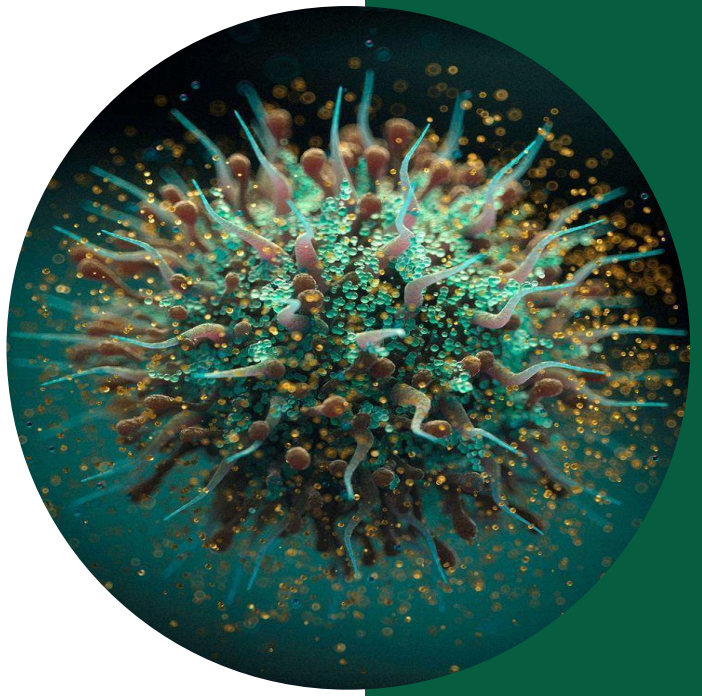
بسم الله الرحمـٰن الرحيم

(وَفَوْقَ كُلِّ ذِي عِلْمٍ عَلِيمٌ)

Pathology | MID #

MSS & Skin Tumors pt.4



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Hala Otoom

OSTEOMYELITIS:

Bone | Bone marrow | Inflammation

- **Inflammationof bone/marrowdue to infection**
- **Part of systemic infection** (especially inneonatesandchildren) **or primary solitary focus (much more common)**
- **Any organism can cause osteomyelitis** (bacteria, viruses, fungi, etc.

However, when we're talking about osteomyelitis we almost always focus on **bacterial osteomyelitis (pyogenic osteomyelitis).**

Formation of pus

- **Pyogenic osteomyelitis: bacteria** (the most common organism that causes osteomyelitis);
  among thebacteria,the most common is **Staph. Aureus** [gram positive cocci] **(80-90%) of acute osteomyelitis cases.**
  E. Coli, Pseudomonas &Klebsiella [illicab evitagen-marg]**aremorecommon when UTI or IVdrug abuse is present.**

-Patients who are heroin addicts or HIV patients probably they will have more unusual organisms such as G(-ve) bacilli.

Neonatal sepsis occurs when a bacterial, viral, or fungal pathogen enters the bloodstream, leading to systemic infection affecting multiple organs, including the bones (osteomyelitis).

This information is very important which help us to choose a proper antibiotic

PYOGENIC OSTEOMYELITIS:

-Pathogenesisof pyogenicosteomyelitis

Three Mechanisms: (how it reaches the bone and the bone marrow to cause infections

1.Hematogenousspread(more common inchildren)

- This is the most common source of acute myelitis specially children.

2. Extension from the contiguous site (e.g., nearby infected area in adults, diabetic foot)

- Patients with diabetes mellitus often have peripheral neuropathy, which reduces sensation in their feet. As a result, minor injuries may go unnoticed and become infected, leading to a diabetic foot ulcer. If left untreated, the infection can spread into the underlying bone, causing osteomyelitis.

3.Direct implantation (aftercompound fracturesor orthopedic procedure)

- In compound fractures, the broken bone penetrates the skin, exposing it to external pathogens. Without the protective barrier of the skin, bacteria from the environment can enter the bone and cause infection.

