MUSCULOSKELETAL BLOCK
Pathology

OSTEOMYELITIS and SEPTIC ARTHRITIS

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2014

Objectives

Infectious arthritis

- Pathogenesis
- Bacteria commonly involved
- Characteristics of joint fluid

Pyogenic 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 lesions
- Define the terms involucrum and sequestrum

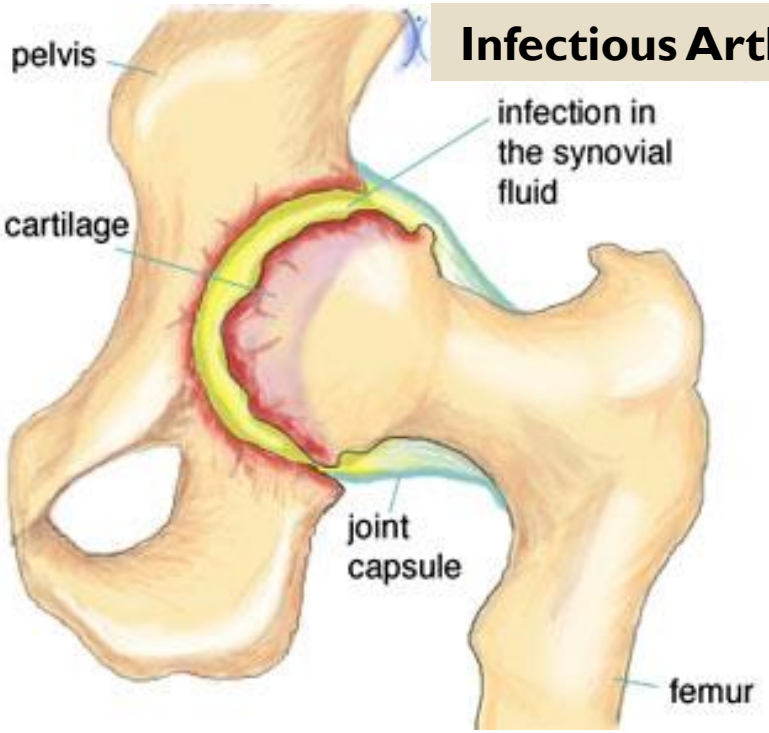
Tuberculous osteomyelitis (Pott disease)

- Incidence
- Bones affected
- Clinical consequences

Infectious Arthritis *(pyogenic, suppurative , septic arthritis)*

- Infectious arthritis is serious. Why?

