PATHOLOGY TEAM
MED
444

MED444
KING SAUD UNIVERSITY

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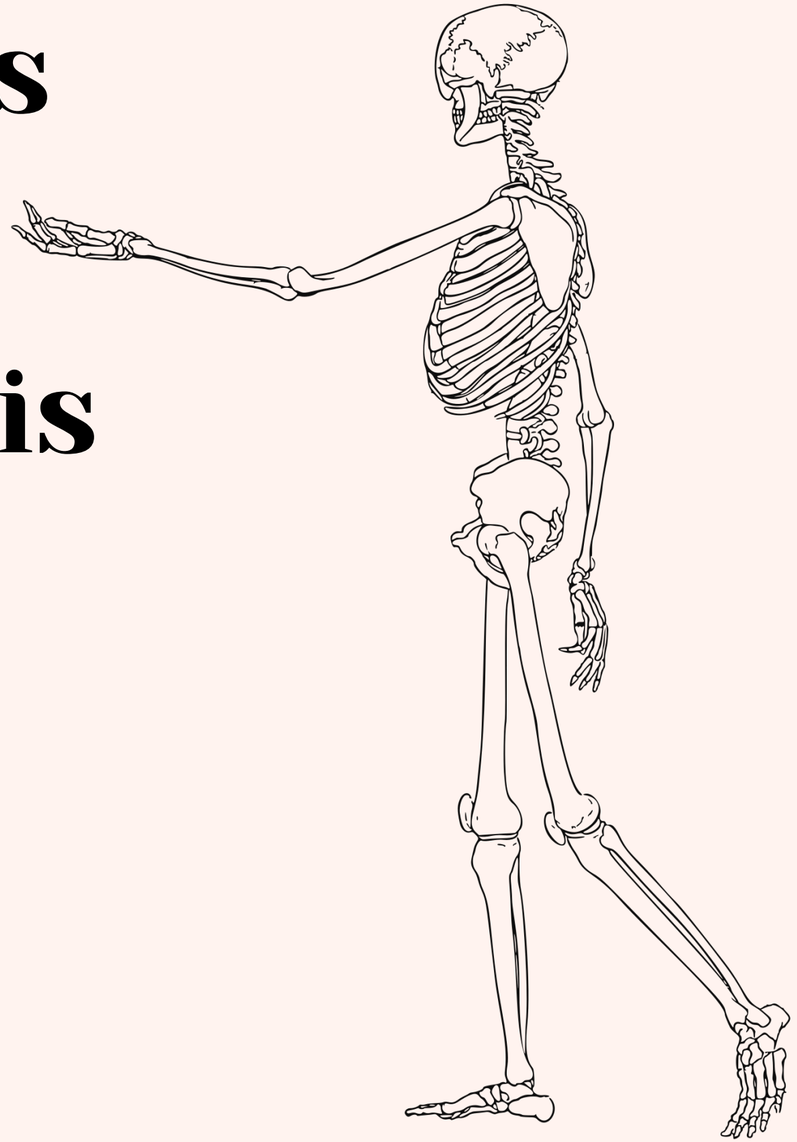
Osteomyelitis and septic arthritis



Editing File

Color index:

Main text (black)

Important (Red)

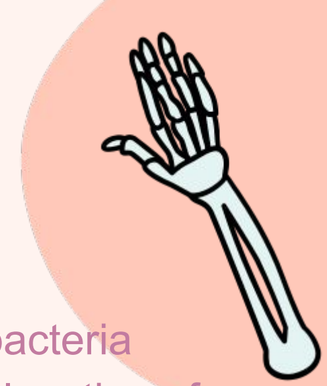
Dr.Notes (green)

Male slides only (blue)

Female slides only (pink)

Extra info(gray)

Objectives



1. Understand the etiology, pathogenesis and clinical features of osteomyelitis, list routes by which bacteria reach bone, list organisms commonly responsible for pyogenic infection in bone, understand how location of osteomyelitis is influenced by vascular supply to the bone, know morphology of acute and chronic osteomyelitis, be familiar with the terminology used: involucrum and sequestrum.

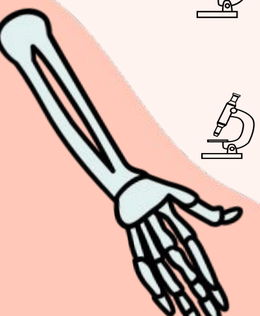
2. Be familiar with tuberculous osteomyelitis and Pott's disease, its incidence, bones affected and clinical consequences.

3. Be aware of infectious arthritis, its pathogenesis, bacteria commonly involved and characteristics of joint fluid

4. Be familiar with some of the terminology used in bone infections like: sequestrum, involucrum, Brodie abscess and Pott's disease.