Iatrogenic infections: These are infections acquired due to medical procedures, often resulting from poor technique, lack of hygiene, or improper sterilization. In orthopaedic surgery, inadequate sterilization can introduce pathogens, leading to osteomyelitis and other serious complications.

- **Neonates:** The most common causative organisms include *Haemophilus influenzae*, Group B Streptococcus and Staph. Aureus

- Neonatal sepsis is primarily caused by bacteria (bacterial septicaemia), but the specific pathogens vary with age.

- **Sicklers** (patients with sickle cell disease):

They are at a higher risk of developing Salmonella osteomyelitis. However, Staph. Aureus remains the most common cause of acute osteomyelitis in all patients.

- **50% of cases: no organisms are isolated** from blood cultures or bone aspirates. This is often due to prior antibiotic use, as many patients receive treatment from multiple clinics before diagnosis, reducing culture sensitivity.

- Long bones (the most commonly affected by Pyogenic OM):

In adults —> metaphysis and epiphysis.

In children —> either epiphysis or metaphysis (not both).

- This is due to differences in bone vascularization at different ages and growth plate .

عشان إزا أجاني
(sickle cell patient)
و شكّيت ب
(osrteomyeltis)
فهون مو بس أغطي ال staph فبغطي برضو ال salmonella
فبعطي
antibiotics
To kill the staph and to kill the salmonela

About the incoming slide:

- The pathological process of osteomyelitis begins with infection, triggering an acute inflammatory response. This leads to tissue necrosis, particularly avascular necrosis, due to compromised blood supply.
Additionally, osteoclast activity causes bone resorption.

As a result, multiple necrotic bone fragments form, known as sequestrum, which can be observed histologically. However, the necrotic bone is typically surrounded by a layer of new reactive bone, called the involucrum.

- If this acute inflammation continues, unrecognised and untreated, it will penetrate the skin leading to a sinus formation, this sinus tract is called Cloaca, then maybe at the end it becomes a chronic inflammation.

● A sinus is an abnormal channel that forms between inflamed tissue and the body surface, usually allowing **pus drainage**.

PATHOLOGY

These are end-artery branches of the nutrient artery

↓

acute inflammatory response due to infection

↓

tissue necrosis, breakdown of bone

↓

Obstruction

↓

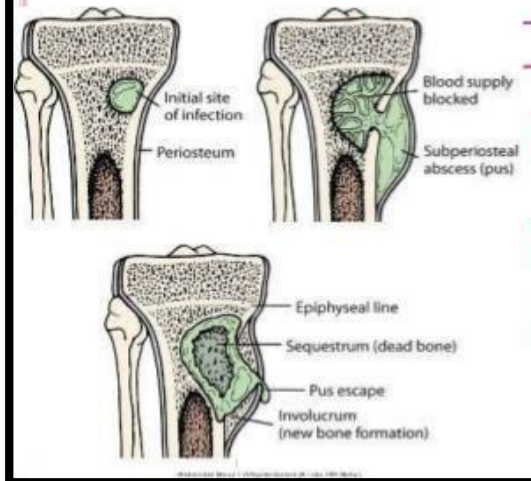
Avascular necrosis of bone

↓

Squestra formation

↓

Chronic osteomyelitis

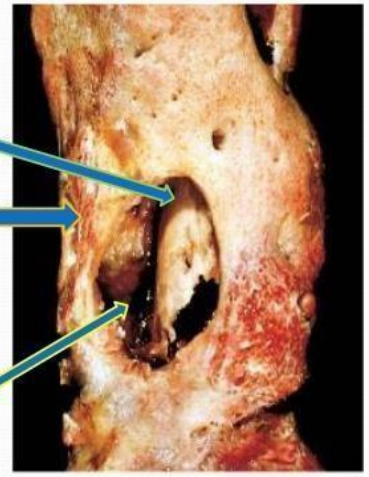


Acute inflammation of marrow tissues → Spread of exudate along the marrow spaces → Thrombosis of vessels due to compression → Necrosis of bone → Liquefaction of necrotic tissues → Lifting of periosteum causing further necrosis

Finally ,Osteoclastic activity >>> SEQUESTRUM

Necrotic bone = dead bone

- **Sequestrum** is the necrotic bone that is embedded in the pus/infected granulation tissue.
- **Involucrum** is the new bone laid down by the periosteum that surrounds the sequestra.
- **Cloaca** is the opening in the involucrum through which pus & sequestra make their way out.