because it can cause rapid joint destruction and permanent deformities



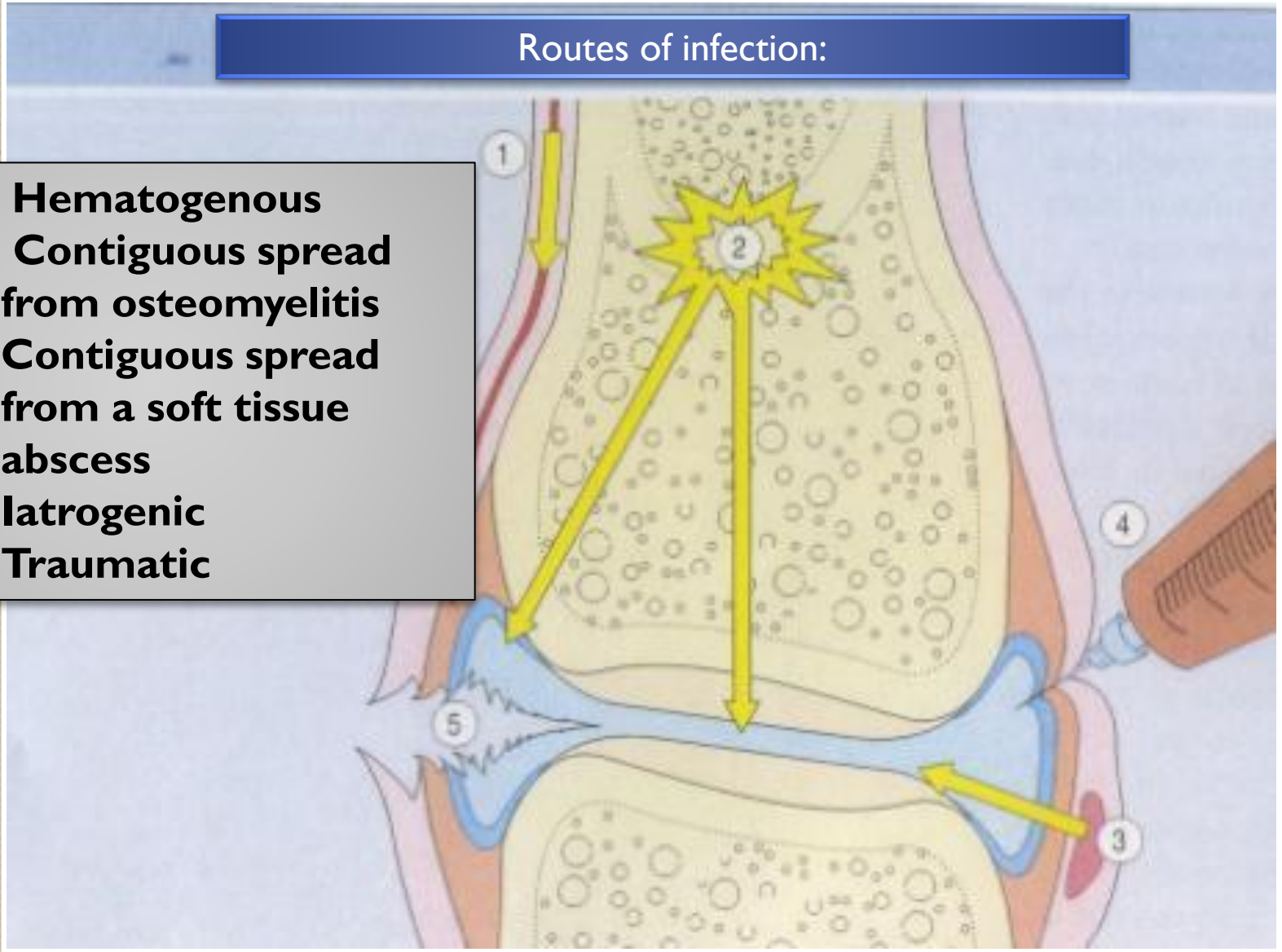
Infectious (Septic) arthritis

- A medical emergencyis 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.

Routes of infection:

1. **Hematogenous**
2. **Contiguous spread from osteomyelitis**
3. **Contiguous spread from a soft tissue abscess**
4. **Iatrogenic**
5. **Traumatic**



Risk factors

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

Infectious Arthritis

- Both genders are affected equally
- Any bacteria can be causal:
  - *Haemophilus influenzae* predominates in children under age 2 years
  - *S. aureus* is the main causative agent in older children and adults
  - *gonococcus* is prevalent during late adolescence and young adulthood.
  - Individuals with sickle cell disease are prone to infection with *Salmonella* at any age.

Infectious Arthritis

- The infection involves only a single joint
- 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.

Infectious Arthritis

Clinical features:

- sudden onset of pain
- redness, and swelling of the joint with restricted range of motion.
- Fever, leukocytosis, and elevated erythrocyte sedimentation rate

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

Figure 1
Knee monoarthritis with inflammatory signs.

Complication

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

OSTEOMYELITIS (OM)

Definition | When? | Which organisms? | Which is most common?

- Denotes inflammation of bones and marrow
- May be a complication of any systemic infection but frequently manifests as a primary solitary focus of disease.
- All types of organisms, including viruses, parasites, fungi and bacteria can produce osteomyelitis.
- The most common are infections caused by certain pyogenic bacteria and mycobacteria

PYOGENIC OSTEOMYELITIS

Cause

- is almost always caused by bacteria.

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.

PYOGENIC OSTEOMYELITIS

What is the most common bacteria?

CAUSES:

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PYOGENIC OSTEOMYELITIS

Bacteria which are common in certain conditions:

- Neonates: *Escherichia coli* and group B streptococci.
- Persons with sickle cell disease: *Salmonella*

PYOGENIC OSTEOMYELITIS

Bacteria which are common in certain conditions:

- Patients with genitourinary tract infections or with intravenous drug abusers: *E.coli*, *Klebsiella* and *Pseudomonas*

- Direct spread during surgery or open fractures (secondary to bone trauma): Mixed bacterial infections, including anaerobes

PYOGENIC OSTEOMYELITIS

Are bacteria isolated in all cases of pyogenic OM?