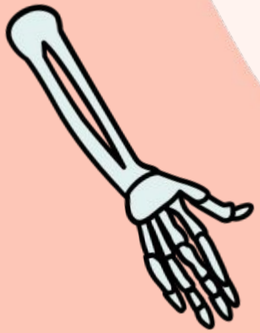
5. Understand the clinicopathological features of tuberculous osteomyelitis.

6. Identify he bacteria commonly involved in septic arthritis, the clinicopathological features and the characteristics of the joint fluid



Osteomyelitis

Definition	Denotes inflammation of bones and marrow secondary to infection
happens When	May be a complication of any systemic(الجسم كامل) infection but frequently manifests as a primary solitary(مكان واحد) focus of disease
Which organisms	All types of organisms, including viruses, parasites, fungi and bacteria can produce osteomyelitis.
Which are the most common	The most common are infections caused by certain pyogenic bacteria and mycobacteria



Osteomyelitis can be

- Part of systemic infection
- Primary solitary focus of disease

Important Page

Pyogenic osteomyelitis

Pus forming infection in bone

Pyogenic osteomyelitis is almost always caused by?

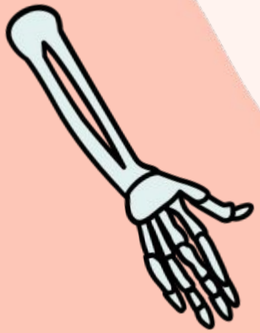
Bacteria and rarely by fungi

What is the most common bacteria?

Staphylococcus aureus is responsible for 80% to 90% the cases of pyogenic osteomyelitis in which an organism is recovered.

Why?

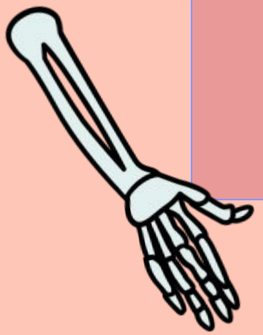
Staph. aureus expresses receptors to bone matrix components, may be related to the fact that facilitating its adherence to bone tissue.



Very important

Bacteria which are common in certain conditions:

Neonates **“ less than 1 month”**	▪ Haemophilus influenzae ▪ group B streptococci
Persons with sickle cell disease	. Salmonella enterica “ unknown why”
After genitourinary tract infection and in intravenous drug abusers	▪ Escherichia coli ▪ Klebsiella ▪ pseudomonas
After surgery or open fracture	▪ mixed bacteria



Pyogenic osteomyelitis

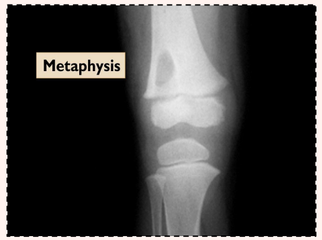
- **Is it a must to isolate bacteria in all cases of pyogenic OM? No**

In 50% of cases no organisms can be isolated

Routes of infection

- Hematogenous spread
  most common
  (من الدم)
- Extension from
  a contiguous site
  (التهاب قريب)
- Direct implantation
  after compound fractures or
  orthopedic procedures

Sites of involvement
Metaphysis



Pyogenic osteomyelitis

Deep Focus Questions

- **A patient with osteomyelitis doesn’t response to the antibiotics against staphylococcus aureus, you noticed that were bruises on his arms and around veins, your second antibiotic should be against?**

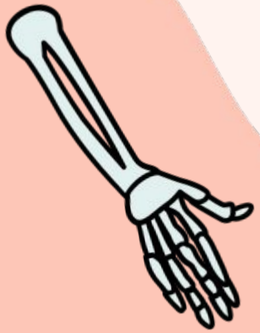
A. **Group B streptococcus**
B. **pseudomonas**
C. **Salmonella enterica**
D. **Haemophilus influenzae**

Answer: B

- **Which of the following is a causative organism of osteomyelitis predominantly in patients with sickle cell disease?**

A. **Group B streptococcus**
B. **Klebsiella**
C. **Salmonella enterica**
D. **Haemophilus influenzae**

Answer: C



Pyogenic osteomyelitis

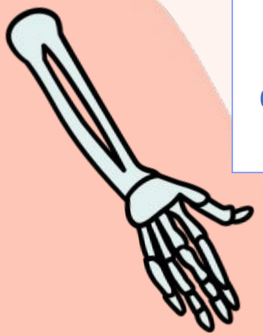
Why is this lesion in the metaphysis?

The location of the lesion depends upon the route by which bacteria gain access to the bone.

The most common route is hematogenous.

The metaphysis is quite vascular and hence is often the site where infection localizes.

Children	Adults
Most cases is hematogenous (bacteremia) in origin and develops in the long bones. From trivial mucosal injuries, such as may occur during defecation or vigorous chewing of hard foods, or from minor infections of the skin	Osteomyelitis more often occurs as a complication of open fractures, surgical procedures, and diabetic infections of the feet



Deep Focus Question

Which is best imaging modality for suspected osteomyelitis in children ?