ACUTE	PUS s NEUTROPHILS
CHRONIC	LYMPHOCYTES AND PLASMA CELLS

The diagnosis and the curing of chronic osteomyelitis is not easy.

OSTEOMYELITIS CLINICALLY:

الفكرة انه لازم نفكر بهاد المرض ونذّكره لنعرف نشخصه

- **Hematogenous OM: fever, malaise,** which is loss of appetite, **chills, leukocytosis,** This is why peripheral blood sampling is important when the presence of acute osteomyelitis is suspected and **throbbing pain locally;** this sign gives you a hint about the location of the bone affected.
- **Infants: subtle**
- **Adults: local pain**
- **DX: high index of suspicion; X-ray may be normal in early phases (u should not wait till we see x-ray lytic changes).**
- **Tx: admission,** proper long period of **IV antibiotics and sometimes surgical drainage of pus.**

○ A normal X-ray does not rule out acute osteomyelitis; the diagnosis relies on a high index of suspicion.

CHRONIC OSTEOMYELITIS:

- 5-25% of Acute OM persists as chronic OM due to maybe unproper treatment or unproper duration of treatment.
- Very bad debilitating disease

Causes:

- Delay in diagnosis
- Extensive necrosis if the organism or the immunity of the patient is very bad.
- Inadequate therapy (A. biotics or surgery) is a major cause.
- Weakened host immunity

- Amyloidosis is the deposition of amyloid protein in various organs, such as the brain, leading to tissue damage, as seen in Alzheimer's disease.

COMPLICATIONS OF CH. OM:

- Pathologic fractures
- Secondary amyloidosis.
- Endocarditis is inflammation of the endocardium and the .valves.
- Sepsis (generalized bacteremia).
- Squamous cell carcinoma of draining sinus and progressive dysplasia with cases that developed cloaca.
- High risk of bone sarcoma with chronic OM.

MYCOBACTERIAL OSTEOMYELITIS:

- Any organism can cause acute or chronic osteomyelitis, mycobacteria is one of the organisms that can cause osteomyelitis.

- It used to be a disease in developing countries. In countries like Jordan and other parts of the Middle East, tuberculosis (TB) is endemic.
- However, in recent years, the incidence of mycobacterial infections affecting the bone and bone marrow has been increasing even in developed countries.

- Now, there are more cases in developed countries: immigrant & immunocompromised patients.
- The theories behind it, people from endemic areas, like Bangladesh to the USA or Australia, bringing the organisms with them.
- The pathogenesis of tuberculosis involves a latent phase, during which the infection remains dormant. However, when immunity declines, the initial TB infection can reactivate, leading to active disease

- 1-3% of pts with pulmonary (probably the most common organ involved in TB) or extrapulm TB can have bone involvement.
- Hematogenous (most common route of infection) or direct spread.
- Clinically: it's really difficult to diagnose due to it's

maybe subtle and chronic course, unlike sharp acute pain, which is typically associated with a full systemic inflammatory response.

- Pathology: the main pathologic feature of TB is **necrotizing (caseating) granuloma.**