- In 50% of the cases no organisms can be isolated.

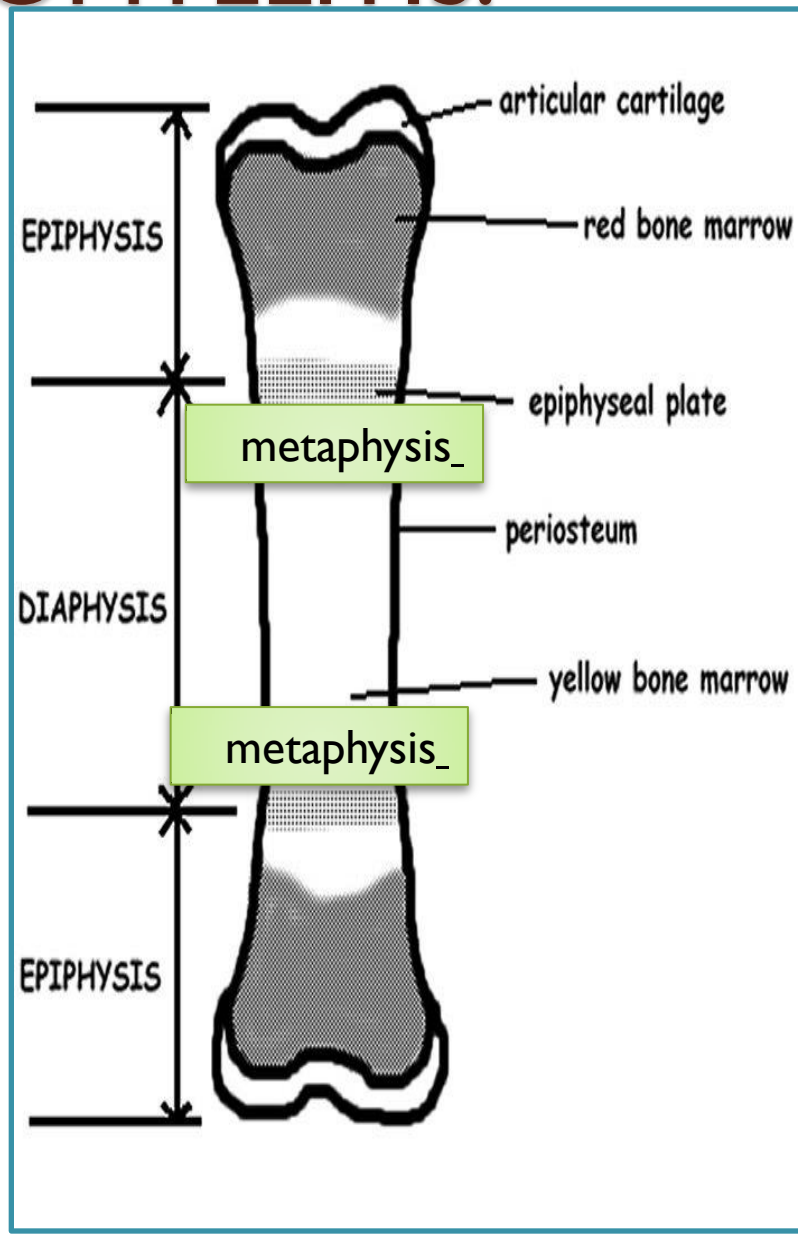
PYOGENIC OSTEOMYELITIS

Routes of infection

1. Hematogenous spread, most common.
2. Extension from a contiguous site.
3. Direct implantation.

PYOGENIC OSTEOMYELITIS:

- Sites of involvement:



PYOGENIC OSTEOMYELITIS

Sites of involvement:

- Influenced by the vascular circulation, which varies with age.
- **Neonates**: the metaphyseal vessels penetrate the growth plate, resulting in frequent infection of the metaphysis, epiphysis or both.
- **Children:** metaphyseal.
- **Adults:** epiphyses and subchondral regions.

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.

Sites of infection

- The most common sites are the distal femur and proximal tibia
- Risk factors include:
  1. childhood and adolescence
  2. diabetes mellitus (especially involving the foot)
  3. compromised immunity (including AIDS)
  4. sickle-cell disease

PYOGENIC OSTEOMYELITIS

Stages :

- Acute
- Sub acute
- Chronic.