A. X-Ray
B. Ultrasound
C. MRI
D. None

Answer: c

In female slide

Pyogenic osteomyelitis

Sites of involvement

Influenced by the vascular circulation, which varies with age.

Children	Neonates	Adults
metaphyseal	The metaphyseal vessels penetrate the growth plate, resulting in frequent infection of the metaphysis, epiphysis or both.	metaphyseal, epiphyseal and subchondral regions.

Risk factors

1- Childhood and adolescence

2- Diabetes mellitus (especially involving the foot)

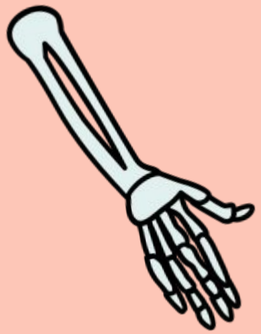
3- Compromised immunity (including AIDS)

4- Sickle-cell disease

Stages

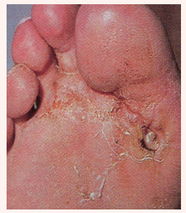
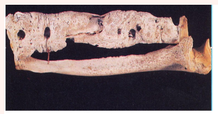
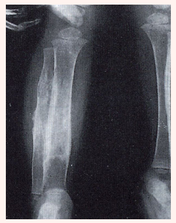
Acute → **Sub acute** → **Chronic**

Sites of infection :
The most common sites are the distal femur and proximal tibia



Pyogenic osteomyelitis

Pictures relating to osteomyelitis :

A purulent discharging ulcer at the base of the big toe in a diabetic patient	Osteomyelitis at the base of the ulcer, associated with x-ray changes, including bone erosion and sequestrum formation (dead bone)	Salmonella osteomyelitis is a common complication of sickle-cell disease.
	  The radius and ulna of an 18-th century sailor. The "granular bone" is the involucrum and the circular defects are the site through which pus drained.	

Pathophysiology

The primary site of infection is usually in the metaphyseal region, from which the infection may spread to involve the cortex and form a subperiosteal abscess; may spread into the medullary cavity and rarely may spread into the adjacent joint

First 48 hours(acute):

- Bacteria proliferation
- Neutrophilic inflammatory reaction
- Necrosis of bone cells and marrow

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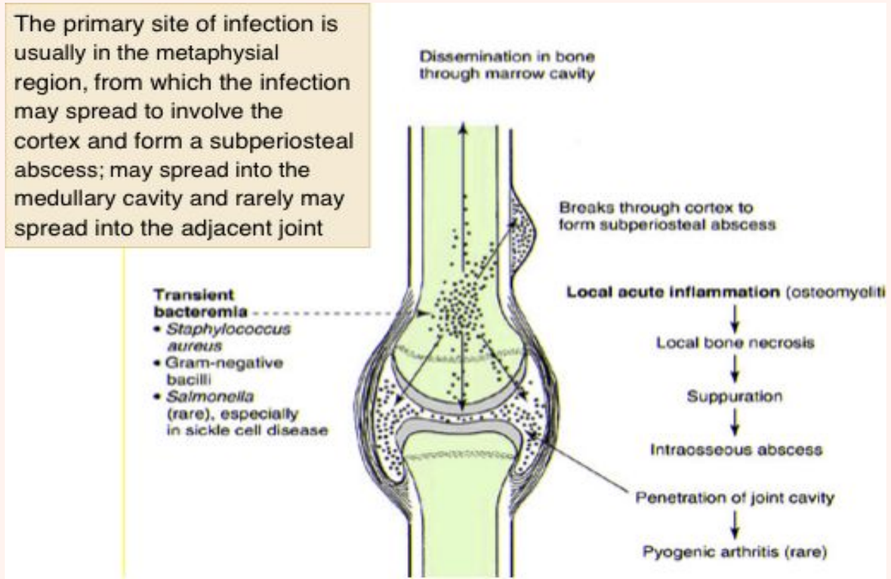
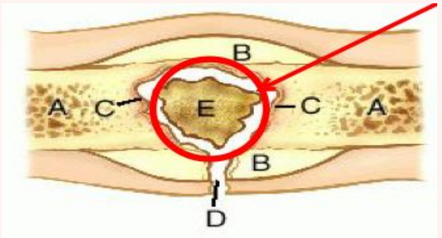


