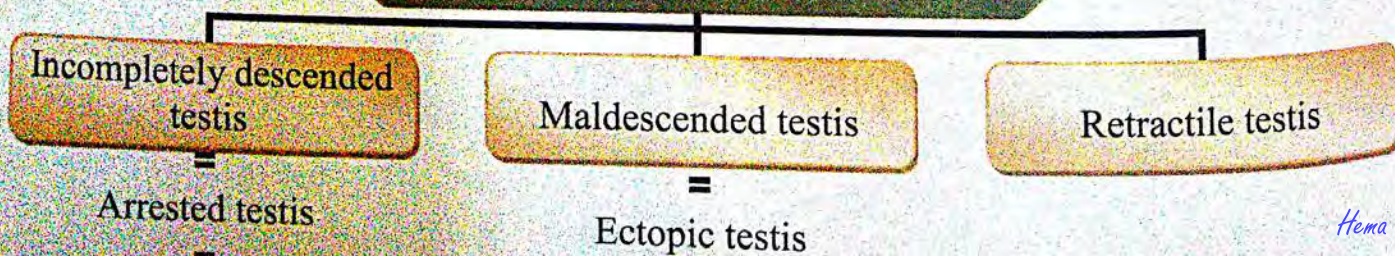
#### c. Loop inversion

The epididymis & ductus deferens encircle the testis



## Imperfectly Descended Testis

#### 1. Imperfect descent of the testis





## A-Incompletely Descended Testis

➔ See Pediatric surgery GIT7

## B- Ectopic testis (Maldescended testis)

### Definition

- The testis has passed the external ring to an ectopic subcutaneous position

### Etiology

⇒ Lockwood theory:

- Rupture of the gubernaculum, so one of the accessory tails is in work.

### Sites

#### A. Around inguinal ligament:

- Above: superficial inguinal pouch. (most common)
- Below: femoral triangle.

#### B. Around penis:

- Above root of the penis.
- Below in perineum.

#### C. Transverse scrotal.

### Complications

- Psychological.
- Liability to trauma & torsion which may occur intra-uterine leading to vanishing testis (DD. strangulated hernia)

NB. Normal spermatogenic & hormonal functions

### Clinical Picture

### Symptoms

- Mother complains that one or both sides of her baby scrotum are empty

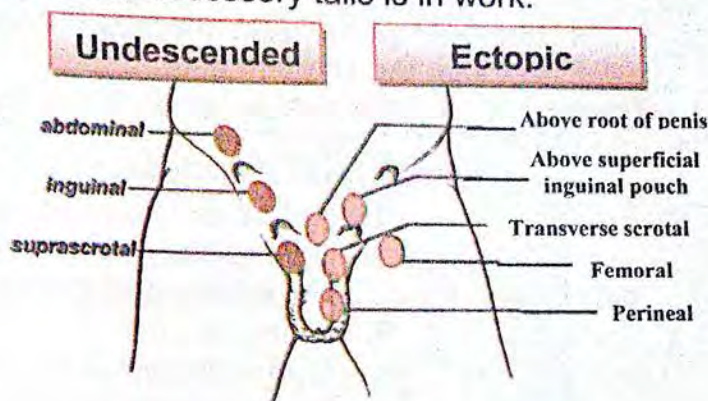
### Signs

#### 1- The Scrotum:

- Empty scrotum (unilateral or bilateral)
- Is well developed (normally, at the external ring the testis secretes hormones to develop the scrotal compartment of its same side.

#### 2- The Testis:

- It is **outside** the inguinal canal & during muscle contraction the testis becomes better felt.
- It is of **normal size**.



### DD

1. Arrested testis
2. Retractable testis.

3. Surgically removed testis.
4. Agenesis.

### Investigations

- No need for investigations as its site can be detected clinically.

### Treatment

- Orchiopexy which means Surgical replacement of the testis in the corresponding scrotal compartment.
- It is easier as the cord is usually long.



## C- Retractable Testis

- *Very mobile testis due to exaggerated cremasteric reflex, it retracts with:*
  - 1- Cold exposure.
  - 2- Scratch of the medial side of the thigh.
- It is not a disease because the testis has descended normally to the bottom of the scrotum.
- It is commonly seen in young children.

### It is diagnosed by

1. Scrotum is well developed.
2. The testis is of normal size.
3. Repeated examination in warm room.
4. Make the child squat this help the descend of retractile testis, which is milked down to touch the scrotum floor.

**Treatment:** no treatment is required just reassurance.

### Differential diagnosis of empty scrotal compartment

1. Retractable testis (the commonest)
2. Incompletely descended testis.
3. Mal descended testis.
4. Agenesis
5. Surgically removed testis.
6. Atrophied testis (vanishing testis)

## Traumatic diseases of the testis

### Torsion of the Testis

No torsion on top of normal testis

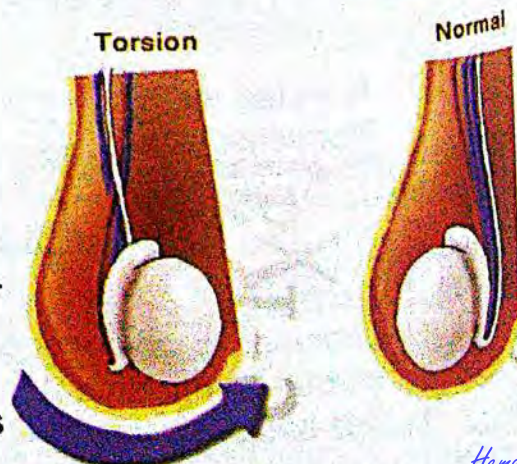
#### Definition

- It is the most common pediatric urologic emergency, in which there is rotation of the testis & epididymis around the axis of the spermatic cord blocking the blood supply of the testis.

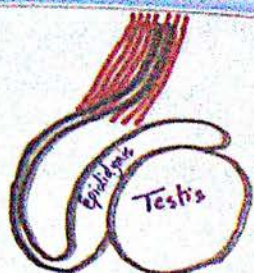
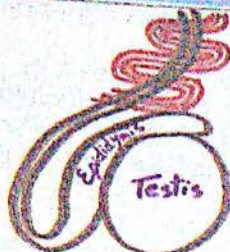
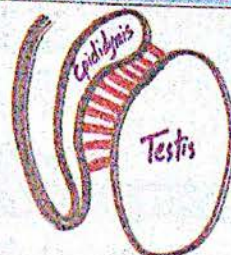
#### Etiology

#### Predisposing Factors

1. Inversion of the testis ( the most common)
  - Anterior Inversion (more common)
  - Polar inversion (epididymis on upper pole associated abnormal tunica vaginalis)
2. Imperfectly descended testis (incomplete or ectopic)
3. Long mesorchium.
4. High investment of the tunica vaginalis (Clapper in a bell effect).
5. Spirally attached cremasteric muscles.
6. Separation of epididymis from body of testis  
→ torsion around the pedicle between them.





Normal  
cremasteric M.Spirally attached  
cremasteric M.Long  
mesorchium

### Precipitating Factors

- Straining or minor trauma but spontaneous torsion may occur.

### Pathology

- The testis rotates from outside inwards.
- It becomes oedematous and congested.
- The color becomes dark and finally Gangrene occurs within 8-12 hours if the condition is not treated.
- The spermatic cord shows the twists (one or more).
- If torsion persists → the blood vessels are thrombosed.
- There is hydro-haematocele in the tunica vaginalis.
- The scrotal skin is red and oedematous.

Testicular  
torsionGangrenous  
testis on  
top of

### Clinical Picture

*Infant or adult 15-25 years with sudden severe testicular pain*

### Symptoms

- Pain → sudden severe agonizing pain in scrotum, groin & lower abdomen.
- Swelling → Testicular swelling.
- Reflex symptoms → Nausea, vomiting & collapse.

### Signs

⇒ **General:** pallor, sweating & tachycardia (up to shock).

⇒ **Local:**

#### 1- Torsion of imperfectly descended testis:

- The scrotum is empty in the corresponding side.
- The inguinal canal is swollen, tender.

#### 2- Torsion of the complete descended testis:

- The scrotum:
  - Swollen, red & tender.
  - Dimple in site of gubernaculum.
  - Elevation of the scrotum ↑ the pain.



## Special Surgery

396

- **The cord:** twist might be felt on the cord.
- **The testis is:**
  - High up in position.
  - Tender & irreducible.
  - Small vaginal hydrocele.

The cremasteric reflex is absent in the affected side.

### D/D of acute scrotum

#### I. Acute epididymo-orchitis:

	Testicular torsion	Acute epididymo-orchitis
Age	Adolescent & children	Adult or elderly
History	Mild trauma	UTI symptoms
Temperature	Normal or slightly elevated	elevated
Scrotal elevation	↑ pain	Partially relieves pain
Urine analysis	Free	Pus cells
Doppler	Obstructed testicular Vs.	Patent Vs.

#### II. Strangulated inguinal hernia: irreducible, no impulse on cough, tense & tender

#### III. Idiopathic scrotal edema:

- a. Between 4-12 years.
- b. C/P → huge scrotal swelling that may extend to perineum, penis and groin with little pain and tenderness.
- c. Resolves within few days.
- d. Recurrent.

#### IV. Torsion of a testicular appendage which is hard to be differentiated from testicular torsion, the most common to be rotated is hydatid of morgagni.

### Causes of Acute Scrotum

- 1) Epididymis: epididymitis (acute epididymo-orchitis).
- 2) Testis: orchitis- Rupture testis.
- 3) Cord: funiculitis – torsion.
- 4) Tunica: pyocele – hematocele.
- 5) Torsion one of testicular appendages e.g. hydatid of Morgagni.

### Investigations

- **Doppler:** detect obstruction of blood flow in testicular vessels which ↑ in inflammatory state i.e. epididymo-orchitis.
- **Duplex scan:** confirm the condition by detecting the thrombus in the vessels.
- **Urine analysis.**

If the investigations are not available and the diagnosis is suspected → It's advisable to proceed directly to scrotal exploration even if it prove negative, to avoid testicular gangrene.



### Treatment

→ Testicular torsion is a surgical emergency. Even in case of doubt, urgent surgery is still recommended.

1. In 1<sup>st</sup> hour: it may possible to untwist the testis by gentle manipulation.
2. Correct general condition.



**3. Urgent operation:**

a- In early cases:

- Untwist the cord.
- Orchiopexy to prevent recurrence.
- Eversion of the tunica to prevent hydrocele formation.

b- In late cases (where the testis is gangrenous):

- Orchiectomy is done above the level of twists.

**4. Orchiopexy of the other testis:**

- As the anatomical cause of the torsion is likely to be bilateral.
- Fixation by non absorbable sutures between tunica vaginalis & tunica albuginea.

## Varicocele

### Definition

- It is varicosity (dilatation, elongation and tortuosity) of pampiniform & cremasteric plexuses of veins, i.e. varicose veins of the spermatic cord.
- Varicocele is usually primary and rarely secondary.

### Primary Varicocele

### Incidence

- 15% of general population.

### Etiology

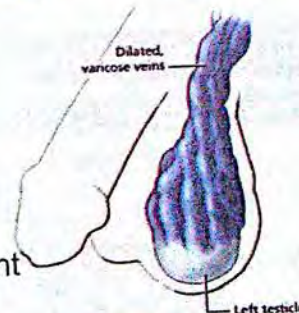
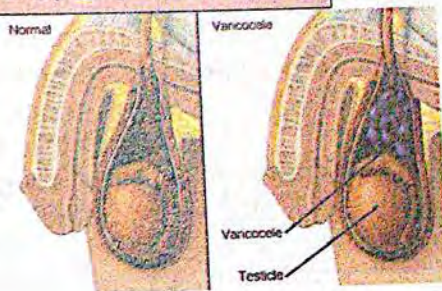
Its exact cause is unknown

### Predisposing factors

- o **Age:** young adults (15-30 years).
- o **Congenital weak mesenchyme:**
  - Which might be associated with hernia & varicose veins, piles and flat feet.

### Precipitating factors

- o **Increase venous pressure**
  1. Prolonged standing.
  2. Straining as in constipation.
  3. Venous congestion due to unrelieved sexual excitement



### Why primary varicocele more common on left side than right?

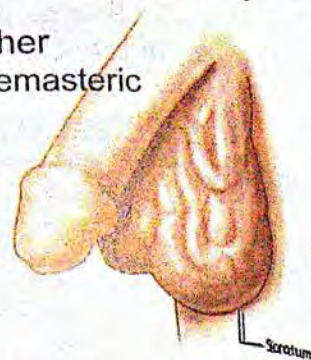
1. Pelvic colon passes on the left testicular vein.
2. The lower position of the left testis with longer testicular vein than the right vein (i.e. more venous pressure).
3. The left testicular vein opens at right angle in the left renal vein.
4. Left suprarenal gland secretes adrenaline near the mouth of the left testicular vein.
5. The left common iliac vein is crossed by the right common iliac artery this causes higher pressure in the veins of the vas & cremasteric vein.
6. High pressure in the left renal vein as it is compressed between the superior mesenteric artery & aorta (nut cracker effect).
7. The left testicular artery arches over the left renal vein in 16 % of cases.
8. Valves at the end of the left testicular vein are usually malformed while on the right side are usually competent.



## Clinical Picture

### Symptoms

- Usually symptomless and discovered at medical examination but it may present by:
  - Pain: increase by prolonged standing or hot weather
    1. Dragging pain: due to relaxation of Dartos & cremasteric muscles.
    2. Throbbing pain in case of thrombophlebitis.
  - Swelling: scrotal swelling.
  - The patient may complain of infertility.



### Signs

- General:
  - Patient is usually tall & thin & viscerop-tosis may be present.
- Local:
  - Inspection:
    - Left side of the scrotum hangs lower than the right side.
    - Scrotal skin may have dilated veins.
    - Large varicoceles are also visible.
  - Palpation: (on standing)
    - Scrotal neck test fullness at the neck of the scrotum.
    - Varicosity is felt as a bag of worms.
    - Thrill on cough may be felt due to turbulence of blood flow.
    - Swelling which disappears when patient lies down & scrotum is elevated.
    - Small lax 2ry hydrocele → can be detected by pinching test.



To differentiate it from 2ry varicocele

## Complications

### 1. Subfertility (20 % of cases) (particularly when bilateral)

→ due to ↓ count, vitality and mobility of sperms (Asthenospermia).

#### Why?

#### Thermal Theory:

- The temperature difference between scrotum & rectum has to be 2.5°C.
- If less this might impair spermatogenesis.
- Even if unilateral due to transmission of heat by contact with the other side.

### 2. Thrombosis → thrombophlebitis

### 3. Secondary hydrocele

- Due to chronic congestion of the testis.

### 4. Testicular atrophy!!! (very late)

- Chronic congestion → ↑ venous pressure → ↓ arterial blood supply → testicular atrophy.
- The testis becomes softer in consistency & smaller in size.

### 5. Neurosis

DD

Inguino-scrotal swelling.



## Investigations

### Laboratory

- Semen analysis (for medico-legal importance) → **stress pattern**. (asthenospermia & oligospermia.)

### Radiological

- **Doppler or Duplex scan** → detects reversed blood flow & bilaterality.
- **Scrotal or Transrectal U/S:**
  - Best test to evaluate the seminal vesicles and ejaculatory ducts.
  - Valuable in visualizing and grading varicocele.
- **Abdominal U/S** → to exclude 2ry varicocele e.g. hypernephroma.