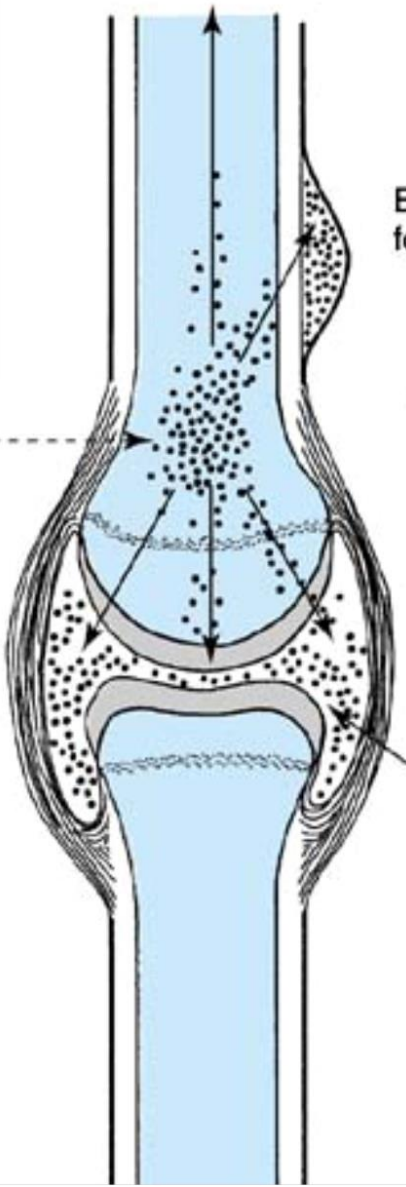
PYOGENIC OSTEOMYELITIS

Pathophysiology

- Necrosis of the bone within first 48 hrs.
- Spread of bacteria and inflammation within the shaft of the bone and may percolate through the Haversian systems to reach the periosteum.
- In children, the periosteum is loosely attached to the cortex; so large subperiosteal abscess occurs.
- Further ischemia and bone necrosis occurs.

Acute osteomyelitis

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



Dissemination in bone through marrow cavity

Breaks through cortex to form subperiosteal abscess

Transient bacteremia
- *Staphylococcus aureus*
- Gram-negative bacilli
- *Salmonella* (rare), especially in sickle cell disease

Local acute inflammation (osteomyelitis)

↓

Local bone necrosis

↓

Suppuration

↓

Intraosseous abscess

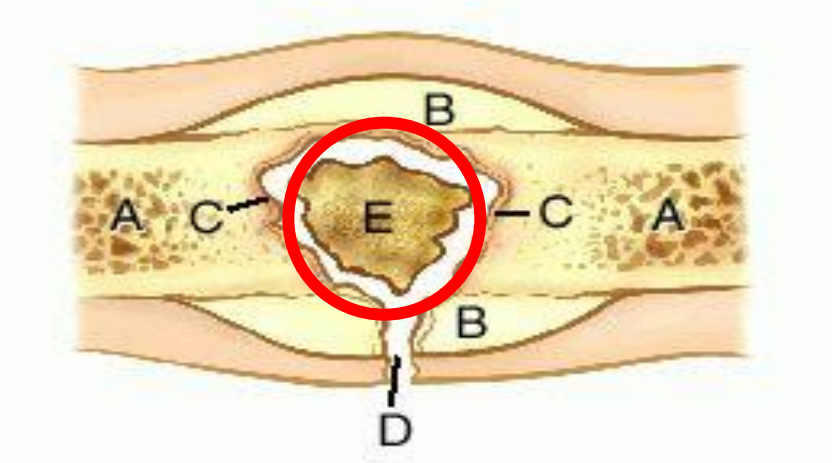
Penetration of joint cavity

↓

Pyogenic arthritis (rare)

SEQUENCE OF INFECTION:

- Once localized in bone, the bacteria proliferate and induce an acute inflammatory reaction and cause cell death.
- Dead pieces of bone is known as the **sequestrum**

