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**MSS**

Musculoskeletal System

**Pathology**

Doctor 2018 | Medicine | JU

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In the Previous lecture we discussed a wide and important topic (fractures); which is considered one of the most common bone disorders. We also mentioned types of fractures and healing of fractures. And now we will switch gears to talk about two very important topics regarding bone diseases and disorders.

**Osteonecrosis**

**Osteomyelitis**

## Osteonecrosis

→ **Osteonecrosis** : Death of the bony tissue , Mainly due to **ischemia** (loss of blood supply) that's why it is also called **Avascular necrosis**. It can be referred to as **infarction ( ischemic necrosis ) of bone and marrow cells.**

- **Osteonecrosis can occur in any bone.** However, it occurs more commonly in certain bones and fracture sites ; like the **femoral head which is the main classical example of a bone with Avascular necrosis.**

→ A diverse set of conditions pre-disposes and leads to bone ischemia.

# For example ; somebody is completely normal , he doesn't take any drug and there's no underlying disease , so → unlikely to have an Avascular Necrosis of femoral head .

# Associated conditions

## ● Vascular injury

- **Trauma**: it is considered one of the major causes of osteonecrosis .It includes **fractures** ; for example : Fracture of the neck of femur → blood supply gets compromised → Avascular necrosis .

- **Vasculitis** : Is an inflammation of the blood vessels → can affect arteries , veins and capillaries → risk factor for vascular thrombosis → ischemia .

## ● Drugs

- **Steroids / corticosteroids**: increases osteoclasts activity ( as we learned before ) → osteoporosis and bone loss → fractures → blood supply becomes compromised → ischemia

## ● Systemic diseases

- **Sickle cell disease** : this disorder comes in many forms , and the one that causes Avascular necrosis is the severe form ; which can cause sickle cell crisis → **the patient becomes at higher risk to develop vascular thrombosis everywhere** → ischemia ,, **so patients come to emergency room with severe bone pain from thrombosis and ischemic pain .**

## ● Radiation

- **Osteoradionecrosis**: bone death due to radiation . Repeated radiation therapy damages vascular components of the bone → ischemia \*from google\*

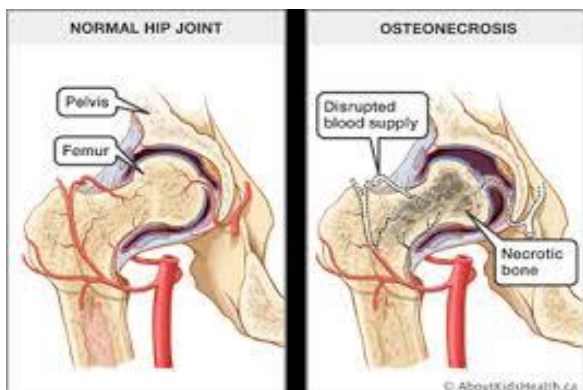
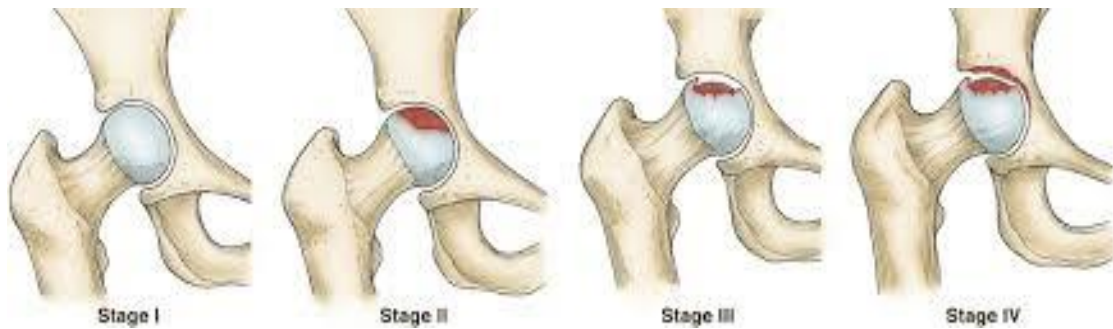
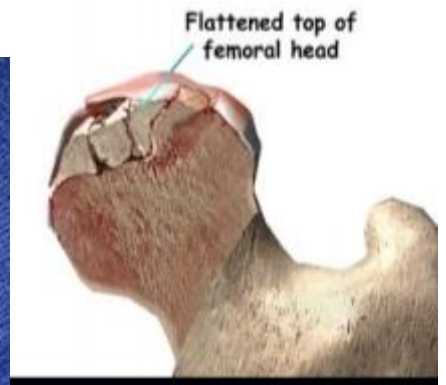
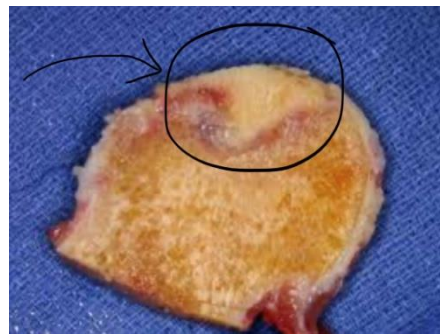
**# for ex. Somebody with tumor in the head of femur treated by radiotherapy**  
→ **Radiation treatment will induce vascular injury .**