## Treatment

### Conservative Treatment

(2 supports)

- 1- **Reassurance of the patient:** (in early cases) as the condition is usually self limiting around the age of 40 years (**Psychological support**).
- 2- **Scrotal support:** For pain a scrotal suspender or close-fitting underpants can be used especially in hot weather.
- 3- **Sedatives.**
- 4- **Avoid constipation,** pelvic congestion.
- 5- **Cold baths** to the scrotum.

### Operative Treatment

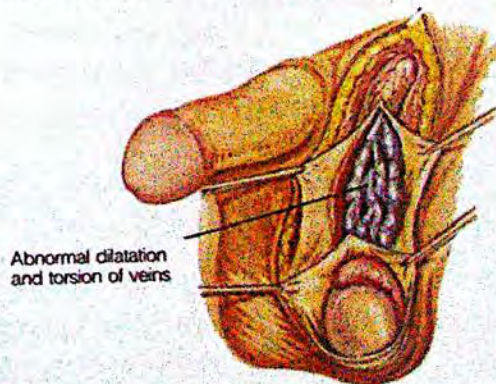
#### ○ Indications:

1. Deficient spermatogenesis (oligospermia): Sperm count and infertility improve in 30-50% of cases after surgery.
2. A large painful varicocele: when the pain does not respond to conservative measures.
3. Recurrent thrombophlebitis.
4. Neurotic patient.

#### ○ Operations:

→ Prevention of venous reflux is achieved by attacking the venous return of the testis at one of these levels:

1. Ligation and division of the testicular vein(s) in the extra-peritoneal space as it emerges from the internal ring (**Palomo's operation**).
2. Ligation and division of the pampiniform plexus in the inguinal canal.
3. Ligation and division of the pampiniform plexus high in the scrotum.





## Secondary Varicocele

### Causes

*It is due to venous obstruction of spermatic vein.*

1. The commonest cause is **hypernephroma**:
  - a- It spreads in the renal vein or IVC like finger in glove.
  - b- Pressure from outside by the renal mass.
2. Retroperitoneal tumors or fibrosis.

### It differs from primary type in

- 1- Older age group. (usually >40 years)
- 2- It affects both sides equally.
- 3- Rapidly progressive.
- 4- No thrill on cough.
- 5- Size is not reduced when patient lies down & scrotum is elevated.

### Treatment

- Of the cause.

## Testicular Neoplasm

### Definition

Abnormal rapid and invasive growth of malignant cells in the testis.

### Incidence

- 99 % of testicular neoplasms are malignant.
- 1-2% of malignant tumors in male.
- The commonest cancer in young men (15-40 years old).
- more common in Right side due to ↑ incidence of Maldescended testis.
- 10% of patients have history of undescended testis whose surgical treatment does not reduce the susceptibility to malignancy.

### Classification

#### A. Germ cell tumors:

- Seminomas 40 %.
- Teratoma 32 %.
- Seminoma + Teratoma 14 %.

*Main types*

#### B. Interstitial tumors 1.5 %

- Leydig cell tumor.
- Sertoli cell tumor.

*Rare types*

#### C. Secondary tumors

- Lymphoma 7%.
- Leukemic infiltration of the testis.
- Metastatic tumors.



Seminoma	Teratoma
Age	
30 – 50 years.	20 - 35 years.
Origin	
Seminiferous tubules.	Totipotent cells which have trigeminal potentiality (differentiate into ectoderm, endoderm, mesoderm).

### Risk factors of germ cell tumor

- Undescended testis especially intra-abdominal varieties. The incidence of malignancy in undescended testis is 15 times more than normal population
- Positive family history.
- Testicular dysgenesis e.g. Klinefelter syndrome
- HIV infection
- Genetics: 80% of these tumors have a specific marker chromosome called isochromosome 12 p
- **Carcinoma in situ.**
- **Trauma** : which attract the patient attention rather than causing it

### Pathology

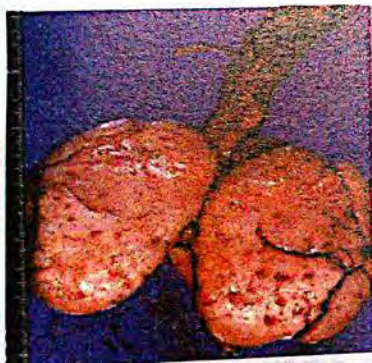
#### ❖ Macroscopic picture:

- **Large**, firm & smooth.

#### Cut section:

- **Homogenous** & creamy or pink in color.
- Fibrous Septa divide the mass into lobules.
- Areas of hemorrhage and necrosis.

**Cut section  
Seminoma**



#### ❖ Microscopically

##### Cells.

- Resemble spermatocytes.
- Rounded or oval cells with large rounded nuclei and clear cytoplasm.
- Arranged in sheets separated by fibrous stroma.
- Tumor is infiltrated by lymphocytes (good host reaction → good prognosis)

#### ❖ Macroscopic picture:

- Variable size, variable consistency and irregular surface.

#### Cut section:

- Heterogenous & yellowish.
- Areas of hemorrhage and necrosis.
- shows cysts that contain gelatinous material.

**NB.** Teratoma is surrounded by tunica albuginea → so shape of testis is preserved.



**Cut  
section  
Teratoma  
(MTI)**

#### ❖ Microscopically:

1. **Teratoma differentiated** (Dermoid cyst )
  - Cyst is lined with stratified squamous epithelium and may contain hair bone, muscles as well as glandular element.
  - There are no histologically recognizable malignant components, but it can metastasize, so it is not benign.
2. **Malignant teratoma intermediate (The commonest testicular teratoma) MTI**
3. **Malignant Teratoma Anaplastic:**
  - Composed of undifferentiated embryonal (anaplastic) cell.
  - Cells derived from yolk sac produced increased level of alpha-feto protein



4. **Malignant teratoma tropho-blastica (choriocarcinoma)**
- Malignant villous or papillary cyto-trophoblast **produces HCG** and spread early by blood and lymph.
  - **Most malignant testicular tumor**

## Staging

- **Stage I** → tumor is confined to the testis.
- **Stage II** → involvement of LNs below the diaphragm.
- **Stage III** → involvement of LNs above the diaphragm.
- **Stage IV** → distant metastasis.

## Spread

- **Local**
    - Spermatic cord, epididymis, scrotal wall.
  - **Lymphatic**
    - Para-aortic lymph nodes → thoracic duct → Virchow's gland (Troisier sign).
  - **Blood (rare)**
    - Where lungs are the first site
- NB: If there is invasion of the scrotum the inguinal LNs will be affected.*

Mainly lymphatic spread

Mainly blood spread

## Markers

- B-HCG & LDH (Radio-sensitive)

- B-HCG & α-feto-protein (Chemo-sensitive)

## Clinical Picture

**Middle aged male patient with testicular mass either discovered accidentally or after trauma (in 10% of cases) as trauma arouses patient attention to mass.**

## Symptoms

- May be **asymptomatic**.
- Painless testicular **swelling** (Gradual onset, progressive course).
- Sense of heaviness (when testis enlarged 2 or 3 times).
- **Pain** (30% of cases): present in advanced cases or in case of acute hemorrhage within the neoplasm.
- Symptoms of metastasis for example bone pain.
- Gynecomastia can occur in advanced stages of teratoma.
- Past history of undescended testis can be given.

## Signs

### 1- **Local:**

- **Testis is:**
  - Enlarged.
  - Hard, smooth, Heavy mass → later on areas of softening may be present.
  - May be fixed to surrounding structures in advanced cases.
- Early loss of testicular sensation. (occur in syphilis & seminoma)
- Secondary hydrocele (in 10% of cases) → rapidly accumulating.



- Thickening of spermatic cord may occur late.
- **The epididymis is:**
  - At first normal → becomes stretched over the swelling → finally becomes infiltrated with the tumor.

## 2- **Abdominal:**

- Para-aortic LNs enlargement.
- Liver enlargement.

## 3- **General:**

- Manifestation of metastasis for example pleural effusion, enlarged supraclavicular LNs.

- Any rapidly accumulating vaginal hydrocele should be investigated for tumors.
- Inguinal LNs are only affected on infiltration of scrotal skin.
- The clinical course of the tumor may be very slow (takes 2-3 years to develop) as dermoid cyst or very aggressive as hurricane type which kills the patient within 1-2 years, however testicular neoplasms may be presented with picture like acute epididymo-orchitis.
- Abdominal mass with an empty scrotal compartment should rise suspicion of malignant transformation in abdominal undescended testis.

## DD

### *Of testicular mass with loss of testicular sensation.*

1. Syphilis (Gumma).
2. Old clotted hematocele.

## Investigations

### For diagnosis

#### 1. **Radiological:**

##### ⇒ **Scrotal U/S:**

- Shows testicular mass and calcification (is more frequent with seminoma).
- Differentiate it from other lesions, e.g., epididymitis.

#### 2. **Laboratory:**

##### ⇒ **Tumor markers: (used also for follow-up)**

- **Beta HCG by Aschheim - Zondek test (pregnancy test):**
  - Raised in 100% of patients with choriocarcinoma.
  - In less than 10% in seminoma.
  - Sustained elevation after treatment suggests residual disease.
- **Alpha fetoproteins**
  - Raised in teratoma.
  - Never raised in Seminoma alone.
  - May be raised in seminoma teratoma which is diagnosed by histopathology.
- **Serum LDH (isoenzyme 1):** elevated in 60% of cases.

#### 3. **Instrumental:**

1. **Biopsy for testicular tumors NEVER taken through the scrotum neither by incision nor by needle aspiration.:**
  - The lymph drainage of the scrotum differs from that of the testis so, don't open new channel for spread to inguinal L.Ns.

2. **Frozen section biopsy:** (done during operation)

##### **Indications:**

1. When clinical diagnosis is doubtful.
2. When the markers are negative.



### For staging

- Bone scan, liver U/S, CXR.
- Abdominal CT scan: for lymph nodes and liver deposits.
- IVP: distortion of the ureteric course which may indicate Para- Aortic LN metastasis.

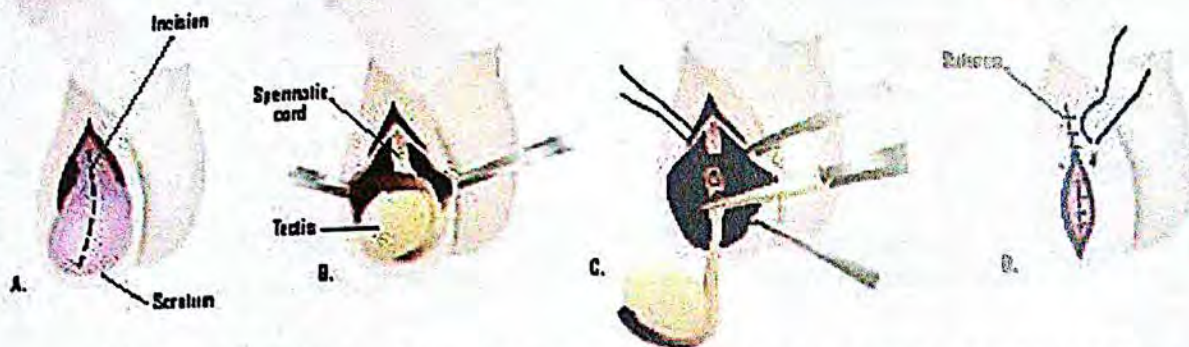
### For preoperative preparation

- CBC, blood sugar, ECG, urine analysis....

### Treatment

A- Initial treatment is by high inguinal simple Orchiectomy

No radical surgery as removal of Para-Aortic LN carries high morbidity & mortality



- 1- Through an inguinal incision, the spermatic cord is identified and isolated at the internal inguinal ring.
- 2- A vascular clamp is applied as high as possible on the spermatic cord to avoid the risk of blood dissemination while manipulating the tumor.
- 3- The testis can now be delivered out and inspected:
  - a) If there is a frank testicular tumor → the testis and the spermatic cord are excised after ligating and dividing the cord at the internal ring.
  - b) If the surgeon is in doubt → biopsy is taken for frozen section examination while the clamp is in place.

B- Further management depends on type & stage of the disease

#### Seminoma (radio- & chemo-sensitive)

- Stage I → Radio-therapy to **Para-Aortic L.N.**  
(With protection of kidneys & other testis).
- Stage II → Radio-therapy that extends **Above the diaphragm.**
- Stage III → chemo-therapy (Cisplatinum) +/- radiotherapy
- Stage IV → Chemo-therapy

#### Teratoma (radio-resistant)

- Stage I → repeated assessment of serum markers and CT, if develops L.Ns enlargement → surgery or chemo-therapy.
- Stage II-IV → Combination chemo-therapy.  
(Cisplatinum, Methotrexate, Bleomycin & Vincristine)

**Retroperitoneal LNs dissection may be recommended with the initial treatment if there is no distant metastasis.**

Following surgery, follow up of patient with Tumor Markers must be done:

- Success of therapy is known by reduction of tumor markers to normal levels.
- Incomplete reduction indicates residual tumor.
- Re-elevation indicates recurrence.



**Prognosis**

5 year survival

	Stage I & II	Stage III & IV
Seminoma	95 %	75 %
Teratoma	85 %	65 %

**Interstitial Cell Tumors****Leydig cell tumor (pre-pubertal tumor)**

- It leads to masculinization of the patient (**infant Hercules** i.e. precocious puberty).

**Sertoli cell tumor (post-pubertal tumor)**

- It leads to feminization of the patient (loss of frontal recess, silky hair, change in body contour, Gynecomastia, loss of libido and aspermia ).
- Orchiectomy is curative in both types.
- Pregnancy test is +ve

**Haematocele**

- Haematocele is accumulation of blood or bloodstained fluid in the tunica vaginalis.
- It may be acute or chronic.

**A- Acute Haematocele  
(Recent Haematocele)****Causes**

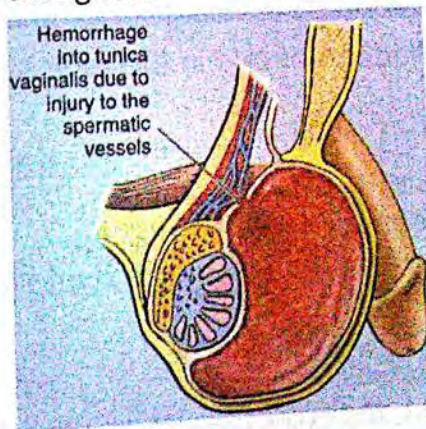
1. Trauma to the testis: injuring the tunica albuginea.
2. Postoperative: e.g., testicular biopsy.
3. Aspiration of hydrocele.
4. Acute funiculo-epididymo-orchitis.
5. Torsion of the testis.

**Clinical Picture**

- Blood accumulates rapidly.
- The tunica becomes tense, tender and opaque with transillumination.

**Treatment****Surgical:**

- Evacuation of the blood and excision of the tunica vaginalis.
- If there is a tear in the tunica albuginea, it should be repaired.





## B- Chronic Haematocoele (Old Clotted Haematocoele)

### Causes

1. Neglected acute haematocoele.
2. Malignant neoplasm of the testis.
3. Repeated haemorrhage in blood diseases.  
→ The blood clots → Fibrosis and thickening of the tunica will result.

### Complications

1. Infection.
2. Compression and atrophy of the testis.
3. Calcification in old-standing cases  
→ may be mistaken for malignancy.

### Clinical Picture

- Pain and heaviness in the scrotum.
- Swelling:  
a- soft (early) or hard (late).  
b- opaque on transillumination.
- The contents of the scrotum cannot be differentiated.