Pyogenic osteomyelitis

Pathophysiology

1. After infection, acute inflammation occur with neutrophils infiltration
2. Spread of bacteria and inflammation longitudinally within the shaft of the bone and may percolate through the Haversian systems to reach the periosteum.
3. In children, the periosteum is loosely attached to the cortex; so large subperiosteal **abscess** form that can dissect for long distances along the bone surface (occurs).
4. Lifting of the periosteum impairs the Blood supply (will be affected) contributing (leading) to necrosis of the bone within first 48 hrs
5. Further ischemia and bone necrosis occurs (Dead bone) (formation of sequestrum)Dead bone in osteomyelitis called SEQUESTRUM
6. Once localized in bone, the bacteria proliferate and induce an acute inflammatory reaction and cause bone cell death. Dead pieces of bone is known as the sequestrum (next page is the pic)
7. After first week
   - Chronic inflammatory cell become more numerous release cytokines.
   - Stimulate osteoclast bone resorption, ingrowth fibrous tissue, and deposition of reactive(new) bone at periphery(New bone may be deposited as a sleeve of living tissue known as the:
   - (shell/INVOLUCRUM(next page is the pic)

Pyogenic osteomyelitis



sequestrum

Involucrum

in male slide only

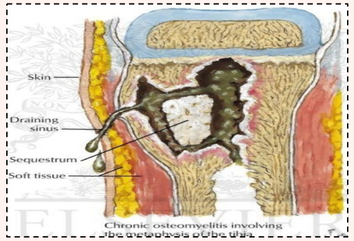
Septic (suppurative) arthritis

1. Infants (uncommon in adults)
2. Infection of epiphysis.. articular surface or along the capsule (tendoligamentous insertion)... Joint
3. Cause destruction to the articular cartilage and permanent disability
4. An analogous process can involve vertebrae, with an infection destroying intervertebral discs and spreading into adjacent vertebrae

Brodie abscess

is a small intraosseus abscess that frequently involves the cortex and is walled off reactive bone.
Rupture of the periosteum leads into soft tissue abscess which can channel to the skin lead to draining sinuses

In infants epiphyseal infection may spread to the adjacent joint and causes septic or suppurative arthritis; may lead to permanent disability

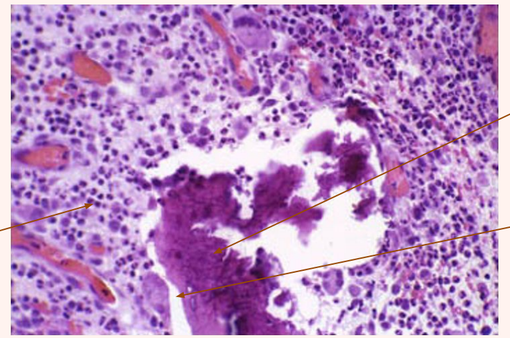


Chronic osteomyelitis involving

Small intraosseous abscess that frequently involves the cortex

Pyogenic osteomyelitis

A fragment of dead bone surrounded by numerous acute inflammatory cells.



Deep Focus Question

Patient with osteomyelitis commonly have..... C-reactive protein and erythrocytes sedimentation rate

A. High
B. Medium
C. Low
D. I don't know صعب السؤال

Answer: A

It is an inflammation all inflammation tests will be elevated

Clinical Course

- Acute systemic illness
- malaise
- fever (high graded)& chills
- leukocytosis
- marked throbbing pain over the affected region

Diagnosis

- Sign/symptoms
- X-ray
- Blood Cultures

- Biopsy
- Bone cultures

- Radiology (lytic focus of bone destruction surrounded by a zone of sclerosis)

Pyogenic osteomyelitis

Treatment

Pain relief

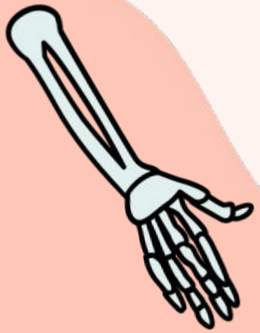
Parenteral antibiotics (means through I.V)(Requires aggressive antibiotic therapy.)

for at least 2 weeks, followed by oral antibiotics for at least 4 weeks

Surgical decompression and removal of any dead bone

Rehabilitation

Because it causes muscle weakness

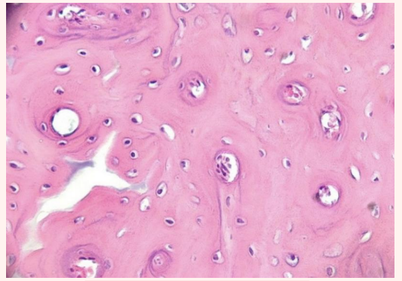


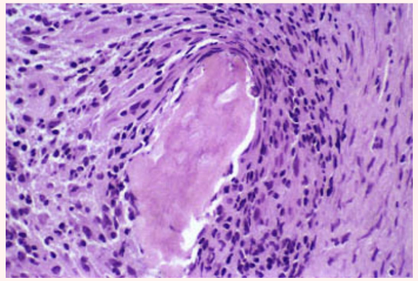
Inadequate treatment of acute osteomyelitis may lead to chronic osteomyelitis which is notoriously difficult to manage