**\*\* so when you have a scenario of one of these conditions with sudden pain specially in the right head of femur , think about Avascular Necrosis of femoral head .**

**→ From the associated conditions mentioned above ,we can conclude that Osteonecrosis can happen in these suspected mechanisms :-**

- 1 – Mechanical disruption ( Trauma → cut of blood supply )**
- 2 – Thrombotic occlusion ( sickle cell )**
- 3 – Extra vascular compression ( Trauma / Hematoma / Tumors → compression on blood supply of particular bone ) .**

**# Necrotic bone is pyramidal in shape , the base of pyramid is faced at articular cartilage ( classic scenario )**



# Osteomyelitis

→ Osteomyelitis :**Osteo** (relating to bones)-**myeloid** (relating to bone marrow)-**itis**( inflammation ) .

So it simply means :

- inflammation of bone / marrow due to an infection ( virtually always secondary to infection )

**# It's a Medical Emergency and very serious → you have to pick it up and diagnose and treat properly .**

→ Osteomyelitis may be a complication of any **systemic infection specially in children** ( ex : Bacteremia ) or **Neonatal sepsis could be involved in bone and bone marrow** . a **Primary solitary focus** which is much **more common and frequent** (ex :from surgical procedure at a certain site).

→ **Any organism** can cause osteomyelitis .

→ Acute osteomyelitis **almost always caused by bacteria** and rarely by fungi and viruses .

→→ **Pyogenic Osteomyelitis**: ( inflammation of bone caused by infecting organism ) \ pyogenic means ; pus forming inflammation .

● **bacteria ; Staph.aureusis** ( **gram +ve cocci** ) responsible for 80 to 90 % of the cases of culture-positive pyogenic osteomyelitis.

● **Escherichiacoli (gram –ve bacilli) , Pseudomonas & Klebsiella** are more frequently isolated from individuals with **genitourinary tract infections (UTI)** or who are **intravenous drug abusers** ( More virulent organisms ) .

# **Gram –ve bacilli are tough organisms and lethal , like: Pseudomonas**

# **Before culture results , we give the patient Empirical treatment (which is treatment depending on clinical ground → so we give him a drug against staph.aureus .**

→ Such organisms may reach the bone by three main routes \ mechanisms :

**1-Hematogenous spread : most common** and occurs mainly in children , it can happen without any open fracture or skin penetration ( untreated Tonsillitis → bacteremia → Pyogenic osteomyelitis )

**2-Extension from contiguous site(another sort of infection) :** from Abscesses or ulcers , also more frequent in diabetic patients; ( Toxic hyper glycemia → neuropathies in the sensory neurons along with many complications → Diabetic Foot → can't feel any cut or injury → increased susceptibility for infections ) .

Occurs more often in adults .

**3-Direct implantation after compound fractures and orthopedic surgeries (induce infection from surgical procedures \ not sterile \ iatrogenic ) .**

\***For prevention** : Aseptic techniques and prophylactic antibiotics should be considered .

→ different age groups get infected with different type of organisms .

→ Neonates : Haemophilus influenzae & Group B strep for systemic infection .

→ Sicklers : Patients with sickle cell disease are more likely to develop Salmonella pyogenic osteomyelitis for some reason .

\*\*\*\*\*

● Extra : It is not fully known yet about the relationship of salmonella pyogenic osteomyelitis with sicklers . However, It is suggested that the peculiar susceptibility of patients with sickle cell anemia to salmonella osteomyelitis is due to spread of salmonella from the intestine facilitated by devitalization of gut caused by intravascular sickling , and that infarcts in bone became infected either by transient bacteraemia or by activation of dormant foci of salmonella in bone marrow when tissues are devitalized .

( It is also further suggested that immunological defects in sicklers may impair host response to infection, while hemolysis and hepatic dysfunction, both of which occur in sicklers, and favor propagation of salmonella.) I'll go with this one 😊

\*\*\*\*\*

→ Note : The most common cause of pyogenic osteomyelitis for patients with sickle cell disorder is (( Staph. aureus )) and we should think about Salmonella .