### Treatment

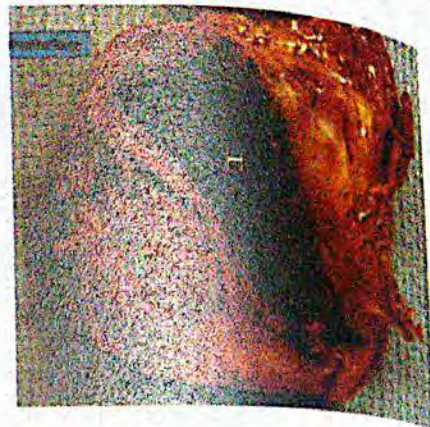
#### 1. In early cases:

→ Dissection of the clot from the testis and excision of the tunica.

#### 2. In late cases:

→ Orchidectomy is performed to exclude malignancy.

→ It is difficult to differentiate between both cases unless the testis is bisected and biopsied.



## Pyocoele

### Definition

Collection of pus in the tunica vaginalis.

### Causes

1. Infected haematocoele.
2. Infected hydrocele especially after tapping.
3. Secondary to suppurative funiculo-epididymo-orchitis.
4. Post-operative.

### Clinical features

- **General:** FAHM, tachycardia.
- **Local:** Redness, hotness, oedema and tenderness.

### Treatment

1. Rest, elevation of the scrotum, Antibiotics and Antipyretics.
2. Incision and drainage of pus.

## Chylocele

→ Chyle (lymph) accumulates in the tunica due to rupture of distal lymphatic vessels in case of **Filariasis**.

→ This forms a swelling which is **similar to hydrocele**, but is **opaque on transillumination**.



# B- Diseases of the Epididymis

## i- Acute Epididymo-orchitis

### Causative Organisms

- E.coli, Staph, Strepto, Gonococci.
- The commonest sexually transmitted infection causing epididymitis is now Chlamydia

### Route of Infection

- 1- Ascending infection (common route): Along the vas.
- 2- Peri-vasal Lymphatics.
- 3- Via blood stream (rare): secondary to specific fever as mumps..

### Predisposing Factors

#### ➤ UTI

1. Cystitis.
2. Urethritis, prostatitis and seminal vesiculitis.
3. Catheterization.
4. During the third week of Gonococcal urethritis.

- 18% of males infected with mumps develops acute epididymo-orchitis.

### Clinical Picture

#### Symptoms

- **Of the cause:** for example history of prostatitis or mumps → dysuria.
- **General:** FAHM.
- **Local:** Acute **painful** scrotal **swelling**, relieved by elevating scrotum.

#### Signs

- **General:** temperature 39° C.
- **Local:**
  - Scrotal skin is **red & edematous**.
  - Enlarged **tender** epididymis.
  - Secondary hydrocele.
  - Signs of **pus loculus** if abscess is formed.

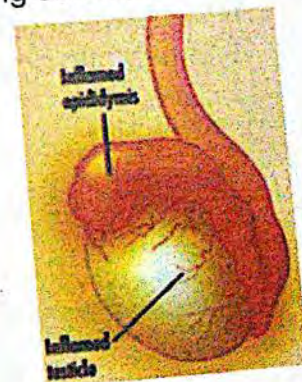
#### DD

#### (Testicular torsion)

- More in children & adolescent following mild trauma.
- O/E → Testis is swollen, tender & *higher than normal*.
- Twist may be felt on the cord.
- Elevation of the scrotum increases pain.
- Doppler → Obstructed testicular vessels.

### Complications

- 1- Testicular abscess.
- 2- Testicular atrophy.
- 3- Chronicity.





**Investigations**

- 1- **Urine analysis** → show pus cells + culture & sensitivity.
- 2- **Duplex** → to exclude testicular torsion.

**Treatment**

→ Inflammation may subside spontaneously, but recurrence is common.

1- **Prophylactic:**

- proper treatment of UTI

2- **Curative:**

- Analgesics & antipyretics.
- Antibiotics: usually a member of the Quinolones group, is given for 2-3 weeks.
- Rest of the affected organ (elevation of the scrotum) for the first few days.
- If an abscess formed → drainage.
- A residual epididymal mass may persist for up to 6 weeks and then resolves spontaneously.

**ii- Chronic Epididymo-orchitis****Chronic Non Specific Epididymitis****Causes**

1. Bad General condition of the patient.
2. Inadequate treatment of acute abscess.
3. Persistence of predisposing Factors (i.e. urinary tract infection)

**Clinical picture**

The epididymis is enlarged & tender.

**Treatment**

- 1- Treatment of the cause.
- 2- Antibiotic according to culture.

*Inflammation is the response of the living tissue to irritant whether chemical, physical, or microbiological*



## TB Epididymitis

## Incidence

- The epididymis is the primary site of affection in genital tuberculosis.
- Occurs mainly in young males.

## Route of Spread

- Reaches the epididymis through the vas deferens from tuberculosis of the seminal vesicle and the prostate.
- lymphatic borne through the Peri-vasal lymphatics.
- Blood borne.
- It is usually unilateral.

- Tail = Globus Minor
- Head = Globus Major

## Pathology

- Multiple tubercles affect the **tail of epididymis**.
- The nodules enlarge and may undergo caseation and cold abscess formation.
- It becomes adherent to the skin and bursts to form a tuberculous sinus on the posterior aspect of the scrotum.
- The vas deferens is **thickened and beaded** (studded with multiple tubercles).
- The testis usually remains free for a long time, but in neglected cases it may be affected.

## Investigations

- 1- Urine analysis → sterile pyuria.
- 2- IVU → to detect urinary TB.
- 3- Culture of secondary on Lowenstein Jensen media

## Treatment

- 1- Improve the general condition (**Sanatorial treatment**).
- 2- Essentially medical by anti-tuberculous drugs.
- 3- If there is no response to conservative treatment after two months → excision of the vas deferens and epididymis is indicated.





# Special Surgery

410

		TB mass	Bilharzial mass	Filarial mass (endemic funiculitis)
Route of Infection		<ul style="list-style-type: none"> <li>- Blood born (rare).</li> <li>- Lymphatic born from the urinary tract → through the vas.</li> </ul>	Worms reach the pampiniform plexus through 2 routes: <ul style="list-style-type: none"> <li>- Vesico-prostatic plexus of veins.</li> <li>- S.M. → through anastomosis bet. The mesenteric &amp; spermatic vs.</li> </ul>	Through lymphatic.
Pathology	<u>Commonest site</u>	<ul style="list-style-type: none"> <li>- If lymphatic born the tail of the epididymis is involved then the whole of it.</li> <li>- If blood borne it affects the head at first then the whole epididymis.</li> </ul>	<ul style="list-style-type: none"> <li>- lower part of the cord and the epididymis.</li> <li>- cord → peri-vascular affection</li> <li>- Granular type.</li> <li>- Nodular type.</li> </ul>	- All the cord became thick and matted
Clinical Picture	<u>History</u>	Of TB urinary tract.	Of bilharziasis	Of an acute attack in an endemic area
	<u>Examination</u>			
	The cord.	Affects the vas only (thickened & beaded in lymphatic borne).	<ul style="list-style-type: none"> <li>- Thickened but not matted.</li> <li>- Contains Bilharzial masses of different sizes.</li> <li>- Beading of veins.</li> </ul>	Affect both the vas & the vessel, they are tender, swollen, & matted that you can't identify both.
	Epididymis.	Nodular & swollen.	Fine nodules & not tender.	Swollen & tender
	Testis.	It affected late. Or never	Never affected	
	2ry hydrocele.	Small lax hydrocele.	Moderate.	Large hydrocele
	DRE	T.B. nodule in the seminal vesicles & prostate.	Chronic fibrotic prostatitis.	Free.
Treatment		<ul style="list-style-type: none"> <li>- Medical Antituberculous.</li> <li>- Surgical, if failed medical do Epididymo-vasectomy.</li> </ul>	- Medical.	<ul style="list-style-type: none"> <li>- Medical only Antibiotics &amp; Hetrazan.</li> </ul>



## Cysts of the Epididymis

### Spermatocele

#### ➤ Definition:

- It is a retention cyst of the vasa efferentia.
- It containing living, dead sperms.
- Fluid rich in cholesterol.
- It contains Barley water fluids

#### ➤ Symptoms:

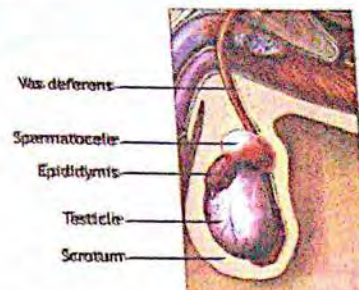
- The patients usually complain of painless scrotal swelling.
- The cyst is usually small, yet it sometimes attains a large size that it looks to the patient like a third testis.

#### ➤ Signs:

- Painless cystic purely scrotal swelling at the upper pole of the testis.
- Not separated from the testis by interval. ( to differentiate it from encysted hydrocele of the cord ).
- The main difference from vaginal hydrocele is that an epididymal cyst is felt separate from testis

#### ➤ Treatment:

- Excision for fear of complications.
- Care should be taken not to injure the epididymis while removing the cyst.



### Simple Cysts of the Epididymis

- Cysts of the epididymis are of unknown etiology.
- It is related to vestigial structure (hydatid of Morgagni).
- They often arise from the head of the organ.
- It contains crystal clear fluid, no sperms.
- It may give multiple transillumination (Chinese lantern appearance).

Treatment Excision only if causing complications.

## C- Diseases of Cord

- TB of the cord: vas is beaded if lymphatic born.
- Bilharziasis of the cord: veins are beaded (site of ovum deposition → fibrosis & granulation tissue formation).
- Fibrosis of the cord : lymphedema of the cord . Cord is thick and matted.

## D- D.D. of Scrotal Swellings

➔ See differential diagnosis book

## Acute Scrotum

➔ See differential diagnosis book



## Points to remember (testis)

### Ectopic Testis

- ▶ **Etiology:** ruptured gubernaculum.
- ▶ **Sites:** superficial inguinal pouch (common).
- ▶ **C/P:** empty scrotum, testis outside inguinal canal, scrotum & testis are well developed.
- ▶ **Comp.:** trauma, torsion, psychological.
- ▶ **Invest.:** not needed.
- ▶ **TTT:** Orchiopexy (easier).

### Primary Varicocele

- ▶ **Incidence:** 15%, more on Lt. side.
- ▶ **Etiology:** cong. mesenchymal weakness.
- ▶ **C/P:** dragging pain, bag of worms, thrill on cough, ↓ on lying down (1ry only).
- ▶ **Comp.:** Subfertility, Thrombophlebitis, Secondary hydrocele, Testicular atrophy, neurosis.
- ▶ **Invest.:** Duplex, semen analysis.
- ▶ **TTT:** Conservative, Operative (Palomo's).

### Hematocele

- ▶ **Acute Hematocele:**
  - **Causes:** trauma, post-operative, aspiration of hydrocele, infection, torsion.
  - **C/P:** Bl. accumulate rapidly, tunica (tense, tender, opaque with transillumination).
  - **TTT:** Surgical (evacuation of blood + excision of tunica, if tear → repair).
- ▶ **Chronic Hematocele:**
  - **Causes:** neglected acute, neoplasm, repeated Hge in bl. disease.
  - **C/P:** pain, heaviness, swelling (soft or hard & opaque on transillumination).
  - **Comp.:** infection, compress. and atrophy of testis calcification in old hematocele.
  - **TTT:** Early (dissection of the clot).  
Late (Orchidectomy).

### Pyocele

- ▶ **Causes:** infected hematocele or hydrocele, post-op., 2ry to Epididymo-orchitis.
- ▶ **C/P:** FAHM, redness, hotness, tenderness.
- ▶ **TTT:** -rest, elevation, antibiotics, antipyretics.  
- Incision and drainage of pus.

### Torsion Testis

- ▶ **Etiology:** inversion (most common)
- ▶ **C/P:** young adult, sudden severe pain, swelling, tender testis, elevation of the scrotum ↑ the pain.
- ▶ **D.D.:** epididymo-orchitis.
- ▶ **Invest.:** Doppler, Duplex, urine anal.
- ▶ **TTT:** Bilat. Orchiopexy or orchiectomy.

### Testicular Neoplasm

- ▶ **Types:** seminoma 40%, teratoma 32%.
- ▶ **Etio.:** Undescended testis (commonest).
- ▶ **C/P:** swelling, pain(late), lost sensation, epididymis: 1<sup>st</sup> normal, finally infiltrated.
- ▶ **Invest.:** - Diag.: U/S, Markers (β HCG, alpha feto protein, LDH), Biopsy.  
- Staging, Pre-operative.
- ▶ **TTT:** Orchiectomy + chemo ± radio.
- ▶ **Follow up:** by Tumor markers.

### Acute Epididymo-Orchitis

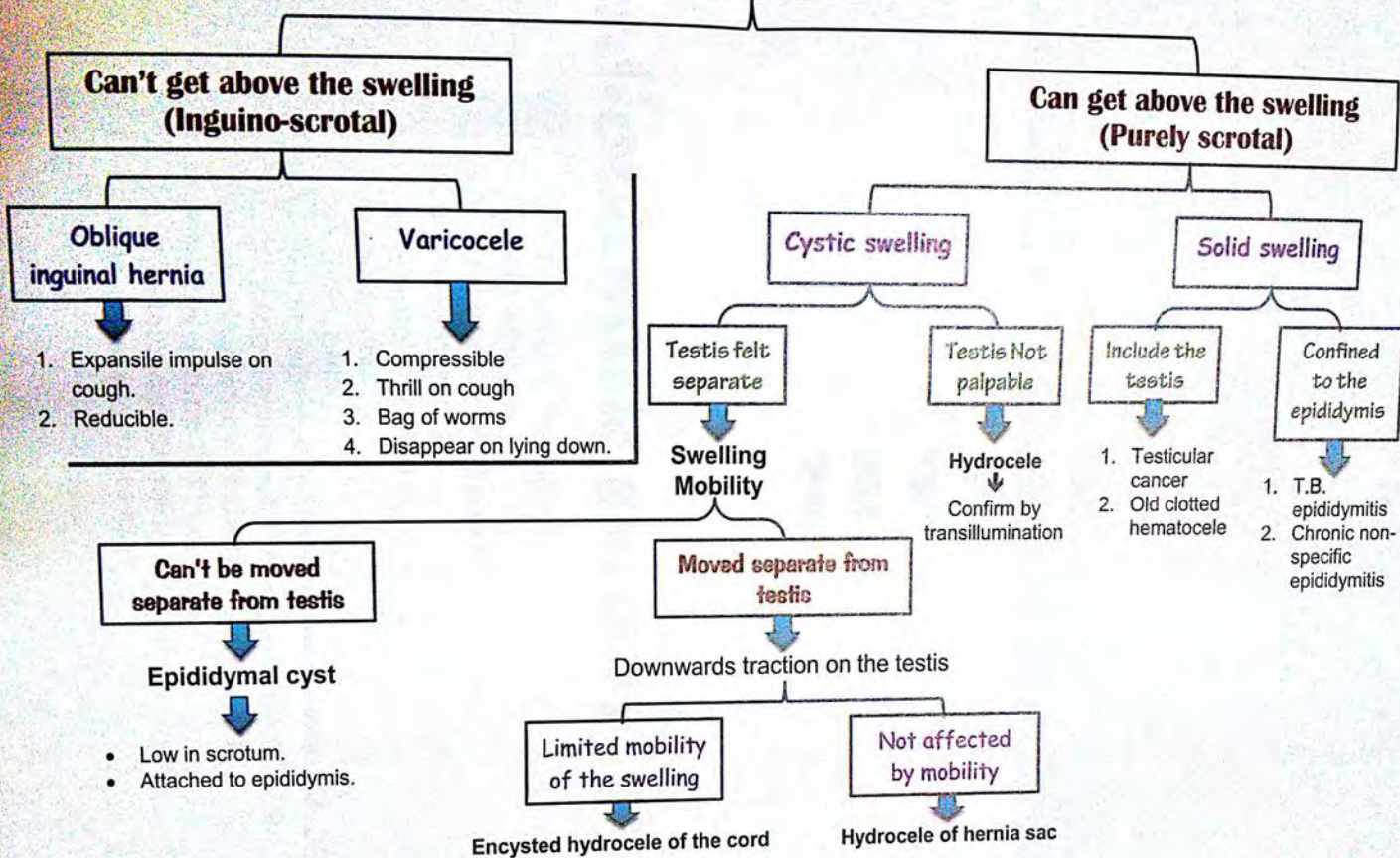
- ▶ **Etiology:** UTI, STDs (Ascend. Infection).
- ▶ **C/P:** FAHM, pain, swelling, redness, tenderness, signs of pus loculus.
- ▶ **D.D.:** testicular torsion.
- ▶ **Comp.:** Chronicity, abscess, atrophy.
- ▶ **Invest.:** urine analysis, C&S, Duplex.
- ▶ **TTT:** AAA (Quinolones for 2-3 weeks) + drainage if abscess.