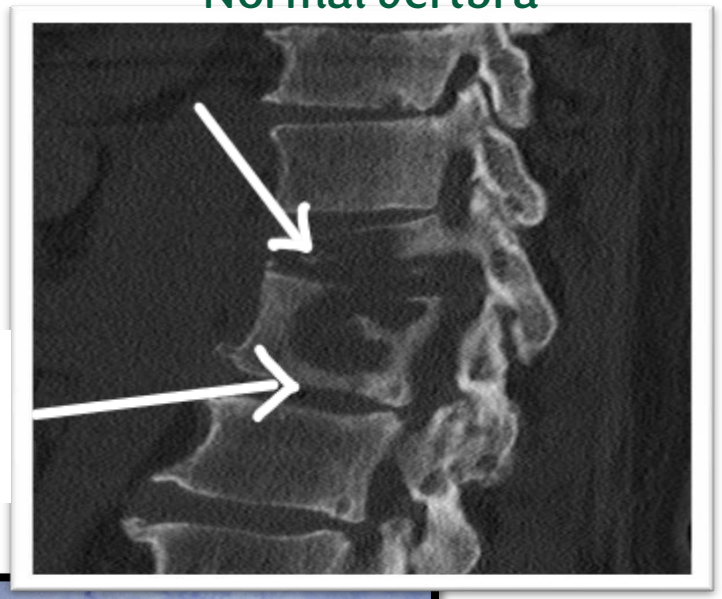
- Granuloma is a collection of immune cells seen in chronic inflammation. It can be diagnosed through aspiration or biopsy, granulomas appear as aggregates of **histiocytes, epithelioid histiocytes, plasma cells, and lymphocytes**. If necrosis is present in the center, it is called a necrotizing granuloma, **most commonly caused by mycobacterial tuberculosis.**

TB SPONDYLITIS (POTT DISEASE):

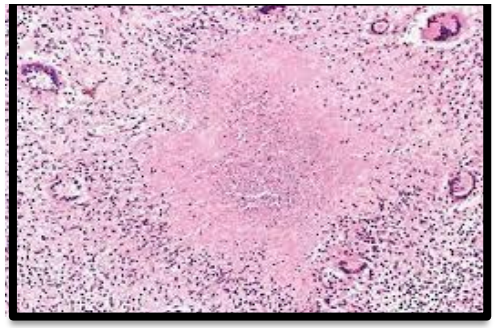
- If the TB osteomyelitis effect the vertebral body we call it (Pott disease).

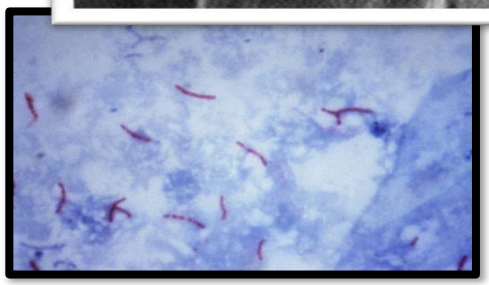
- **Destructive spine TB**
- **Difficult to treat**
- **May lead to fractures, neurologic deficit, scoliosis, kyphosis**

Normal vertbra



What happened here is
Collapsed or compression
Fracture due to the presence
Of TB





If we take a biopsy from this vertebra you will see granuloma with multinucleated giant cells, plasma cells and
Lymphocytes and central necrosis
As pathologists, we routinely perform special stains for granulomas. For tuberculosis (TB), we use the Ziehl-Neelsen (ZN) stain, also known as the acid-fast stain, to detect acid-fast bacilli (AFB).
Under the microscope, AFB appear red and are often referred to as "red snappers.“.

- **BONE TUMORS AND TUMORLIKE CONDITIONS:**

- **Primary bone tumors are rare** (metastatic tumors are more common)

Benign >>>> malignant tumors

- **Primary bone tumors are rare** (metastatic tumors are more common)

Benign >>>> malignant tumors

- **First 3 decades (benign); adults are more likely to be malignant**

and then the percentage of the malignant tumors of the bone goes up with increasing age, so if the patient with a malignant tumor at the age of 70 it's most likely metastatic carcinoma, not a primary malignant bone tumor.

- The management of cancer treatment has evolved significantly over time. In the past, surgical approaches were highly aggressive. In some cases, entire portions of the lip were removed, and for tumors such as osteosarcoma, treatment often required joint disarticulation or even limb amputation.

- Today, treatment is more advanced. The approach begins with diagnosis, followed by neoadjuvant chemotherapy and, in some cases, radiotherapy, which help shrink the tumor and improve surgical outcomes. After this, limb-salvage surgery is performed, where the affected bone (e.g., the distal femur) is removed and replaced with a prosthesis, while soft tissues and muscles are reconstructed. Remarkably, patients can often be discharged within a few days and regain function quickly.