→ In almost 50% of suspected cases , no organisms can be isolated ( **blood culture is negative** ) . why ? , mainly due to previous administration of antibiotic, so improper diagnosis and treatment interferes with your blood culture results (patient that was partially treated ) .

→ Long bones get infected more often .

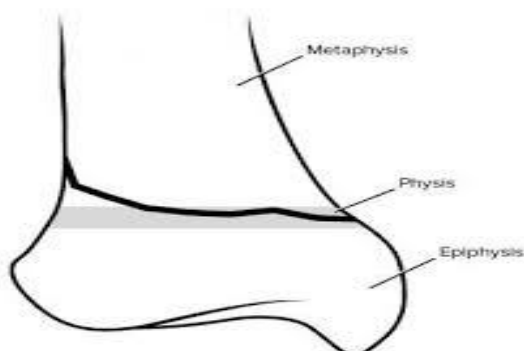
● in adults : **Metaphysis &** epiphysis

● in children : **Metaphysis Or** epiphysis ( not both )

\*\*\*\*\*

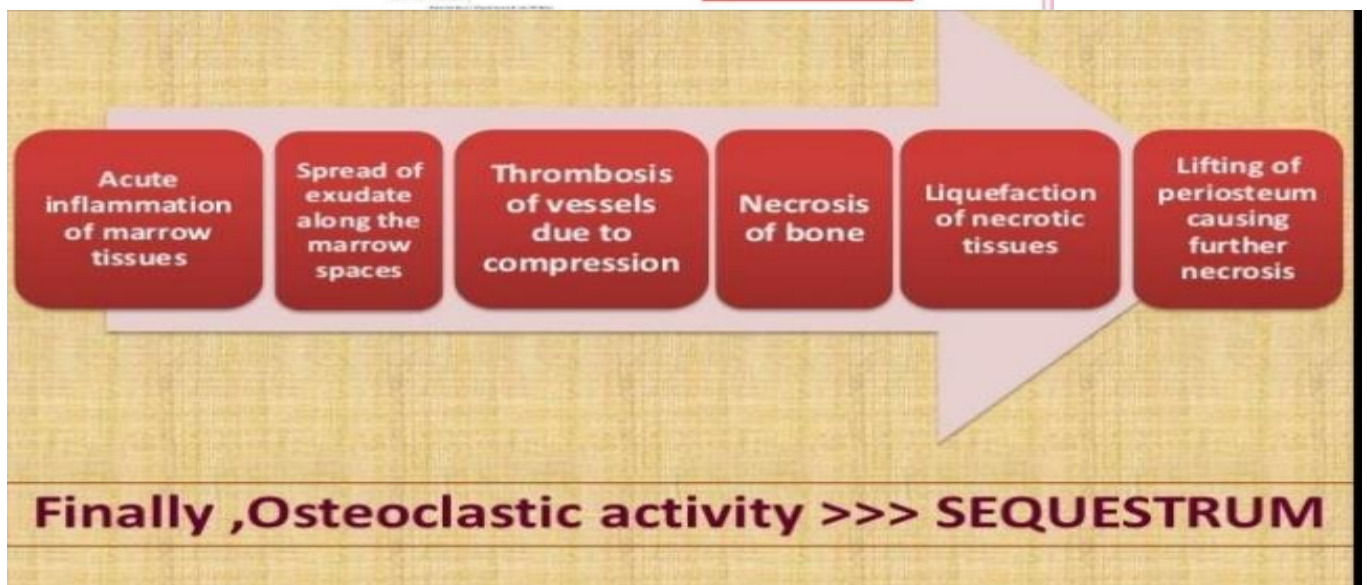
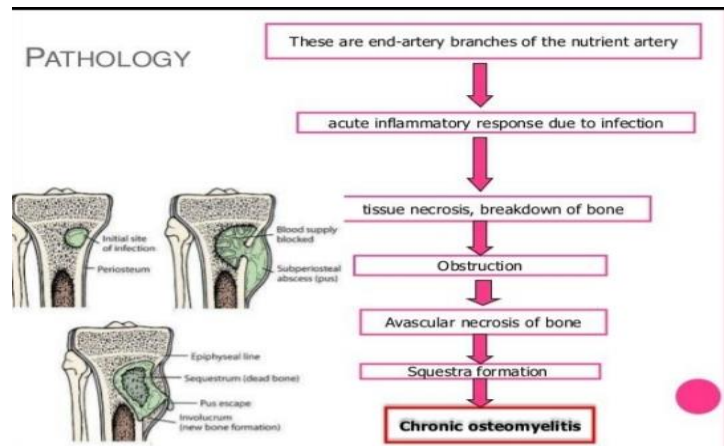
**Extra** : Why ?