### T.B. Epididymitis

- ▶ Lymphatic borne, blood borne.
- ▶ **Pathology:** 1<sup>st</sup> affect tail, undergo caseation, sinuses on post. aspect of scrotum, vas becomes thickened and beaded.
- ▶ **Invest.:** urine analysis, culture, IVU.
- ▶ **TTT:** - Sanatorial, anti-TB drugs.  
- if no response in 2 months → excision of vas and epididymis.



# Scrotal swelling





# CHAPTER 5 P T E R

## *Cardiothoracic surgery*

- Trauma to the chest
- Rib fracture
- Pulmonary contusion
- Pneumothorax
- Pleural effusion
- Hemothorax
- Empyema
- Adult respiratory distress syndrome (ARDS)
- Postoperative Pulmonary Complications
- Cardiac arrest & Cardio-pulmonary resuscitation (CPR).
- Mediastinal injuries
- Mediastinal masses



# Trauma to the chest

## Types of trauma

- A- **Blunt trauma:** non-penetrating, such as car accidents (pleura may be intact).
- B- **Penetrating trauma:** Pleura is injured by stabs or gunshot. The kinetic energy of the bullet is proportional to its mass multiplied by its square velocity.
- C- **Blasts:** (part of chest wall may be lost)
  - Stress waves, which disrupt the alveolo-capillary membrane resulting in hemorrhage and leakage of interstitial fluids into the alveoli (C/O dyspnea and cough with frothy bloody sputum).

## Clinical picture

(Varies according to the nature of trauma)

## History

1. Time & nature of the accident.
2. Dyspnea and chest pain.

## Examination

1. General examination:
  - a- **Signs of shock** may be present: pallor, ↓ BP, ↑ pulse, hypothermia etc...
  - b- **Signs of respiratory distress** may be present: cyanosis, working ala nasi.
  - c- **Associated injuries:** (**Examine Abdomen**) hepatic or splenic rupture.
2. Local examination: **bruises & ecchymosis** + one of the followings
  - a- Pneumothorax → mediastinal shift, ↓ TVF, **Hyper-resonant** note, ↓ air entry.
  - b- Hemothorax → shifted mediastinum, ↓ TVF, **dullness**, ↓ air entry.
  - c- Rib fracture → localized tenderness & crepitus at the site of fracture.
  - d- Flail chest → flail segment will move in a **paradoxical** way to the rest of the chest wall.

## Investigations

- a- Laboratory:
  1. ABG ( $PO_2$ ,  $PCO_2$ ).
  2. Blood sugar.
  3. KFTs.
- b- Radiological:
  1. Plain CXR.
  2. CT scan.
- c- Instrumental:
  1. Bronchoscopy (if tracheobronchial injury is suspected).
  2. Esophagoscopy (to exclude esophageal injuries).



## Complications of chest injuries

- 1- Chest wall: fracture rib and flail chest.
- 2- Pleura: pneumothorax and hemothorax.
- 3- Diaphragmatic injury.
- 4- Great vessel injury.
- 5- Cardiac injury.
- 6- Lung lacerations.
- 7- Esophageal injury.

Blunt trauma may lead to diaphragmatic rupture



**Treatment of chest injuries****First aid**

1. **Airway:** maintaining upper airways clear, even by insertion of cannula 14F in the cricothyroid membrane.
2. **Breathing:** keeping normal breathing rate by assisted or mouth to mouth breathing with observation of chest movement, the following problems may be present:
  - a- Flail chest → immobilization by strapping.
  - b- Sucking wound → should be sealed.
  - c- Tension pneumothorax → decompression by insertion of a wide-bore cannula in the 2<sup>nd</sup> intercostal space in MCL.
  - d- Penetrating objects → should be fixed (do not remove).
3. **Circulation:** precordial thump (once), external compression (cardiac massage), control of bleeding by compression (better than tourniquet, which may lead to distal ischemia).
4. **D** → **Damaged limb** → should be splinted.  
     → **Drugs** → morphine, if needed.

**At hospital****1- Resuscitation & primary survey:**

- a. Patient kept in semi-sitting (Fowler) position except if the patient is pulseless, he/she should be kept in Trendelenburg position.
- b. Maintain lower airway patency by endotracheal tube if needed.
- c. I.V line supplies the fluid according to patient's need.
- d. Oxygen therapy if needed.
- e. Drugs: antibiotics, analgesics & antiplatelet drugs.
- f. X-ray: upright position if possible.

**2- Continuous monitoring of:**

- a. Level of consciousness.
- b. Vital signs (pulse, BP, temperature, and RR).
- c. Neck veins, CVP.
- d. Urine output, fluid chart and amount of drained fluid.

**3- Secondary survey:**

- After establishment of general condition of the patient 2<sup>ry</sup> survey has to be done.

**Specific treatment**

Life  
threatening  
conditions

1. **Pneumothorax:** insert ICT under water seal in the 2<sup>nd</sup> space at MCL.
2. **Hemothorax:** aspiration or intercostal tube underwater seal.
3. **Rib fracture:** adhesive strapping.
4. **Flail chest:** emergency strapping followed by fixation.

- Emergency thoracotomy may be required if there is uncontrollable internal or external bleeding.
- In serious chest injuries, it is necessary to admit the patient to the ICU where an endotracheal tube is inserted → allow effective and repeated aspiration of the tracheobronchial tree. If the patient is hypoxic or has flail chest, the endotracheal tube should be combined with intermittent positive pressure respiration.
- Upper abdominal rigidity may be present in thoracic injuries not only in abdominal lesions.
- There is frequent hepatic & splenic rupture in lower chest injuries.
- In chest injuries, the most common cause of death between the site of accident and the emergency room is respiratory insufficiency which presents mainly by restlessness & agitation.
- The surest method to diagnose hypoxia is to do **ABG**.



# Rib fracture

## Etiology

1. **Direct trauma** → May produce fracture at any site. Visceral injury is common as the broken ends are driven inwards.
2. **Indirect trauma** → antero-posterior compression of the ribs → fracture at the angle and since the broken ends are driven outwards visceral injury is uncommon.
3. **Muscular violence** → as in convulsions, violent sneezing or coughing. It may cause fracture of the anterior segment of a rib in old people (senile osteoporosis).
4. **Pathological fracture.**

## Types

	1-SIMPLE	2-MULTIPLE
Sites	<ul style="list-style-type: none"> <li>▪ More common in 3<sup>rd</sup>-10<sup>th</sup> ribs, often at the most convex part of the rib (at axilla) following antero-posterior compression.</li> <li>▪ The first two ribs are protected by clavicle &amp; the last two are floating</li> </ul>	
	<b>3- FLAIL CHEST.</b>	<b>4- STOVE IN CHEST.</b>

## Clinical picture

### Symptoms

1. History of trauma to the chest.
2. Severe pain; associated with multiple fractures may limit respiratory expansion especially in **elderly**, thus leading to atelectasis and infection.
3. Swelling at the site injury.
4. Dyspnea.
5. Simple rib fracture can be lethal if there is undetected underlying hemothorax or pneumothorax.

### Signs

- **General:** working ala nasi & cyanosis if multiple rib fracture.
- **Local:**
  - Inspection: ecchymosis, bruises & limited chest movements.
  - Palpation: tenderness & crepitus at the site of fracture.
  - Auscultation: ↓ air entry.
  - Evidence of underlying chest injuries (hemothorax, open or tension pneumothorax).
  - Evidence of associated abdominal injuries (liver, spleen or kidney).

## Complications

- 1- Pneumothorax.
- 2- Hemothorax.
- 3- ↓ Respiratory movements leading to atelectasis & chest infection.
- 4- Rupture mediastinum.
- 6- Rupture spleen (left side).
- 5- Rupture kidney.
- 7- Rupture liver (right side).

**1<sup>st</sup> rib fracture is potentially dangerous as it is associated with injury to great vessels**

## Investigations

- 1- Plain X-ray.
- 2- ABGs: ↓ O<sub>2</sub> saturation and ↑ CO<sub>2</sub> saturation in blood.



**Treatment**

1. **ABCD** (if poly-traumatized patient).
2. **Resuscitation & monitoring then 1<sup>st</sup> survey.**
  - **Pain relief:** *It is essential to allow the pt. to expand the lungs properly.*
    - Analgesics.
    - Intercostal nerve block or epidural anesthesia.
    - In elderly, elastic corset may be useful.
3. **Specific treatment:**
  - ⇒ **Simple** → strapping is better to be avoided.
  - ⇒ **Multiple** → strapping or intermittent positive pressure breathing (IPPB).
  - ⇒ **Flail chest** →
    - 1- Emergency strapping & emergency tracheostomy.
    - 2- IPPB.
    - 3- Skeletal traction on the sunken ribs or open reduction + internal fixation by stainless steel wire sutures.
    - 4- Positive end expiratory pressure (PEEP).
  - ⇒ **Stove in the chest** →
    - Adhesive strapping.
    - Reduction by traction.
    - Internal fixation if there is another indication for thoracotomy or for cosmetic reasons.

➤ **Ventilation may be seriously affected in chest injuries d.t.:**

1. Severe pain d.t. rib fracture.
2. Instability of the chest wall d.t. presence of a flail segment.
3. Lung collapse d.t. hemothorax or pneumothorax.
4. Pulmonary contusion.
5. Accumulation of secretions in the tracheobronchial tree.
6. Depression of respiratory centre d.t. associated head injury.

**1- Simple fractured rib****Definition**

- Only one rib is fractured at one point.

**Treatment**

- 1- **Ensuring patency** of lower airway is a must.
- 2- **Analgesics** should be given liberally up to pethidine (however, do not give at extremes of age and in presence of head injury → **Intercostal nerve block** or epidural analgesia is helpful).

**N. B.** Strapping is better to be avoided since it restricts respiratory movements; also, the fractured rib is efficiently splinted by its neighboring ribs.

**Morphine is contraindicated except if you have to support ventilation**



## 2-Multiple fractured ribs

### Definition

- More than one rib is fractured and each rib is fractured at one point.

### Treatment

- ABCD.
- Ensure patency of the airways.
- Analgesic can be used liberally.
- Intercostal nerves block or epidural analgesia can be helpful.
- Immobilization: either by:
  - External immobilization:
    - Adhesive strapping.
    - Continuous balanced traction using weight and overhead pulley.
  - Internal immobilization:
    - IPPB or controlled ventilation using artificial ventilation if needed.
    - Practically, internal fixation is rarely used unless there are other indications for thoracotomy.



## 3- Flail chest

### Definition

- More than 4 ribs are fractured at 2 points.
- A segment loses its bony continuity with the rest of the chest wall by a direct trauma.

### Pathology

➤ *The flail part has the following effects:*

#### 1. The flail part moves paradoxically with respiration

- During **inspiration**, chest expands while the flail part is **sucked in**.
- During **expiration**, chest collapses while the flail part **bulges out**.

#### 2. Respiratory failure (impairment of gas exchange) due to:

Paradoxical respiration; the lung at the side of injury

- **expands** slightly during **expiration**.
- **collapses** more during **inspiration**.

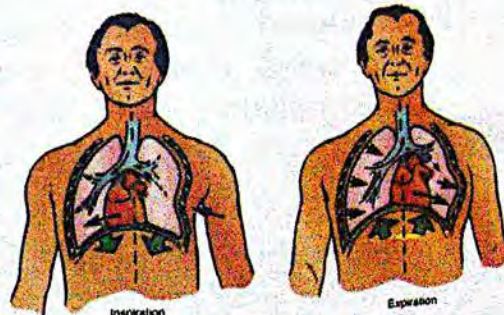
Pendulum respiration due to:

- Oscillation of air between the 2 lungs.
- The normal lung is always filled with air deficient in O<sub>2</sub> & loaded with CO<sub>2</sub>.

#### 3. Circulatory failure due to:

Mediastinal flutter

- The mediastinum move from side to side with respiratory movements leading to kinking of great vessels.



### Clinical picture

### History of trauma

### Symptoms

- Acute chest pain, dyspnea, cough & cyanosis.



## Signs

- **General:** signs of shock, engorged neck veins, cyanosis & respiratory distress (working ala nasi).
- **Local:**
  - **Inspection:**
    - Ecchymosis & bruises.
    - ↓ Chest movements on affected side.
    - Flail segment moves paradoxically with respiration.
  - **Palpation:**
    - Tenderness.
    - ↓ TVF & shift of trachea to the opposite side if associated with pneumothorax.
  - **Auscultation:** ↓ air entry.

## Complications

1. Pneumothorax.
2. Hemothorax.
3. Rupture kidney.
4. Rupture spleen (left side).
5. Rupture liver (right side).
6. Patients with flail chest usually have underlying **pulmonary contusion**.

## Investigations

### Investigation of flail chest

1. CXR & CT scan.
2. ABG & KFTs.

### Investigation of complications

1. U/S → rupture spleen.
2. Hemothorax → obliteration of costo-phrenic angle + fluid rising to axilla.

## Treatment

1. First aid: ABCD at the site of accident.
2. At hospital:
  - Resuscitation & monitoring
  - **If small flail segment** → control the paradoxical movement by **strapping** the chest over firm pad or fixing it to bedside using towel clips is enough.
  - **If there is severe paradoxical respiration** → introduce endotracheal tube and start **positive pressure respiration** (after exclusion of tension pneumothorax).
  - **If there is an indication for thoracotomy** →
    - ⇒ ORIF by stainless steel wire or nails, this will accelerate recovery.

*If the period of required ventilation is more than 10 days, it is preferable to do a **tracheostomy** to avoid laryngeal stenosis with prolonged endotracheal intubation.*

## 4- Stove in chest

- A rib or more is fractured at more than one point and the intermediate segment of the fractured rib/ribs is sucked to the inside and fixed in place leaving a deformity at its place in the form of a groove or depression in the chest wall.
- If marked → ↓ vital capacity

## Treatment

- **Adhesive strapping.**
- **Reduction by traction.**
- **Internal fixation:** if there is another indication for thoracotomy or for cosmetic reasons.





# Pulmonary contusion

## Etiology

- Impact injuries to the chest wall.