- **Trx** (treatment) **: aims to optimize survival while maintaining function.**
- **Age & location help narrow ddx** (differential diagnosis)
  - There are certain tumors which have certain appearances and locations in the bone at a specific age.
- **S&S** (signs & symptoms) **: asymptomatic, pain, pathological fractures .**

Category	Behavior	Tumor Type	Common Locations	Age (yr)	Morphology
Cartilage forming	Benign	Osteochondroma	Metaphysis of long bones	10–30	Bony excrescence with cartilage cap
—	—	Chondroma	Small bones of hands and feet	30–50	Circumscribed hyaline cartilage nodule in medulla
—	Malignant	Chondrosarcoma (conventional)	Pelvis, shoulder	40–60	Extends from medulla through cortex into soft tissue, chondrocytes with increased cellularity and atypia
Bone forming	Benign	Osteoid osteoma	Metaphysis of long bones	10–20	Cortical, interlacing microtrabeculae of woven bone
—	—	Osteoblastoma	Vertebral column	10–20	Posterior elements of vertebra, histology similar to osteoid osteoma
—	Malignant	Osteosarcoma	Metaphysis of distal femur, proximal tibia	10–20	Extends from medulla to lift periosteum, malignant cells producing woven bone
Unknown origin	Benign	Giant cell tumor	Epiphysis of long bones	20–40	Destroys medulla and cortex, sheets of osteoclasts
—	—	Aneurysmal bone cyst	Proximal tibia, distal femur, vertebra	10–20	Vertebral body, hemorrhagic spaces separated by cellular, fibrous septae
—	Malignant	Ewing sarcoma	Diaphysis of long bones	10–20	Sheets of primitive small round cells

Is the most common primary malignant tumor

An additional summary for the pathological stages:

Stage	Pathological Changes
1. Infection & Inflammation	Bacterial invasion → Inflammatory response → Neutrophil infiltration
2. Bone Breakdown	Osteoclast activation → Bone resorption → Tissue necrosis
3. Avascular Necrosis	Thrombosis of vessels → Bone ischemia → Death of bone tissue
4. Sequestrum Formation	Dead bone fragments separate from healthy bone
5. Involucrum Formation	New reactive bone forms around infection
6. Chronic Osteomyelitis	Persistent infection, sinus tract formation, bone deformities

To get a mind map summarising the first 4 lectures click on the right answer:-

- When was Dr. Abbadi a 2nd yr med student:–

A) 1985
B) 1979
C) 1983

a short quiz for this lec

Additional Resources:

رسالة من الفريق العلمي:

السعي جزءٌ من رسالتكم؛ فالله تعالى أمر بالأخذ بالأسباب، وجعل الإتقان عبادة، وجعل لكل مجتهدٍ نصيبًا. قد تتعثرون أحيانًا، وقد تخيب توقعاتكم في اختبارٍ أو تدريب، لكن تذكّروا أن الطريق لا يُقاس بعثرةٍ واحدة، بل بإصراركم على النهوض في كل مرة. النجاح في الطب لا يُبنى في ليلة امتحان، بل في تراكم الأيام التي لم تستسلموا فيها.واليقين بالله هو الزاد الحقيقي في هذا الطريق. حين تضيق بكم السبل، وتثقل المسؤولية على أكتافكم، تذكّروا أن الله لا يضيع تعبًا بُذل بإخلاص، ولا دمعة قلقٍ سقطت خوفًا من التقصير. ما كان لكم سيأتيكم، وما أخطأكم لم يكن ليصيبكم. ثقوا أن تدبير الله ألطف من قلقكم، وأن تأخير بعض الأمور قد يكون عين الخير لكم.اجمعوا بين السعي الصادق والتوكل الحقيقي.

For any feedback, scan the code or click on it.

Corrections from previous versions:

Versions	Slide # and Place of Error	Before Correction	After Correction
V0 → V1			
V1 → V2			