CHRONIC OSTEOMYELITIS

▪ A bone necrotic fragment that is surrounded by a mononuclear cell infiltrate

- 5-25% persist as chronic osteomyelitis
- The course of chronic infections may be punctuated by acute flare-ups; these are usually spontaneous and may occur after years of dormancy





Normal bone

What is the significance of the presence of empty lacunae in the bone fragment?
Empty lacunae are a histologic hallmark of necrosis of bone

Causes

Delay in diagnosis → Extensive bone necrosis → inadequate antibiotic therapy → Inadequate surgical debridement → Weakened host defenses

Complications

1. Pathologic fracture
2. Secondary amyloidosis (Accumulation of abnormal protein)
3. Endocarditis (heart infraction)
4. Sepsis
5. Squamous cell carcinoma if the infection creates a sinus tract. Because of repeated inflammation and repair of tissue
6. Rarely sarcoma in the affected bone

MYCOBACTERIAL TUBERCULOUS OSTEOMYELITIS

- 1% to 3% of individuals with pulmonary or extrapulmonary tuberculosis have osseous infection.
- The bone infection may persist for years before being recognized.

Routes of entry

Usually blood borne and originate from a focus of active visceral disease.

Direct extension (e.g. from a pulmonary focus into a rib or from tracheobronchial nodes into adjacent vertebrae) or spread via draining lymphatics.

Clinical features

1. Symptoms:
pain, low-grade, fever, chills, weight loss.

2. Usually solitary except in immunocompromised patients (AIDS).

3. Caseous necrosis and granuloma are typical.

4. It tend to be more destructive and resistant to control compared to pyogenic osteomyelitis.

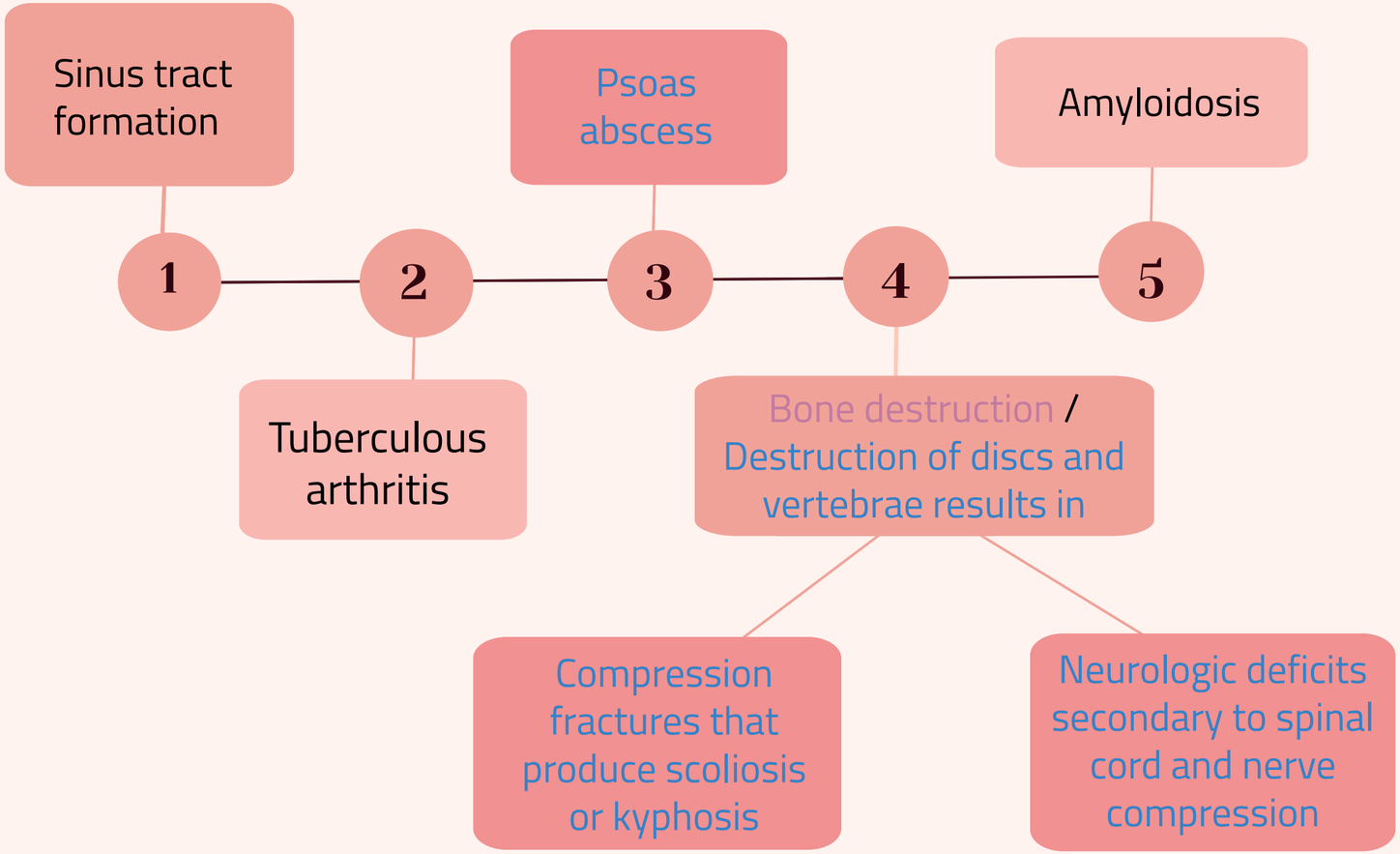
5. May form an inguinal mass " psoas abscess".