## Pathology

- There is outpouring of fluid in the walls of the alveoli and into the alveolar spaces with the development of pulmonary edema and pneumonitis.
- Disturbance occurs in the ventilation perfusion ratio in the contused areas leading to diminished oxygenation of the blood and eventually tissue hypoxia occurs.

## Treatment

- Conservative → antibiotics and physiotherapy.

# Pneumothorax

## Definition

- Presence of air within the pleural cavity.

## Etiological types

### Traumatic

- **Accidental:**
  - Blunt injuries → fracture rib → injury of the pleura.
  - Penetrating injuries.
- **Iatrogenic:**
  - Barotrauma due to positive pressure ventilation.
  - Insertion of a central venous line in the neck (especially subclavian vein).
  - CT guided lung biopsy.



### Spontaneous

- **1<sup>ry</sup>:** rupture of pulmonary bleb.
- **2<sup>ry</sup>:** -Rupture of emphysematous bullae, solitary lung cyst or cystic lung.  
-Rupture of small sub-pleural TB cavity (in this case, there is an underlying pulmonary TB, and hydropneumothorax usually occurs).

## Pathological types

1. Closed pneumothorax (simple).
2. Open pneumothorax.
3. Tension pneumothorax.

## Clinical picture

- **Closed type:** clinically, the condition is usually mild.
- **Open type:** clinically diagnosed by harsh whistling sound of air going through the defect following history of trauma.
- **Tension type:** it is a fatal emergency.

## Symptoms

\*History of trauma.

\*Acute chest pain, dyspnea, cough & cyanosis.

Heema Adel



**Signs**

- **General (in tension & open types only):** signs of shock, engorged neck veins, cyanosis & respiratory distress (working ala nasi).
- **Local:**
  - 1) **Inspection:**
    - Ecchymosis & bruises.
    - ↓ Chest movements on affected side.
  - 2) **Palpation:**
    - Shift of trachea to the opposite side.
    - ↓ TVF.
  - 3) **Percussion:** tympanitic resonance on affected side.
  - 4) **Auscultation:** ↓ air entry.

**Complications (associated injuries)**

See later

**Investigations****For diagnosis****CXR:**

- Jet-black opacity on affected side.
- Total lung collapse on the affected side.
- Partial lung collapse on the opposite side.
- Tracheal and cardiac shadow shift to the opposite side.
- Flattened diaphragm is displaced downwards on the affected side.

**For complications**

- ABGs.

- U/S for associated visceral injuries.

**Treatment**

- **ABCD at the site of the accident:**
  - o Urgent insertion of a wide-bore cannula in the 2<sup>nd</sup> intercostal space (in tension pneumothorax).
  - o Close the wound by adhesive external dressing (in open pneumothorax).
- **Resuscitation & monitoring + 1<sup>st</sup> survey.**
- **Definitive treatment:** insertion of an intercostal tube under water seal in the 2<sup>nd</sup> space at the mid-clavicular line.



# Closed (simple) pneumothorax

## Definition

A limited amount of air is entrapped into the pleural cavity (not communicating with the exterior).

## Clinical picture

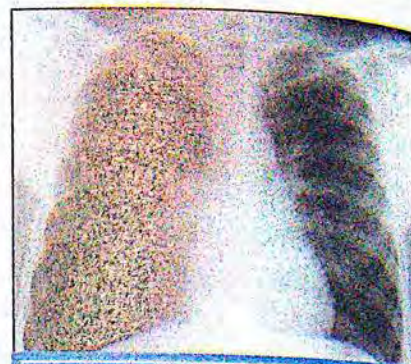
### Symptoms

- History of the cause.

- Chest pain & slight dyspnea.

### Signs

- **Inspection:** - ↓ movements at the affected side.
- **Palpation:** - Confirms diminished movements.  
- ↓TVF, but there is **NO** mediastinal shift.
- **Percussion:** - Hyper-resonance.
- **Auscultation:** - ↓ air entry.



Rt. sided pneumothorax

## Investigations

### Plain CXR shows:

- Absence of lung markings (i.e. Jet-black).
- The edge of the collapsed lung is usually visible.

## Treatment

- If the amount of air is small & there is no dyspnea:

→ The patient is treated **conservatively** (monitoring vital signs & repeated ABGs are done) until spontaneous absorption of the air takes place.

- If there is dyspnea:

→ An **intercostal chest tube with under water seal** is inserted (until complete expansion of the collapsed lung occurs).

# Open pneumothorax (sucking chest wound)

## Definition

The pleural space communicates freely with the exterior.

## Etiology

- Open chest injury with a sucking wound.
- Closed chest injury with tracheobronchial injury or lung rupture.

## Pathology

### 1. Respiratory failure (impairment of gas exchange) due to:

- Paradoxical respiration: on the affected side which:

- **Expands** slightly during **expiration**.
- **Collapses** more during **inspiration**.

- Pendulum respiration due to:

- Oscillation of air between the 2 lungs.
- Normal lung is always filled with air deficient in O<sub>2</sub> & loaded with CO<sub>2</sub>.

### 2. Circulatory failure due to:

- Mediastinal flutter: the mediastinum moves from side to side with respiratory movements leading to kinking of great vessels.

- Loss of negative intrathoracic pressure on the affected side → ↓ venous return → ↓ cardiac output.



**Clinical picture**

Clinically diagnosed by harsh whistling sound of air going through the defect following history of trauma

**Symptoms**

- History of trauma.
- Acute chest pain, dyspnea, cough & cyanosis.

**Signs**▪ **General:**

- Signs of shock, engorged neck veins, cyanosis & respiratory distress (working ala nasi).

▪ **Local:**Inspection:

- Ecchymosis & bruises.
- ↓ Chest movements on affected side.

Palpation:

- Shift of trachea to the opposite side.
- ↓ TVF.

Percussion:

- Hyper-resonance on the affected side.

Auscultation:

- ↓ air entry.

**Investigations****For diagnosis**▪ **CXR:**

- Jet-black on affected side.
- Total lung collapse on the affected side.
- Partial lung collapse on the opposite side.
- Tracheal and cardiac shadow shift to the opposite side.
- Flattened diaphragm is displaced downwards on the affected side.

**For complications**

- ABGs.

- U/S for associated visceral injuries.

**Treatment (emergency)**▪ **ABCD at the site of the accident:**

- Close the wound by adhesive external dressing.

▪ **Resuscitation & monitoring + 1<sup>st</sup> survey.**▪ **Definitive:**

- The wound is sutured with insertion of an intercostal tube under water seal in the 2<sup>nd</sup> space at the MCL.



# Tension pneumothorax

## Definition

- Valvular tear which allows air to enter but does not allow it to come out from the pleural space. It is a **surgical emergency (Rapidly fatal)**.

## Etiology

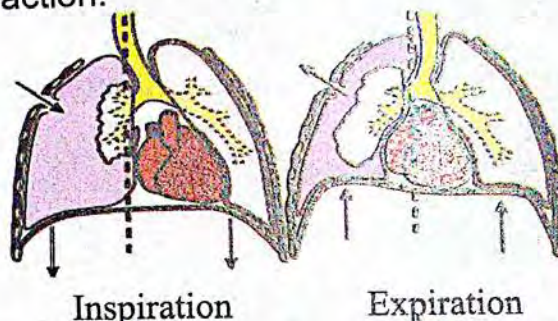
- Valvular wound.

## Pathology

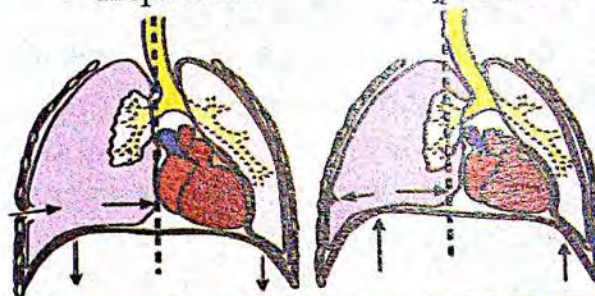
1. **Respiratory failure (impairment of gas exchange) due to:**
  - Marked  $\uparrow$  in intrapleural pressure  $\rightarrow$  collapse of the underlying lung.
  - Mediastinal shift to the opposite side  $\rightarrow$  collapse of the other lung.

2. **Circulatory failure due to:**
  - Loss of the negative intrathoracic pressure  $\rightarrow$   $\downarrow$  venous return  $\rightarrow$   $\downarrow$  COP.
  - Mediastinal shift disturbs heart action.

### Open pneumothorax



### Tension pneumothorax



## Clinical picture

### Symptoms

- History of trauma.
- Acute chest pain, dyspnea, cough & cyanosis.
- Respiratory arrest may occur.

As open pneumothorax but more severe cardio-respiratory distress

### Signs

- **General:** signs of shock, engorged neck veins, cyanosis & respiratory distress (working ala nasi).
- **Local:**
  1. **Inspection:**
    - Ecchymosis & bruises.
    - $\downarrow$  chest movements on affected side.
  2. **Palpation:**
    - Shift of trachea to the opposite side.
    - $\downarrow$  TVF.
  3. **Percussion:**
    - Tympanic resonance on affected sides.
  4. **Auscultation:**
    - $\downarrow$  air entry.

### Complications (associated injuries)

1. Chest wall: fracture rib and flail chest.
2. Pleura: hemothorax.
3. Diaphragmatic injury.
4. Great vessel injury.
5. Cardiac injury.
6. Lung lacerations.
7. Esophageal injury.



DD

**Of acute chest pain + shock**

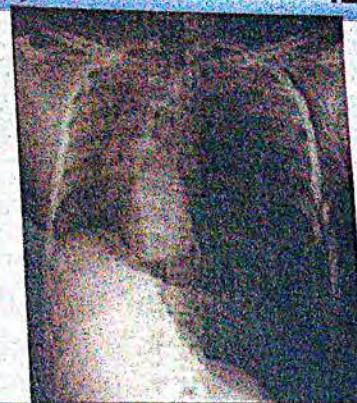
1. Acute myocardial infarction.
2. Cardiac tamponade.
3. Massive pulmonary embolism.

**Investigations***(Rarely needed)*

- They are done if diagnosis is suspicious.
- If not, proceed to urgent treatment that should be done once tension pneumothorax is diagnosed.

**Treatment****First aid**

- **Airway:** maintaining upper airways clear, even by insertion of cannula 14F in the cricothyroid membrane.
- **Breathing:** urgent insertion of a wide-bore cannula in 2<sup>nd</sup> intercostal space MCL.
- **Circulation:** control of bleeding by compression.
- **D** → Damaged limb → should be splinted.  
→ Drugs → morphine if needed.



Plain X-ray showing Lt tension pneumothorax. Sending the pt as such to radiology room is **wrong**. It may cost a life. The case should be diagnosed clinically & **immediate deflation by a wide bore needle** is life-saving. Notice marked mediastinal shift & rib fractures.

**At hospital**

1. **Resuscitation & primary survey:**
  - a. Ryle, IV line and catheter.
  - b. IV fluids, blood transfusion, antibiotics & analgesics.
  - c. Blood transfusion.
2. **Continuous monitoring of:**
  - a. Level of consciousness.
  - b. Vital signs (pulse, BP, temperature, and RR).
  - c. Neck veins, CVP.
  - d. Urine output, fluid chart and amount of drained fluid.
3. **Secondary survey:**
  - After establishment of general condition of patient, 2<sup>nd</sup> survey has to be done.

**Specific treatment**

- An intercostal tube in the 2<sup>nd</sup> space at the mid-clavicular line with under-water seal.

- Continuous bubbling of air through the intercostal tube denotes the possibility of occurrence of broncho-pleural fistula.
- Recently, the intercostal tube is inserted through the fifth space between the anterior and midaxillary lines, then:
  - ⇒ If pneumothorax → the tube is advanced towards the apex of the lung
  - ⇒ If hemothorax → the tube is advanced towards the base of the lung
- Tension pneumothorax is a cause of obstructive shock because it prevents cardiac filling.

**\*\*Classic signs of tension pneumothorax**

Trachea	→
Expansion	↓
Percussion Note	↑
Breath sounds	↓
Neck veins	↑



# Pleural effusion

## Definition

- Abnormal accumulation of fluid in the pleural space

## Etiology

(Trauma, Inflammation, Neoplasm)

- 1- Transudate (part of generalized edema)
- 2- Exudate (inflammation or malignancy) e.g.:
  - Pleurisy
  - T.B. or malignancy (it may contain ↑ RBCs = hemorrhagic).
  - Pancreatitis → Lt. sided effusion.
- 3- Bloody: hemothorax in chest injuries.
- 4- Chylous: obstruction of thoracic duct.

## Clinical picture

### Symptoms

- Pain (dull aching or stitching if active pleurisy).
- Cough, dyspnea.
- Of the cause.

### Signs

- Inspection: ↓ movement.
- Palpation: → trachea shifted to opposite side.  
→ ↓TVF.
- Percussion: stony dullness (basal & rising to axilla).
- Auscultation: ↓ air entry.

## Investigations

1. CXR:
  - Homogenous opacity.
  - Obliteration of costophrenic angle.
  - Rising to axilla.
2. Aspiration (thoracentesis): diagnostic & therapeutic (differentiate exudate from transudate).

## Treatment

- 1- Treatment of the cause.
- 2- Thoracentesis (gradually to avoid complications e.g. hemothorax).



# Hemothorax

## Definition

- Collection of blood in the pleural space.

## Etiology

### Local

- 1- Traumatic injury of intercostal vessels, internal mammary vessels or the lung tissue.
- 2- Post-operative.
- 3- Pathological → due to tumors.  
→ leaking aortic aneurism.

### General

1. Blood disease (hemophilia, purpura).
2. Hypertension.
3. Drugs as anticoagulant.

## Pathology

- The respiratory and cardiac movements defibrinate the blood, so that the collection remain fluid in most cases.
- Blood in the pleural space is very irritant exciting the formation of a considerable effusion that is rich in proteins.
- In neglected cases a fibrin layer is deposited on both layers of the pleura, later this deposit is transformed to a fibrous layer. The end result is a collapsed lung and deformity of the chest wall with crowding of the ribs.
- Blood is an excellent culture and infection is common.
- In traumatic cases, there is commonly associated pneumothorax, i.e., hemopneumothorax.



## Source of bleeding

- Pulmonary (lung lacerations) → non-progressive as pressure in pulmonary circulation is low & when the lung is compressed by blood → the bleeding vessels are also compressed.
- Systemic e.g. heart, great vessels, intercostal arteries or internal mammary; this type is progressive → shock
- From abdomen in thoraco-abdominal injuries with injured organs (e.g. spleen) with ruptured diaphragm.

## Clinical picture

### Symptoms

- History of trauma.
- Hemoptysis (if lung laceration occurs).

As pneumothorax but dull on percussion

- Dyspnea, chest pain.

### Signs

- **General:**
  - Signs of shock, engorged neck veins, cyanosis, working ala nasi.
  - Associated injuries
- **Local:**
  - **Inspection:** ↓ chest movements.
  - **Palpation:** ↓ TVF.  
Tenderness.  
Shift of trachea to opposite side.  
Dullness.



430

**Investigations****For diagnosis**

- **CXR** → If the hemothorax is less than 500 ml, it will lead only to obliteration of costophrenic angle & if more than 500 ml it will lead to an opacity rising to axilla + site of fracture.
- **Aspiration** → blood.

**For complication**

- ABGs.
- Investigations for associated injuries.