In adults the diaphysis and epiphysis share the same nutrient arteries and veins. These arteries and veins form a fine network of arterioles and venules in the metaphysis, which leads to the formation of so called sinusoidal lakes. These sinusoidal lakes can act as pools where micro organisms can accumulate , thus leading to a focus of osteomyelitis . In contrast to the adult situation , in young children the epiphysis has its own nutrient vessels, After 12 to 18 months of age , these transphyseal vessels disappear . As a result the physis acts as a natural border and prevents the spread of osteomyelitis from the metaphysis to epiphysis .





# Stages of osteomyelitis



→ Acute inflammation → spread of mediators & neutrophils and signaling molecules → Recruitment of WBC → Pus Formation (exudates Not transudate → Exudation into marrow spaces → Local-focal vascular thrombosis (complication) → Osteonecrosis → **Lifting of periosteum** (**late** sign of acute Pyogenic osteomyelitis) → we should treat it early .

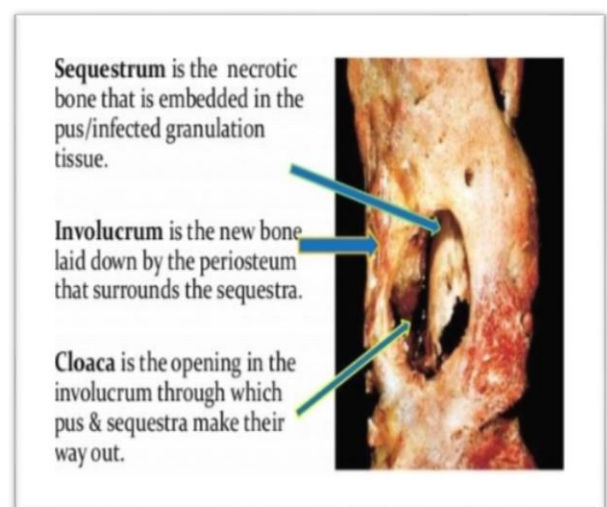
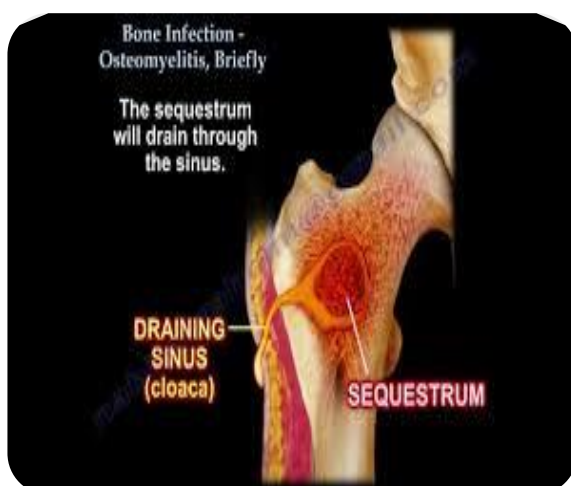
<b>ACUTE</b>	<b>PUS &amp; NEUTROPHILS</b>
<b>CHRONIC</b>	<b>LYMPHOCYTES AND PLASMA CELLS</b>

# Important terms regarding to Osteomyelitis

1 – **Sequestrum** : is the necrotic (dead ) bone that is embedded in the pus / infected granulation tissue .

2- **Involucrum**: is the new bone laid down by the periosteum that surrounds the sequestra ( **active bone forming region** ) / ( **woven viable bone** ) .

3 – **Cloaca** : is the opening in the involucrum through which Pus & sequestra make their way out ( **sinus and drainage of pus** ) .



# Osteomyelitis clinically

## → Manifestations of Hematogenous Osteomyelitis :

- Fever , malaise ( loss of appetite ) , chills , leukocytosis ( increased WBC count ) , **Throbbing pain locally ( helpful for differential diagnosis ) and it is a characteristic of presence of pus .**

→ In infants the presentation is subtle , with only unexpected fever. In adults it appears as a local pain .

→ **Dx** : The diagnosis is strongly suggested by the characteristic radiographic findings of a lytic focus of bone destruction surrounded by a zone of sclerosis ( X-ray maybe normal in early phases → however we shouldn't wait till we see the X-ray lytic changes , **you should have high index of suspicion → it means that when you see these clinical pictures that show an acute OM .** )

**Biopsy and bone cultures are required to identify the pathogen in most instances.**

→ **Tx** : The combination of IV antibiotics and surgical drainage of pus is usually curative , **also the admission is very important .**

# Good luck