Site

The most common sites of skeletal involvement are:

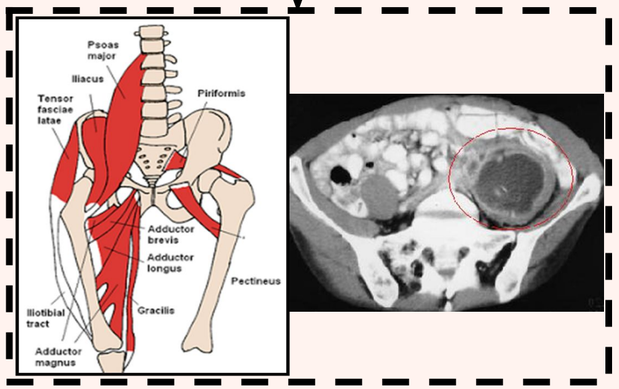
- thoracic and lumbar vertebrae followed by the knees and hips
- Pott's disease is the involvement of spine (40%) followed by the knees and hips.
- in patients with AIDS frequently multifocal

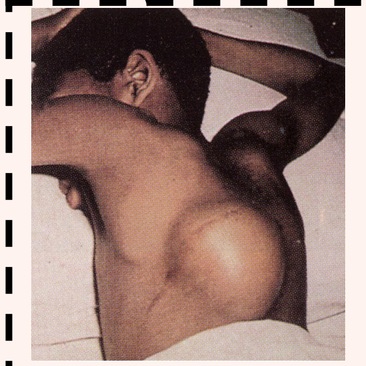
Complications



Pott’s DISEASE

In Pott’s disease, the infection may breaks through the intervertebral discs and extends into the muscle forming psoas abscess



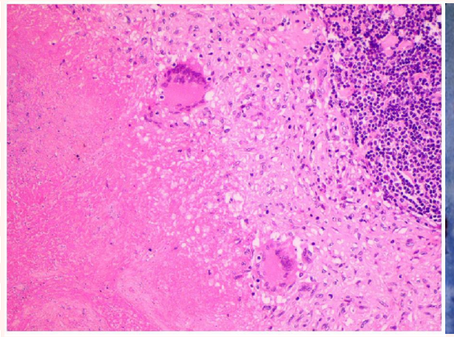


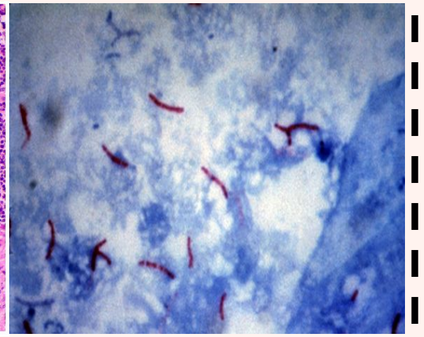
A “cold” abscess may be presenting the feature of tuberculosis of the spine, as in this child who presented with a painless loin swelling.

Tuberculous Granuloma

Histopathology : collections of epithelioid histiocytes and lymphocytes with caseation necrosis

- There is a central area of pink-staining amorphous caseous necrosis C,
- Surrounded by a zone of activated macrophages M.
- Within the macrophage layer can be seen a typical Langhan’s giant cell (arrow).
- Outside the layer of activated macrophages is a ring of lymphocytes L.





Ziehl Neelsen stain
Acid fast bacilli

Infectious Arthritis

(pyogenic, suppurative, septic arthritis)

- Infectious (septic) arthritis is serious. because it can cause rapid joint destruction and permanent deformities
- Infection of one or more joints by (microorganisms bacterial (commonest) fungal, and viral infections
- A medical emergency is caused by bacterial invasion of a joint, resulting in inflammation of the synovial lining.
- If the organisms enter the joint cavity, effusion and pus are formed, with destruction of bone and cartilage.