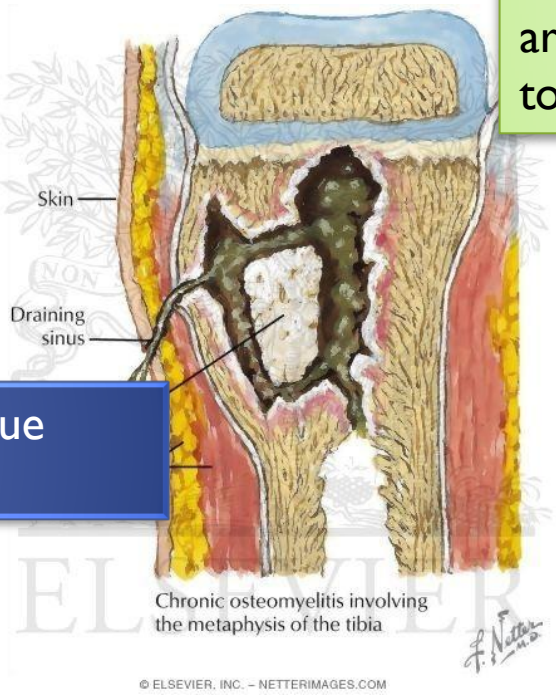


- After the first week chronic inflammatory cells become more numerous with the release of cytokines and deposition of new bone formation at the periphery.
- New bone may be deposited as a sleeve of living tissue known as the **Involucrum**

- **Brodie abscess:**

is a small intraosseus abscess that frequently involves the cortex and is walled off reactive bone.

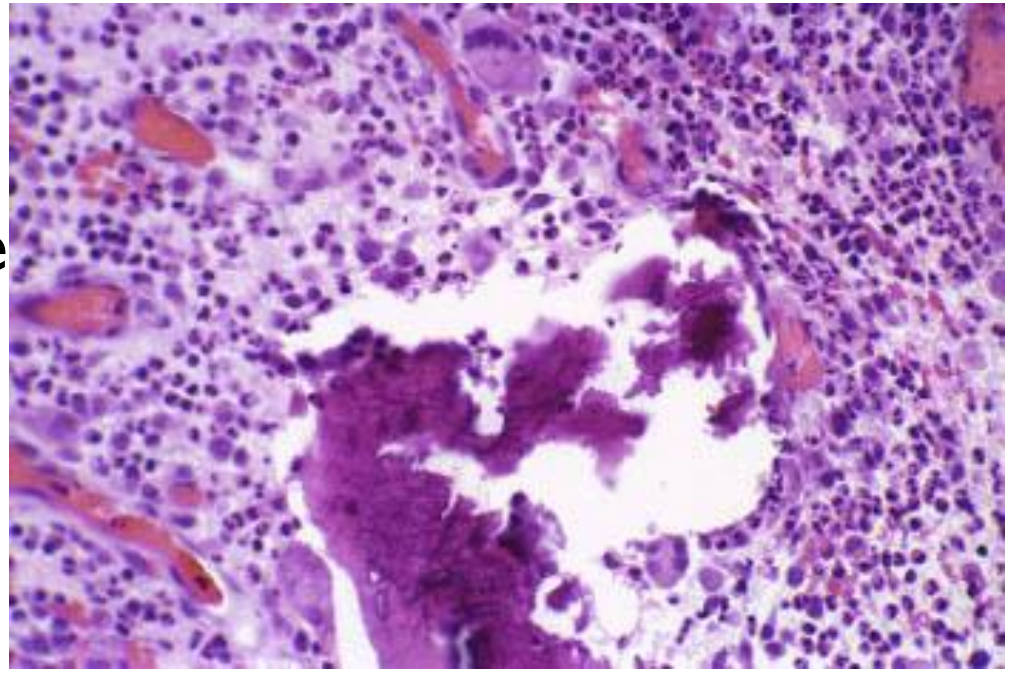
In infants epiphyseal infection may spread to the adjacent joint and causes septic or suppurative arthritis; may lead to permanent disability.



Rupture of the periosteum→soft tissue abscess formation→draining sinuses.