**Treatment**

1. **ABCD** (in poly-traumatized patient).
2. **Resuscitation & monitoring then 1ry survey.**
3. **Complete removal of the blood from the pleura by:**
  - A. Repeated aspiration (if small in amount).
  - B. Intercostal (I.C.) tube with underwater seal in the fifth intercostal space in the mid axillary line (if re-accumulating)  
**Why?** To allow full lung expansion (ensured by X-ray).  
 To prevent clotting, infection, irritation & pleurisy.
4. **Thoracotomy: indicated if: BIALCOFAN**
  - Severe **B**leeding (200 ml/hour).
  - Persisting **B**leeding despite conservative measures.
  - **I**nitial volume of blood coming through the intercostals tube > 2L.
  - **A**ssociated intrathoracic injuries.
  - **L**oculated hemothorax → The tube partially evacuates the blood.
  - **C**lotted hemothorax → diagnosed by failure of the tube to evacuate the blood.
  - Presence of **F**oreign bodies.
5. **For clotting:**
  - Fibrinolytics (early).
  - Decortication (if marked).
6. **Deal with associated injuries.**





# Empyema

## Definition

- Accumulation of pus in the pleural cavity.

## Types

- Acute:**
  - Non-specific.
  - Specific → TB.
- Chronic:**
  - Non-specific.
  - Specific.

## (I) Acute empyema

### Predisposing factors

- More common in children following lobar pneumonia.

### Route of infection

- Local spread:**
  - From chest → pneumonia, mediastinitis or osteomyelitis.
  - From abdomen → subphrenic or liver abscesses.
- Direct access** through open wounds (post-traumatic or post-operative).
- Blood spread:** as in septicemia.

### Causative organisms (Pathological types)

#### 1- Staphylococcal empyema

- Direct from pneumonia or blood spread from septicemia.

#### 2- Putrid empyema

- Following rupture of lung or subphrenic abscess (mixed infection → E.coli, Proteus, Pseudomonas).

	3- Pneumococcal empyema	4- Streptococcal empyema
Incidence	The commonest	Less common
Onset	After lobar pneumonia = metapneumonic empyema	Synchronously with broncho-pneumonia = synpneumonic empyema.
Pus	Thick, green	Thin, yellow
Localization	Adhesions occur early	No adhesions, no localization and empyema is massive.

## Stages

- Diffuse stage.
- Localized stage.
- Neglected stage.

## Clinical picture

### Symptoms

- General:** marked constitutional symptoms (FAHM, rigors).
- Local:** cough, dyspnea & dull aching chest pain.



**Signs**

- **General:** fever, tachycardia, cyanosis & working ala nasi.
- **Local:**
  - Inspection: ↓ chest movements.
  - Palpation: ↓ TVF + shift of the mediastinum.
  - Percussion: dullness.
  - Auscultation: ↓ air entry.

**Complications**

- **General:** toxemia, bacteremia, septicemia, pyemia.
- **Local:** chronic empyema & spread (→ lung abscess).

**Investigations**

- **CXR:** obliterated costo-phrenic angle with opacity rising towards the axilla.
- **Blood picture:** leucocytosis + ↑ ESR.
- **Thoracocentesis:** reveals pus → C & S.

**Treatment****General**

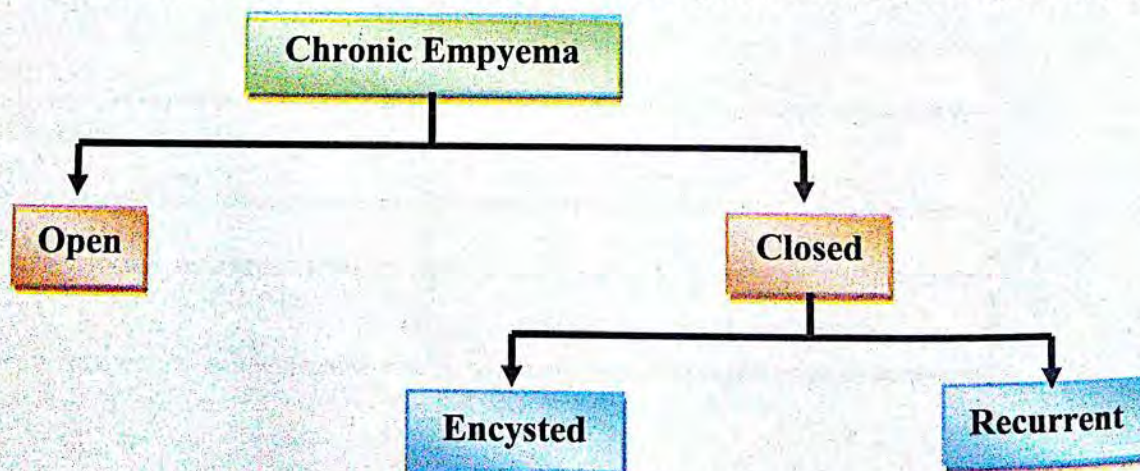
- Rest, Analgesics, antibiotics, antipyretics (AAA).

**Local**

- 1) **Aspiration:** in early stages  
Through the 7<sup>th</sup> space at the midaxillary line repeated until complete drainage occurs, with injection of antibiotics (500,000 units penicillin).
- 2) **Closed drainage:** if pus collects rapidly or if pus becomes too thick to be aspirated.  
By insertion of intercostal tube connected to an under water seal through 7th space at the midaxillary line.
- 3) **Open surgical drainage:** by rib resection + surgical evacuation of pus.  
*Only when full localization has occurred.*

**(II) Chronic empyema****Definition**

Empyema in which the lung is unable to expand after pus evacuation due to fibrosis.

**Types****(1) Open chronic empyema (chronic chest wall sinus):**

It is due to inadequate treatment of acute empyema

- **Inadequate drainage** (too early, too late, too high or too low drainage).
- **Inadequate post-operative care:** as early removal of the IC tube.
- **Underlying disease:** in chest wall (osteomyelitis of ribs), pleura (TB, foreign body) lung (abscess or tumors).
- **Poor general condition:** anemia, D.M...etc.



## (2) Closed chronic empyema:

- Encysted empyema: develops insidiously as the closed collection of pus is completely walled off by adhesions.
- Recurrent empyema: discharging pus intermittently into a bronchus through a bronchopleural fistula.

### Clinical picture

#### General

- Chronic toxemia with clubbing.
- Acute exacerbations with fever & chills.

#### Local

- Open type → chronic sinus in the chest wall leading to the pleura & discharging pus.
- Closed type → **Empyema necessitans**, which perforates an intercostal space leading to a subcutaneous abscess (gives an expansile impulse on cough).
- Due to fibrosis:
  - Contracture and rigidity of chest wall with crowding of ribs from fibrosis.
  - Elevation of the diaphragm.
  - Shift of the mediastinum towards the affected side due to fibrosis.
  - Scoliotic deformity of the spine.

### Complications

A. **General**: septicemia, pyemia, 2<sup>nd</sup> amyloidosis in kidney.

B. **Local**: spread of infection to the surroundings e.g.

1. Pulmonary fibrosis.
2. Bronchopleural fistula.
3. Sinus.
4. Empyema necessitans.
5. Subphrenic abscess.

### Investigations

#### Laboratory

- Culture and sensitivity: for sputum or pus.
- Complete blood picture: anemia, ↑ ESR + leucocytosis.

#### Radiological

- Plain CXR:
  - Overcrowded ribs.
  - Shift of trachea.
  - Elevation of diaphragm.
  - May show the underlying cause.
- CT scan chest & biopsy: **most accurate**.
- Lipidol pleurogram: shows the size of the cavity + any bronchial communications. A few crystals of Sudan III added to lipidol will appear in the sputum if a fistula is present.

#### Instrumental

- Bronchoscopy to detect any cause.

### Treatment

#### General

- Correction of anemia & control DM.
- Antibiotics according to culture & sensitivity.
- Multivitamins.

#### Local

- **Re-drainage** by rib resection in a dependent position + proper physiotherapy to allow lung expansion and obliteration of the cavity.



- If expansion of the lung doesn't follow re-drainage:
  - **Decortication:** the thick visceral pleura is excised and the lung is expanded by positive pressure ventilation.
  - **Thoracoplasty:** for localized cases, the cavity is obliterated by allowing the chest wall to adhere to the lung.

### Tuberculous empyema

#### > Etiology

- may occur as a complication of:
  1. Rupture of a tuberculous cavity.
  2. T.B. pleural effusion.
  3. Operations on tuberculous lungs.

#### > Treatment

- In the absence of secondary infection:

- Sanatorial treatment
- Anti-tuberculous treatment.
- Repeated aspiration.
- If these fail, decortication is performed.

- Cases with secondary infection:

- Prolonged drainage until the secondary infection is overcome followed by decortication.
- Associated lung disease or bronchopleural fistula is dealt with by lobectomy or pneumonectomy at the time of decortication.

## Adult respiratory distress syndrome (ARDS)

### Definition

Lung condition that leads to low O<sub>2</sub> level in blood (= non-cardiogenic pulmonary edema (NCPE)).

### Etiology

1. Severe sepsis. Patients in septic shock are particularly at risk of developing ARDS.
2. Severe shock (any type) especially if requiring large volumes of IV fluids.
3. Major trauma.
4. Extensive burns.
5. Iatrogenic factors:
  - Non-filtered blood transfusion.
  - Overtransfusion of fluids.
  - Use of oxygen concentrations over 50%.
  - Massive doses of steroids.
6. Lung injury due to trauma, inhalation of fumes or aspiration of gastric contents.

### Pathophysiology

- ARDS is associated with severe and diffuse injury to the alveolar-capillary membrane (the air sacs and small blood vessels) of the lungs.
- Some alveoli distend with fluids, while some other alveoli collapse.
- This alveolar damage impedes the exchange of oxygen and carbon dioxide, which leads to a reduced concentration of oxygen in the blood.
- Defect in the 3 aspects of the respiratory process (ventilation / perfusion / diffusion).
- Hypoxia causes damage to other vital organs of the body such as the kidneys.
- ARDS is supposed to be due to activation of platelets, neutrophils & macrophages leading to release of oxygen free radicals.



# Pathology

## Macroscopic picture

- Great increase in lung weight.
- Petechial hemorrhages on epithelial surfaces.

## Microscopic picture

- Interstitial edema and hemorrhage.
- Alveolar edema.
- Peri-alveolar hemorrhage.
- Inconstantly, intravascular fat globules and fibrin plugs.

## Clinical Diagnosis

1. Medical history of conditions that can lead to ARDS e.g. severe pneumonia.
2. Initial state:
  - Shock → Lactic acidosis.
  - Hyperventilation (low  $\text{PaCO}_2$ , but  $\text{PaO}_2$  may be normal or slightly low).
3. Phase of hemodynamic equilibrium (lasts for several days):
  - The patient may appear well recovering
  - Chest X-ray is normal →  $\text{PaO}_2$  is invariably low
4. Phase of clinical respiratory distress followed by respiratory failure:
  - Confusion and occasional petechial rash.
  - Chest x-ray reveals bilateral pulmonary infiltrations.
  - Rising  $\text{PaCO}_2$  and falling  $\text{PaO}_2$  occur despite oxygen supplement

## Complications of ARDS

- 1- Infection.
- 2- Pneumothorax.
- 3- Deep vein thrombosis (DVT) & pulmonary embolism.
- 4- Lung scarring:
  - ARDS causes the lungs to become stiff (scarred) → cannot expand.
  - Being on a ventilator for a long time also can cause lung scarring.

## Investigations

- Laboratory:
  - a- ABG: reveals hypoxemia (reduced levels of oxygen in the blood).
  - b- CBC: ↑WBCs in sepsis.
- Radiological:
  - a- CXR: may show the presence of fluid in the lungs.
  - b- CT scan chest: may be required only in some situations (routine chest x-ray is sufficient in most cases).
  - c- Echocardiogram: exclude heart problems that cause fluid build-up in the lung.
- Instrumental:
  - a- Monitoring with pulmonary artery catheter may be needed to exclude a cardiac cause for the difficulty in breathing.
  - b- Bronchoscopy may be considered to evaluate the possibility of lung infection.

## Treatment

(No specific therapy for ARDS exists.)

- Admission to an intensive care unit (ICU).

- Treatment is primarily supportive using:

1. Supplemental oxygen.

2. Mechanical ventilator (in the stage of respiratory failure indicated by a  $\text{PaO}_2 < 60 \text{ mmHg}$ ).

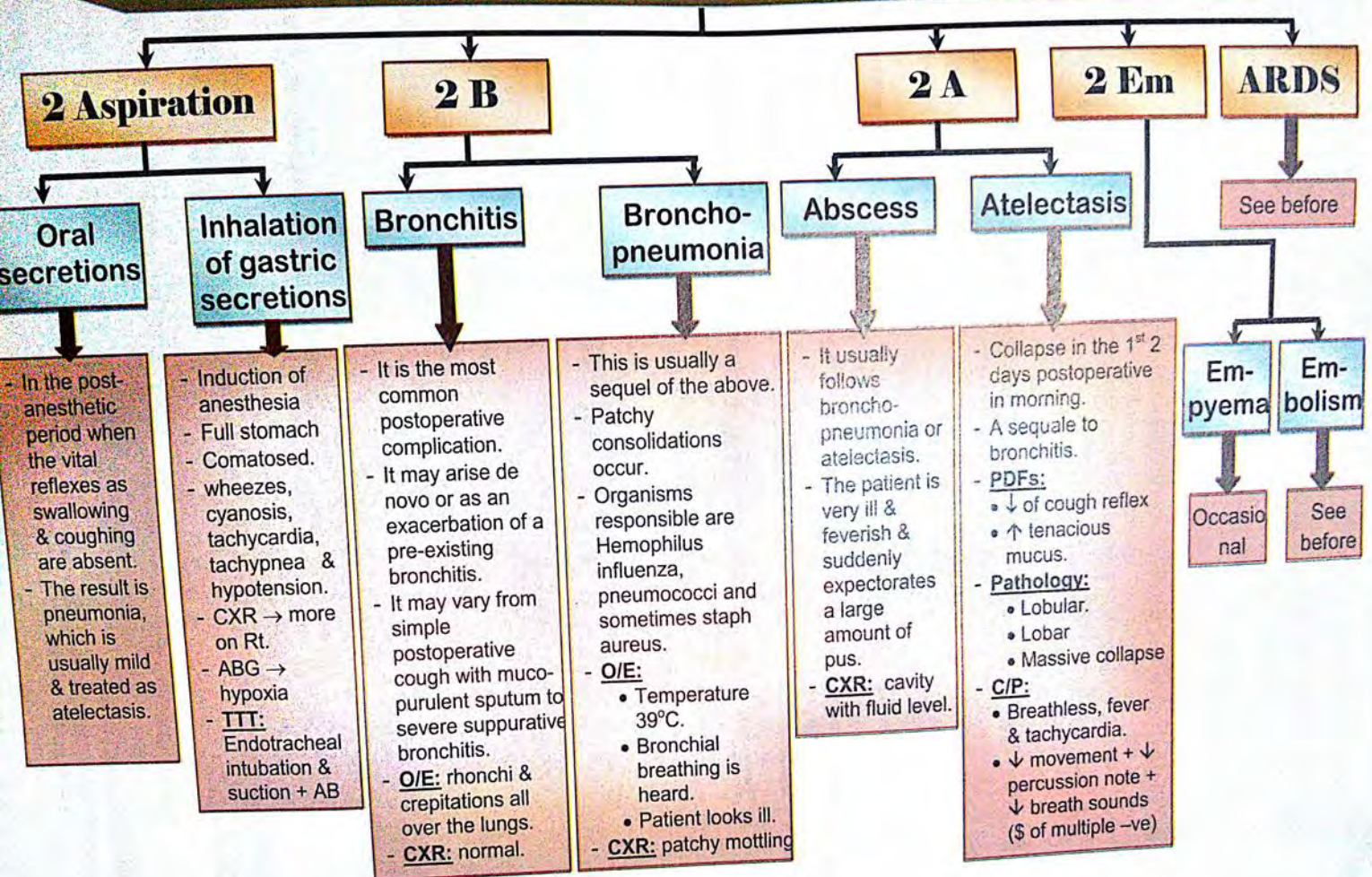
3. Treatment of the cause e.g. correction of shock and eradication of sepsis.