Risk factors

in males slide

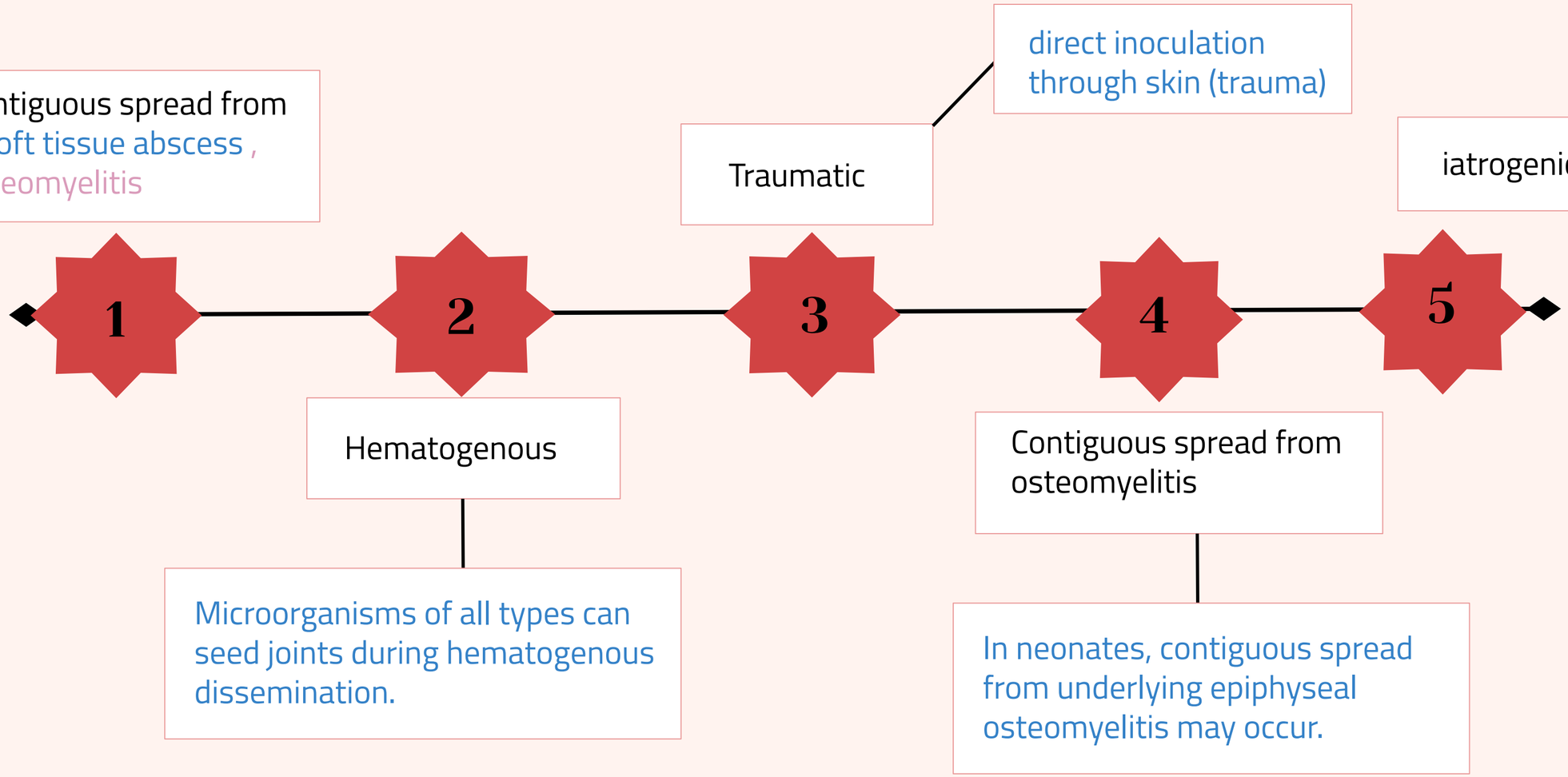
- Immune deficiencies (congenital and acquired)
- Debilitating illness
- Joint trauma
- Intravenous drug abuse (axial joints)

Risk factors

in female slide

1. Any concurrent bacterial infection (of the genitourinary or the upper respiratory tract)
2. Serious chronic illness (cancer, renal failure, rheumatoid arthritis, systemic lupus erythematosus, diabetes, or cirrhosis)
3. Alcoholics and elderly people
4. Other factors: recent articular trauma, joint surgery and intra-articular injections.
   - Both genders are affected equally
5. Diseases that depress the autoimmune system
6. I.V. drug abuse (by heroin addicts)

Routes of infection

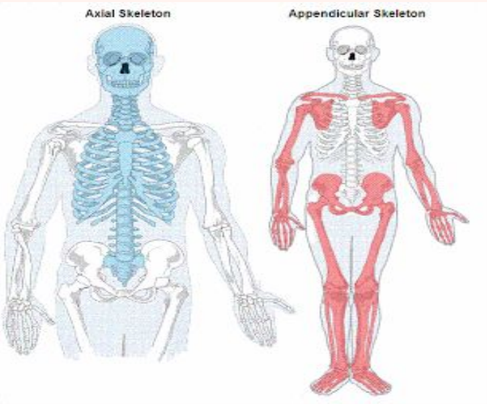


Suppurative Infectious Arthritis

any bacteria can be casual:

Haemophilus influenzae	children under age 2 years
Staphylococcus aureus	older children and adults
Neisseria gonorrhoeae Gonococcus	- late adolescence and young adulthood. - Sexually active women - Disseminated gonococcal infection in Individuals with deficiencies of complement components (C5, C6, C7, or C9)
Salmonella	sickle cell disease are prone to infection

- The infection involves only a single joint (in 90% of nongonococcal cases)
- site : usually the knee-followed in order by hip, shoulder, elbow, wrist, and sternoclavicular joints.
- Joint aspiration is typically purulent
- Culture allows identification of the causal agent.



Clinical features

Figure 1
Knee monoarthritis with inflammatory signs.

Sudden onset of pain and sudden development of an acutely painful, warm redness, and swelling of the joint with restricted range of motion.

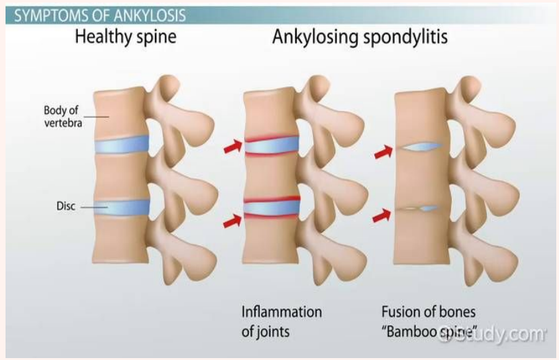
Systemic fever, leukocytosis, and elevated erythrocyte sedimentation rate are common.

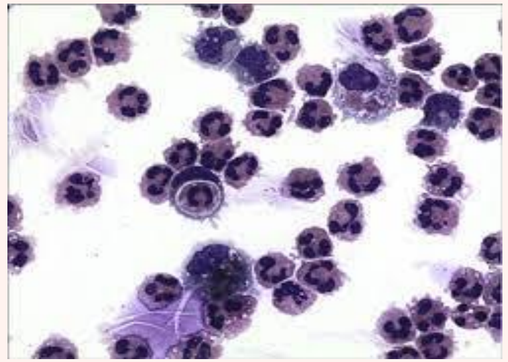
Cartilage has limited repair potential, so prompt recognition and effective antimicrobial therapy is vital to prevent permanent joint destruction

Infectious arthritis must be rapidly diagnosed and treated promptly to prevent irreversible and permanent joint damage.

Complications

- Septic arthritis can lead to ankylosis and even fatal septicemia.
- However, prompt antibiotic therapy and joint aspiration or drainage cures most patients.





MCQs

Q1. Dead pieces of bone is known as the…						
A) Involucrum		B) Brodie’s abscess		C) sequestrum		D) Periosteum
Q2. Which bacteria is responsible for 90% cases of pyogenic osteomyelitis						
A) Staphylococcus epidermidis		B) Salmonella		C) Neisseria gonorrhoeae		D) Staphylococcus aureus
Q3. What is the most common route of infection for pyogenic osteomyelitis						
A) Trauma		B) Hematogenous spread		C) Direct implantation		D) Extension of a contiguous site

1)C 2)D 3)B

MCQs

Q4:A 51 year old man with a 20 years history of rheumatoid arthritis on immunotherapy. At his last clinic appointment. He complained of increasing shortness of breath, fever, weight loss, and back pain during the last month. A chest X-ray shows lung cavitation. In addition, MRI imaging shows abscess near the lumbar vertebral bone. Serum hematology showed a normocytic normochromic anemia. What might be the cause of this pain?						
A-Brodie		B-Acute osteomyelitis		C-Tuberculous osteomyelitis		D-salmonella osteomyelitis
Q5: 0: A 26-year-old male came to the emergency department with a fever and red swelling in his right ankle joint. An aspiration was taken from the inflamed joint and culture showed Neisseria gonorrhoeae. What is the definite diagnosis?						
A-Acute osteomyelitis		B-Chronic osteomyelitis		C-Septic arthritis		D-Joint prosthesis infection
Q6:40-years-old man that has tuberculosis osteomyelitis that extended to his knee joint. What are the histological characteristics you can see under the microscope?						
A-Necrotic granulomatous inflammation		B-Synovial hyperplasia		C-Joint eburnated		D-Granulation inflammation

4-C / 5-C / 6-A

Pathology Team

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- Faisal Alamoud
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