4. **IV fluids** are given to provide nutrition and prevent dehydration, and are carefully monitored to prevent fluid from accumulating in the lungs (pulmonary edema).
5. The following **drugs** may be administered:
  - Antibiotics to treat infection because it is often the cause of ARDS.
  - Anti-inflammatory drugs, such as corticosteroids, to reduce inflammation in the lungs in the late phase or sometimes if the person is in septic shock.
  - Diuretics to eliminate fluid from the lungs.
  - Drugs to counteract low blood pressure that may be caused by shock.
  - Anti-anxiety drugs to relieve anxiety.
  - Inhaled drugs administered by respiratory therapists to decrease inflammation and provide respiratory comfort.



# POST-OPERATIVE PULMONARY COMPLICATIONS





# Postoperative Pulmonary Complications

- More surgical patients probably die of postoperative chest problems than anything else.
- Such morbidity and mortality can be largely prevented by adequate pre-and postoperative care.

## Predisposing factors

### A. Preoperative predisposing factors

- **Age** → Extremes of age are more liable to complications.
- **Sex** → Males are more predisposed probably due to smoking.
- **Smoking** → Heavy smokers have chronic bronchitis → excessive production of mucous and damage of the cilia → stagnation of mucous in the bronchial tree.
- **Dehydration** → leads to thick bronchial mucous that is difficult to expel.

### B. Operative and post-operative predisposing factors

- **Anesthetics** → trauma to the tracheobronchial tree, premedication with atropine and prolonged unconsciousness → predispose to respiratory problems.
- **Nature of the operation** → thoracic and upper abdominal operations are more liable to complications as the wound pain interferes with deep breathing and coughing.
- **Abdominal distension** → e.g. due to paralytic ileus interferes with the movement of the diaphragm.
- **Postoperative pain** → interferes with deep breathing and coughing leading to stagnation of secretions.
- **Excess use of narcotics** → interferes with deep breathing and coughing.

## Types of postoperative pulmonary complications

- I. **Aspiration** → Aspiration of oral secretions  
→ Inhalation of gastric content (Mendelson's syndrome)
- II. **Excessive secretions:**
  - a- Bronchitis
  - b- Bronchopneumonia
  - c- Lung abscess
  - d- Atelectasis
  - e- Empyema
- III. **Postoperative hypoxia**
- IV. **Pulmonary embolism**
- V. **Adult respiratory distress syndrome (ARDS)**

## I- Aspiration

### a- Aspiration of oral secretions

- It occurs in the post-anesthetic period when the vital reflexes as swallowing & coughing are absent.
- The result is pneumonia, which is usually mild & treated as atelectasis.

### b- Inhalation of gastric contents (Mendelson's syndrome)

#### Etiology

- It occurs during induction of anesthesia in a patient who has a full stomach or has intestinal obstruction or in pregnancy.
- It can also occur in comatose patients, e.g. after head injury or drug poisoning.

#### Clinical picture

- Wheezes, cyanosis, tachycardia, tachypnea & hypotension.
- The result is severe pneumonitis, which may be fatal.



**Investigations**

- CXR → widespread lung infiltration more on the right side and more in the lower lobes.
- ABG → severe hypoxia.

**Treatment**

- **Prophylaxis** → all high-risk patients should have a nasogastric tube inserted before the operation for suction of the gastric contents.
- **Endotracheal intubation & suction** of the aspirated material followed by cleaning with saline irrigations.
- **Antibiotics** are given together with corticosteroids.

**II- Excessive Bronchial Secretions**

These are responsible for the majority of post-operative chest complications

**1- Bronchitis**

- It is the most common postoperative complication.
- It may arise de novo or as an exacerbation of a pre-existing bronchitis.
- It may vary from simple postoperative cough with muco-purulent sputum to severe suppurative bronchitis.
- **O/E:** rhonchi & crepitations all over the lungs.
- **CXR:** normal.

**2- Bronchopneumonia (Aspiration pneumonia)**

- This is usually a sequel to bronchitis or atelectasis.
- Patchy consolidations occur.
- Organisms responsible are Hemophilus influenza, pneumococci and sometimes staph aureus.
- **O/E:**
  - Temperature 39°C.
  - Bronchial breathing is heard.
  - Patient looks ill.
- **CXR:** patchy mottling.

**3- Atelectasis (Pulmonary collapse)**

- It usually occurs in the first two days post-operative, in the morning.
- It is produced by occlusion of a bronchus by viscid secretions of mucus or pus & is a sequel to bronchitis.
- The obstruction leads to atelectasis of the affected lobe.
- **It is predisposed to by:**
  - ↳ Depression of cough reflex, by pain or sedation & poor ventilation.
  - ↳ Production of tenacious mucus due to:
    - Pre-operative respiratory tract infection.
    - Premedication with atropine.
    - Prolonged ether anesthesia.
    - Inhalation of foreign bodies, vomitus or septic material.
    - Post-operative dehydration.

**Pathology**

- Obstruction of a bronchus by a plug of mucous is followed by absorption of air distal to the obstruction and deflation of the affected area.
- **The consequent collapse may be:**

1. **Lobular:** collapse of scattered areas throughout the lung.
2. **Lobar:** collapse of one lobe usually the lower.
3. **Massive:** collapse of the whole lung.

\* Atelectasis is the precursor of most post operative chest complications, particularly bronchopneumonia & lung abscess.



### Clinical picture

- The patient does not feel well, is breathless & there may be fever & tachycardia.
- Restricted movement of the affected side of the chest with impaired percussion note & diminished breath sounds.
- Slight cough and sputum is scanty & difficult to expel.

### Investigations

#### ➤ CXR:

- The collapsed lobe appears as a homogeneous wedge-shaped opacity.
- Major atelectasis causes approximation of the ribs, elevation of the diaphragm and deviation of the mediastinum toward the affected side.

### Prophylaxis

#### ✚ Preoperative

- Eradication of respiratory infections
- Proinhibition of smoking
- Breathing exercise
- Avoidance of dehydration
- Avoidance of heavy premedication, particularly with atropine & morphine

#### ✚ Operative: Avoidance of

- Trauma to the upper air passage during intubation
- Deep unconsciousness & vomiting under anesthesia
- Tight strapping & bandaging of the chest & abdomen

#### ✚ Postoperative:

- Correction of dehydration
- Avoidance of heavy sedation
- Encouragement of deep breathing, expectoration & postural drainage
- Early ambulation
- Adequate analgesia to ↓ pain with coughing & deep breathing

### Treatment

1. All attempts are made to expel the obstructing plug;
  - ✓ Turning the patient from side to side.
  - ✓ Percussing the affected side of the chest.
  - ✓ Encouraging expectoration, if necessary by nasopharyngeal catheter.
  - ✓ Loosening the sputum by mucolytics, expectorants & steam inhalation.
  - ✓ Suction. If aeration does not occur within 6 hours, the bronchial plug should be removed by bronchoscopic suction.
2. Antibiotics are given to prevent infection & breathing exercise & early ambulation are encouraged to accelerate expansion of the lung.
3. Oxygenation & if necessary intubation with mechanical ventilation of the O<sub>2</sub> saturation & PO<sub>2</sub> are low.

### 4- Lung abscess

- It usually follows broncho-pneumonia or atelectasis.
- The patient is very ill & feverish & suddenly expectorates a large amount of pus.
- CXR: cavity with fluid level.

### 5- Empyema - It is an occasional complication of any of the above.

## IV- Post-operative hypoxia

- It is common and serious condition.

### Manifests clinically by

- Restlessness, anxiety or confusion.
- Tachycardia, arrhythmias or hypotension.
- Central cyanosis is late.
- Tachypnea.



**Common causes**

- Pulmonary aspiration.
- Failure to breathe deeply and cough during recovery from anesthesia.
- Airway block by secretions.
- Hypoventilation due to pain of upper abdominal or thoraco-abdominal incisions, opiates overdose or prolonged recumbency.
- Pulmonary embolism.
- Pulmonary edema.

**Investigations**

1. pulse oximetry (normal values 95 – 100 %).
2. ABG; increased PCO<sub>2</sub> denotes ventilation failure and decreased PO<sub>2</sub> denotes oxygenation failure.
3. Chest x-ray: collapse, pneumothorax or consolidation.

**Treatment**

- Treat the specific cause.
- The patient may need mechanical ventilation.

**III- Pulmonary embolism**

- See vascular surgery

**IV-Adult respiratory distress syndrome (ARDS)**

- See before

## Cardiac arrest & Cardio-pulmonary resuscitation (CPR)

**Definition**

- Sudden failure of the heart to maintain circulation (No COP).

*The brain can tolerate no more than 3 minutes of arrest before irreversible damage & death.*

**Types** (Differentiated by ECG)

- 1- Ventricular fibrillation (VF) → the most common type and the best survival rate.
- 2- Asystole.
- 3- Electromechanical dissociation.

**Causes****A- Myocardial depression:**

1. Myocardial anoxia e.g. myocardial infarction, shock, asphyxia...etc.

**2. Metabolic:**

- a- Hyerkalemia / hypokalemia.
- c- Acidosis.

b- Hyponatremia.

d- Drugs e.g. adrenaline IV → VF

3. Vagal stimulation e.g. catheterization.
4. Gas poisoning.
5. Electrocution.

6. Severe trauma.

7. Myocardial disease which ↓ the vitality of myocardium or interferes with the conduction as in Stokes-Adams's attacks.

**B- Inadequate venous return:****1- Mechanical:**

- Massive pulmonary embolism.
- Cardiac tamponade.

- Pleural effusion.

**2- Acute hemorrhage.**

3- General or spinal anesthesia.



- **For simplification, remember the common causes of cardiac arrest as 5H & 5T:**  
**5H** ( **H**ypovolemia, **H**ypoxia, **H**yperkalemia, **H**ydrogen ion excess & **H**ypothermia).  
**5T** (Thrombosis of coronary arteries, Thromboembolism, Tension pneumothorax, cardiac Tamponade & Toxic disorders).

- **Cardiac arrest is classified into 2 main types according to the ECG findings:**

- Shockable rhythm:** ventricular tachycardia or fibrillation.
- Non shockable rhythm:**
  - Cardiac asystole & pulseless electrical activity.
  - In the later, there is ECG rhythm compatible with a pulse, but the pulse is absent.
  - The principal difference in the management of the two groups is the need for defibrillation in patients with shockable rhythm.

## Diagnosis

- 1- Sudden loss of consciousness.
- 2- Absence of carotid pulse.
- 3- Cessation of respiration.
- 4- Bilateral dilated fixed pupil (relatively late sign)
- 5- Under anesthesia, ECG monitoring of the arrest & sudden cessation of bleeding are the main features.

The stethoscope has no place in the diagnosis of cardiac arrest. Once the condition is suspected the carotid vessels are palpated and if no pulse is felt, cardiac arrest must be assumed and resuscitation is started immediately

## Management

- **The proper management is carried out immediately and consists of three phases.**

### i. **Pre-hospital management (cardiopulmonary resuscitation) = (CPR)**

- External CPR by direct mouth-to-mouth breathing and closed cardiac massage.
- The aim is not to restart the heart but to provide an artificial circulation and artificial ventilation until appropriate facilities are available.
- **Technique:**
  1. The patient is laid on firm surface and the legs raised to increase the V.R. the head is tilted back with one hand to ensure clear airway, and the nostrils are closed by the other hand while the mouth is applied to the patient mouth's to fill his lung with expired air at a rate of 10-15 times per minute.
  2. At the same time, another person performs external cardiac massage by compressing the lower half of the sternum against the spine at a rate of about 100 times per minute ( alternate 2 breaths and 30 sternal compressions). The person compressing the sternum should stop while the otherb gives mouth-to-mouth breathing.
  3. The efficiency of ventilation and massage must be monitored by observing chest expansion and palpating the femoral pulse. The patient should be transferred to the hospital as soon as possible while continuing CPR until endotracheal intubation and medical treatment are available.

### ii. **Hospital management:**

1. The aim is to restore the normal cardiac rhythm.
2. An endotracheal tube is passed and the lung are ventilated with O<sub>2</sub>.
3. A venous cannula is inserted and suitable infusions are given.
4. ECG monitoring is applied to differentiate cardiac asystole from ventricular fibrillation or tachycardia.



- Open cardiac massage is employed if the chest is already opened or if closed massage has been unsuccessful.
- The chest is opened through the left 5<sup>th</sup> intercostal space and the pericardium is widely opened to permit bimanual massage with one hand above and the other below the ventricular mass.
- Massage is continued at a rate of 60-80/min until the cardiac tone returns and the heart becomes smaller, firmer and pink.

### Asystole or electromechanical dissociation

Maintain CPR + an intracardiac injection of adrenaline  
i.e. in the ventricle, or IV calcium chloride is given.  
While seeking potentially reversible causes e.g.

(4H)

Hypoxia  
Hypovolemia  
Hypothermia  
Hyperkalemia  
Other metabolic causes

(4T)

Tension Pneumothorax  
Tamponade  
Toxic/ therapeutic  
Thrombo-embolic

Sinus rhythm  
Or  
Fibrillation

If no response

Open cardiac  
massage

### Defibrillation

- First, at 200 joules.
- If failed → repeat again.
- If failed → a 360 joules shock is done.
- If failed → 1 mg IV epinephrine followed by a 1 minute CPR before trying up to 3 shocks each at 360 joules.

VF

Sinus rhythm  
Or  
Cardiac asystole

Open cardiac  
massage  
→ if no cardiac tone →  
- Procainamide  
injection and Internal  
defibrillation  
- CaCl is injected IV

If cardiac asystole persists in spite of adequate myocardial tone an injection of adrenaline or isoprenaline into the right ventricle often restores the normal rhythm.

### iii. Subsequent treatment (in ICU):

(After correction of normal rhythm)

- Control blood pressure ( kept over 90)
- If the chest has been opened it is left open for half an hour to watch for refailure of the heart.
- Control hyperkalemia → CaCl<sub>2</sub>, glucose, insulin.
- Control hypothermia & dehydration.
- Control metabolic acidosis → NaHCO<sub>3</sub> 8.4%
- If recurrent VF → prophylaxis lignocaine or implantable cardioverter defibrillator.
- Anticonvulsants agents for convulsions (may result from severe anoxic cerebral damage).

➤ **After stabilization of the case, find and treat the primary cause (e.g. coronary bypass surgery for coronary occlusion).**



# Mediastinal injuries

## Types

### Closed injury

Abrasions or bruises.

### Open Injury

**Non-penetrating wound** → pleura is intact.

**Penetrating wound** → pleura is opened. It may be:

- 1) **Sucking wound** → communicating the pleural space with the exterior → open pneumothorax.
- 2) **Valvular wound** → Allow air to enter the pleura but does not allow it to come out → tension pneumothorax.
- 3) **Extensive wound** with lacerations & loss of a part of the chest wall.

## Site

### Esophagus

- Hematemesis
  - Retrosternal pain
  - Mediastinitis
- } TTT: Urgent thoracotomy & repair

### Mediastinal pleura & lungs

- Mediastinal emphysema, mediastinitis → severe dyspnea & chest pain.

### Thoracic duct

- Chylous effusion.
- TTT: repeated aspiration & low fat diet.

### Heart & great vessels

#### Heart:

- Progressive hemothorax.
- Fatal hemorrhage (atrial hemorrhage).
- Cardiac tamponade:

Beck's  
Triad

- Shock (tachycardia, hypotension).
- Engorged neck veins.
- Distant heart sounds.
- Cardiac dullness is enlarged.
- **X-ray** → globular heart.
- **TTT:** urgent aspiration → thoracotomy → evacuate the pericardial hematoma then repair the ventricle.

#### Great vessels:

- Mediastinal hematoma.
- Hemothorax.
- Fatal hemorrhage.
- TTT: urgent thoracotomy & repair the vessels.



## Diaphragmatic injuries

- More common in penetrating chest injuries
- More common in left side
- Usually associated with herniation of abdominal viscera into the chest
- Abdominal tenderness, Dyspnea, shoulder pain, diminished breathing sounds, audible intestinal sounds on chest
- Plain CXR & CT chest are diagnostic
- **Treatment** → Abdominal repair

## Esophageal Injuries

- Perforations may have a serious outcome

### Etiology

1. **Iatrogenic (commonest)**: eg. Endoscopic dilatation of stricture
2. Penetrating or blunt injuries to neck or the chest
3. Swallowing of corrosives or foreign bodies
4. Spontaneous perforation (rare) due to forceful vomiting (Boerhaave's syndrome) or perforation of tumours

### Clinical picture

1. Acute onset of pain at site of rupture
2. Acute onset of fever, tachycardia, hypotension
3. Mediastinal emphysema which presents as subcutaneous emphysema of the neck or chest wall. Mediastinitis is rapidly fatal if not urgently treated
4. Pneumothorax &/or pleural effusion

### Investigations

1. Plain X-ray: Mediastinal emphysema or hydropneumothorax
2. Water soluble swallow may reveal the perforation

### Treatment

- a) Generally:** Management of Shock, IV antibiotics, Nil by mouth are essential.  
Do not pass nasogastric tube

**b) Specific:**

Site	Time	Management
Cervical perforation	Early	Surgical closure & external drainage
	Late	external drainage & IV hyperalimentation
Thoracic perforation	Early	Surgical repair & chest drainage
	Late	Esophageal resection
Abdominal perforation	-----	Must be treated surgically



## ► Radiological finding in thoracic injuries

Lungs, Pleura	Pneumothorax, Hemothorax, Pulmonary contusion
Mediastinum	<ul style="list-style-type: none"> <li>- Widening of the mediastinum suggests aortic rupture.</li> <li>- Air in the mediastinum suggests esophageal perforation.</li> </ul>
Diaphragm	<ul style="list-style-type: none"> <li>- Diaphragmatic rupture on the left side with herniation of abdominal viscera</li> </ul>
Bones	<ul style="list-style-type: none"> <li>- Rib fractures, flail segments</li> <li>- Fractures of the first rib or sternum denotes high velocity injuries with serious outcome</li> <li>- Fractures of the lower ribs raise the probability of splenic or liver injury</li> </ul>

## Mediastinal masses

- ⇒ Mediastinum is usually a silent area.
- ⇒ Mediastinal masses are often discovered as an incidental finding on CXR.
- ⇒ Mediastinum is divided into 4 compartments: superior, anterior, middle and posterior.

### Anterosuperior masses

- Retrosternal extension of thyroid.
- Aneurysm of aorta.
- Thymoma.
- LN masses.

### Posterior mediastinum masses

- Esophageal duplication.
- Bronchogenic cyst.
- Hiatus hernia.
- Neurogenic tumors arising in nerve sheath.
- Hematoma.
- Abscess.
- Lymph nodes.
- Extramedullary hematopoiesis
- Bronchogenic cyst.

### Middle mediastinal masses

- Lymph nodes.
- Tumor (metastasis, lymphoma, leukemia, sarcoidosis or TB).
- Infection.
- Inhalational TB.



## Bronchogenic carcinoma

- It affects both sexes; however, it is commonest among men than women (10:1).
- It has a very bad prognosis.

### Etiology

1. Excessive cigarette smoking. Both active & passive smoking are implicated & the incidence of lung cancer is proportionate to the frequency of smoking.
2. Inhalation of irritants e.g. silica & cobalt dust in mines & petrol fumes in large cities.

### Pathology

#### Macroscopic

1. The hilar type
  - It is the commonest (75%).
  - It leads to bronchial obstruction → atelectasis, pneumonia or lung abscess.
2. The peripheral type
  - Less common (25%).
  - It remains symptomless for a long time
  - It includes the Pancoast's tumor which arises at the apex of the lung & invades the brachial plexus, sympathetic trunk → Horner's syndrome & the first rib.

#### Microscopic

- 1) Squamous cell carcinoma: the COMMONEST (60%).
- 2) Oat cell carcinoma (30%): the most MALIGNANT, occurs near the hilum)
- 3) Adenocarcinoma (10%): It is commoner in FEMALES.

### Spread

- Direct
- Lymphatic.
- Blood.

### Clinical picture

#### ➡ Type of patient:

A male 40-60 years old, manifested by one of the following 5 syndromes:

#### 1. Insidious type:

- In most cases, the onset is insidious with a dry irritant cough, often ascribed to smoking, which later becomes asthmatic & associated with hemoptysis, dyspnea & chest pain.

#### 2. Acute type:

- Symptoms of pneumonia which fails to resolve or relapses within few days or weeks.

#### 3. Latent type:

- In peripheral carcinoma, the disease may remain silent till discovered by mass radiography or produce vague general symptoms e.g. fatigue & indigestion till distant metastasis or symptoms of mediastinal invasion (mediastinal syndrome) appear.
- Distant deposits may produce manifestations of ↑ ICT (headache, vomiting & blurring of vision), pathological fractures, jaundice & adrenal failure.

#### 4. Pancoast type:

- A peripheral tumor at the thoracic outlet (superior sulcus tumor).
- It invades the brachial plexus, sympathetic trunk & upper ribs, producing a lower brachial plexus lesion with Horner's syndrome & erosion of the upper 2 or 3 ribs.



### 5. Extrapulmonary non metastatic type (Paraneoplastic syndrome):

- Undifferentiated tumors especially oat cell carcinoma may elaborate hormone like substances which cause them. They include:
  - a) Cushing like syndrome:
    - Due to ACTH production, which differs from the classic syndrome by an older age incidence, a greater frequency in males & a more rapid clinical course.
  - b) Water retention:
    - Due to secretion of ADH production → hyponatremia, water intoxication & cerebral symptoms.
  - c) Hypercalcemia:
    - Due to PTH like polypeptide.
  - d) Tender gynaecomastia:
    - Due to ectopic gonadotrophin secretion.
  - e) Carcinoid syndrome:
    - Due to secretion of 5-HT.
  - f) Malignant neuromyopathies:
    - Due to elaboration of antibodies to an antigen derived from the tumor.
    - These antibodies may cause myasthenia, dermatomyositis or peripheral neuritis.
  - g) Pulmonary osteoarthropathy:
    - May occur even with a small a symptomatic cancer.
    - It is characterized by a sudden onset of clubbing of fingers, sometimes associated with edema & swelling of the small joints of the hands & ankles & pain in the knees. Removal of the cancer is followed by fast dramatic relief of joint pains & rapid subsidence of the clubbing.

## Diagnosis

**Keep a high index of suspicion**

☞ **Bronchogenic carcinoma should be suspected in all patients over 40 who develop abnormal cough, unresolved or recurrent pneumonia, chest pain or hemoptysis.**

☞ **Even when the pneumonia responds to ordinary medical treatment, CXR should be done 3 weeks after cure.**

## Investigations

### A- Plain X-ray:

- 1) Coin shadow
- 2) Hilar opacity
- 3) Mediastinal LN++
- 4) Pleural effusion
- 5) Erosion of ribs
- 6) Diaphragmatic paralysis
- 7) Signs of obstructive emphysema, atelectasis, pneumonia, lung abscess.

**B- CT** → accurately localizes the tumor and the mediastinal LN++.

**C- CT guided needle biopsy** → is highly accurate for peripheral lesions.

**D- Bronchoscopy** → usually establishes the diagnosis & allows assessment of operability.

- In about 60% of cases, the tumor is visible as a nodular necrotic mass or an irregular stenosis & a punch biopsy can be taken.



**Signs of inoperability are:**

- ⇒ Left RLN paralysis.
- ⇒ Compression of the tracheal.
- ⇒ Widening of the carina by enlarged LN.
- ⇒ Fixation of the affected bronchus or malignant infiltration beyond the proximal centimeter of the main bronchus.

E. **Sputum cytology**

F. **Scalene node biopsy**

→ confirms the diagnosis & assess the operability.

G. **Mediastinoscope**

→ biopsy nodes of the paratracheal LNs.

**Treatment****1) Operable cases:**

- ⇒ Radical resection → Pneumonectomy + removal of mediastinal LNs
- ⇒ In elderly with peripheral carcinoma → Lobectomy.

**2) Operable cases:**

- a) Palliative resection → should be done if inoperability is discovered at thoracotomy as it relieves the chest symptoms & improve the general condition by controlling of hemoptysis & suppuration.
- b) Radiotherapy → relieves SVC obstruction, bronchial obstruction & pain of skeletal metastasis.
- c) Chemotherapy.

**Aortic dissection****Predisposing factors**

- Atherosclerosis and hypertension.

**Pathology**

- Intimal tear → blood dissects the media → creation of false lumen → may rupture in the true lumen or the outside causing fatal hemorrhage.
- As blood dissects its way distally, it occludes the ostia of aortic branches especially coronaries, renal & mesenteric arteries → ischemia.

**Types****I. Type A:**

- It is the most serious.
- Dissection starts in the ascending aorta → aortic incompetence, coronary artery occlusion & fatal cardiac tamponade.

**II. Type B:**

- Dissection starts distal to the arch.

**Clinical picture**

- Severe chest pain that radiates to the interscapular region.
- It is commonly misdiagnosed as acute MI.
- Actually MI may also be present in type A & diagnosis is not easy.



**Investigations**

- 1) ECG
- 2) CT
- 3) Aortography
- 4) Transoesophageal echocardiography

**Treatment**

- 1) **Type A:**
  - Urgent surgery; placement of a synthetic graft at the aortic root.
- 2) **Type B:**
  - Antihypertensives.
  - Elective surgery may be needed in cases of chronic extension of dissection.

**Cardiac surgery complications**

1. *Complications of extracorporeal circulation.*
  - a) Cerebral ischemia that may be severe & induces infarction or may be minimal & causes transient postoperative psychological disturbances or memory disturbances.
  - b) Activation of cytokines that induce SIRS. They are usually minor but in rare cases may cause coagulopathy & renal failure.
  - c) Hemolysis.
2. *Low cardiac output.*
3. *Arrhythmias.*
4. *Fluid accumulation.*
5. *Pulmonary infection.*
6. *Mortality of cardiac surgery ranges from 2% for routine straightforward procedures to over 50% for complex emergency procedures.*



## Points to remember cardiothoracic

### Rib fracture

- ▶ **Etiology:** direct, indirect, pathological fracture
- ▶ **Types:** Simple, Multiple, Flail chest, stove in chest
- ▶ **C/P:** history of trauma + chest pain, dyspnea, swelling at the site of injury
- ▶ **Invest.:** chest x ray, ABGs
- ▶ **TTT:** management of poly trauma patient + specific TTT according to the type of fracture

### Flail chest

- ▶ More than 4 ribs are fractured at 2 points.
- ▶ The flail part has the following effects : respiratory and circulatory failure
- ▶ **C/P:** - **Symptoms:** Acute chest pain, dyspnea, cough & cyanosis.  
- **Signs:** signs of shock, engorged neck veins, cyanosis
- ▶ **Invest.:** for flail chest and complications
- ▶ **TTT:** Management of poly trauma+ definitive TTT according to the finding

### Pneumothorax

- ▶ Air in the pleural cavity. It is types: open, closed, tension
- ▶ **C/P:** - **Symptoms:** history of trauma, chest pain, dyspnea, cough  
- **Signs:** shock, engorged neck veins + tympanitic resonance on percussion of the affected side
- ▶ **Invest.:** chest X ray showing jet black opacity on the affected side
- ▶ **TTT:** management of poly trauma patient + insertion of intercostals type under water seal in the 2<sup>nd</sup> space midclavicular line

### Open Pneumothorax

- ▶ The pleural space communicates freely with the exterior.
- ▶ **Etiology:** open, closed chest injury
- ▶ **Clinically** diagnosed by harsh whistling sound of air going through the defect following history of trauma+ Hyper-resonance on the affected side on percussion
- ▶ **Invest.:** - CXR:  
- Jet-black on affected side.
- ▶ **TTT:** management of poly trauma patient + insertion of intercostals

### Pleural effusion

- ▶ Abnormal accumulation of fluid in the pleural space
- ▶ **Etiology:** exudate, transudate, bloody, chylous
- ▶ **C/P:** - **Symptoms:** chest pain, cough, dyspnea  
- **Sign:** Percussion: stony dullness (basal & rising to axilla)
- ▶ **Invest.:** chest x ray
- ▶ **TTT:** TTT of cause + Thoracocentesis

### Hemothorax

- ▶ Collection of blood in the pleural space.
  - ▶ **Etiology:** as any bleeding general, local causes
  - ▶ **C/P:** As pneumothorax but dull on percussion
  - ▶ **Invest.:** chest x ray
  - ▶ **TTT:** management of poly trauma patient + remove the blood by aspiration or thoracotomy if indicated
- The chest tube will allow drainage of blood & at the same time, it allows for follow up of the patient. So long as the patient is stable, the amount of drained blood is decreasing & the lung is expanding, this means that conservative treatment is successful. The chest tube should be kept until no more drainage occurs & the lung is fully expanded, when the tube should be removed.



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**Acute empyema**

- ▶ Accumulation of pus in the pleural cavity.
- ▶ More common in children following lobar pneumonia.
- ▶ Pneumococcal empyema is the commonest type
- ▶ C/P: - **Symptoms:** FAHM + chest pain, cough, dyspnea
  - **Signs:** fever, tachycardia+ local signs of collections of pus in the pleural
- ▶ Invest.: CXR, CBC
- ▶ TTT: as Abscess 3A+ Drainage

**Chronic empyema**

- ▶ Empyema in which the lung is unable to expand after pus evacuation due to fibrosis.
- ▶ May be open, closed
- ▶ C/P: - **General:** Chronic toxemia with clubbing
  - **Local:**
    - Open type: → chronic sinus in the chest wall
    - Closed type: Empyema necessitans
- ▶ Invest.: CBC, chest X ray
- ▶ TTT: - **General:** Antibiotic, correct the general condition
  - **Local:** Re-drainage, Decortication, Thoracoplasty

**ARDS**

- ▶ Lung condition that leads to low O<sub>2</sub> level in blood.
- ▶ **Etiology:** sepsis, shock, major burn and trauma
- ▶ **Characterized by** damage of alveolar-capillary membrane which leads to defect in ventilation/perfusion/diffusion
  - ▶ C/P: initial state, phase of hemo dynamic equilibrium, phase of respiratory distress
- ▶ **Investigation:** ABG, CXR, CT chest
- ▶ TTT : NO SPECIFIC THERAPY BUT JUST supporting and symptomatic TTT

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# TITLES BY THE AUTHOR

Textbook of General surgery  
Textbook of GIT surgery  
Textbook of Special surgery  
Surgical operations  
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