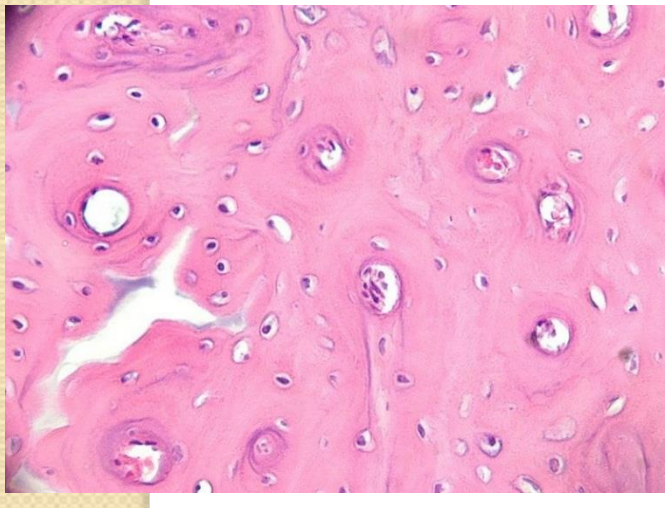
Bone, acute osteomyelitis

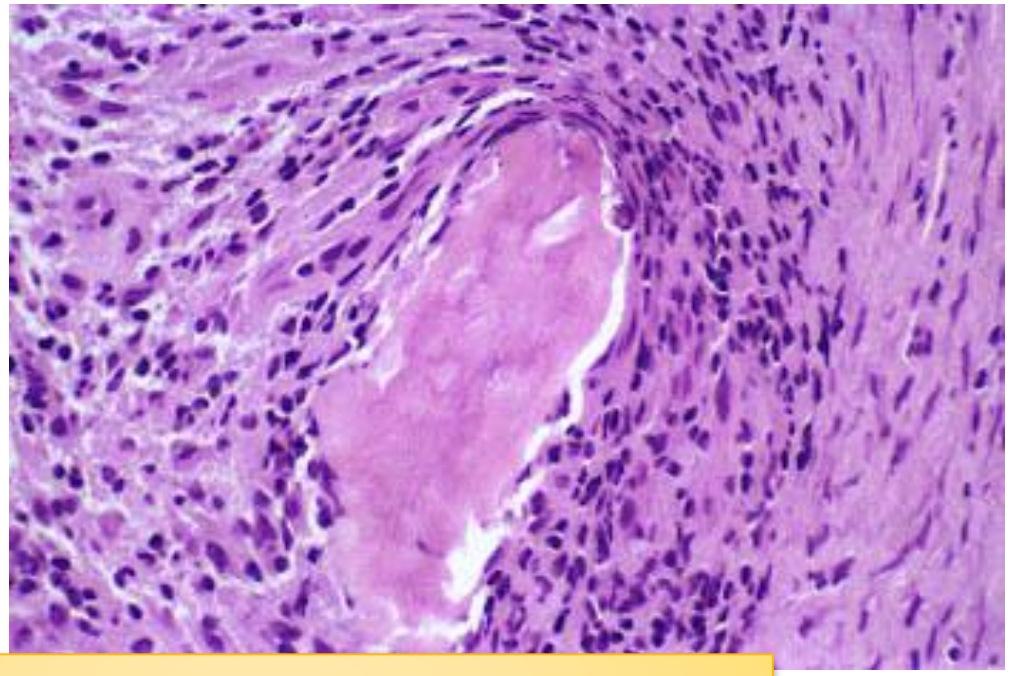
- A fragment of dead bone surrounded by numerous acute inflammatory cells



Bone, chronic osteomyelitis

- A bone necrotic fragment that is surrouded by a mononuclear cell infiltrate





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

PYOGENIC OSTEOMYELITIS

- Clinical Course:
  - Fever ,chills, malaise, marked to intense throbbing pain over the affected region.

- Diagnosis;
  - Sign/symptoms.
  - X-ray
  - Blood cultures
  - biopsy

PYOGENIC OSTEOMYELITIS

Rx :

- Pain relief
- parenteral antibiotics for at least 2 weeks, followed by oral antibiotics for at least 4 weeks
- surgical decompression and removal of any dead bone
- rehabilitation.

- Chronicity may develop with:
  1. delay in diagnosis
  2. extensive bone necrosis
  3. abbreviated antibiotic therapy
  4. inadequate surgical debridement,
  5. weakened host defenses.

PYOGENIC OSTEOMYELITIS

- Complications:
  1. Pathologic fracture.
  2. Secondary amyloidosis
  3. Endocarditis
  4. Sepsis
  5. Squamous cell carcinoma if the infection creates a sinus tract.
  6. Rarely sarcoma in the affected bone

Tuberculous osteomyelitis

Routes of entry;

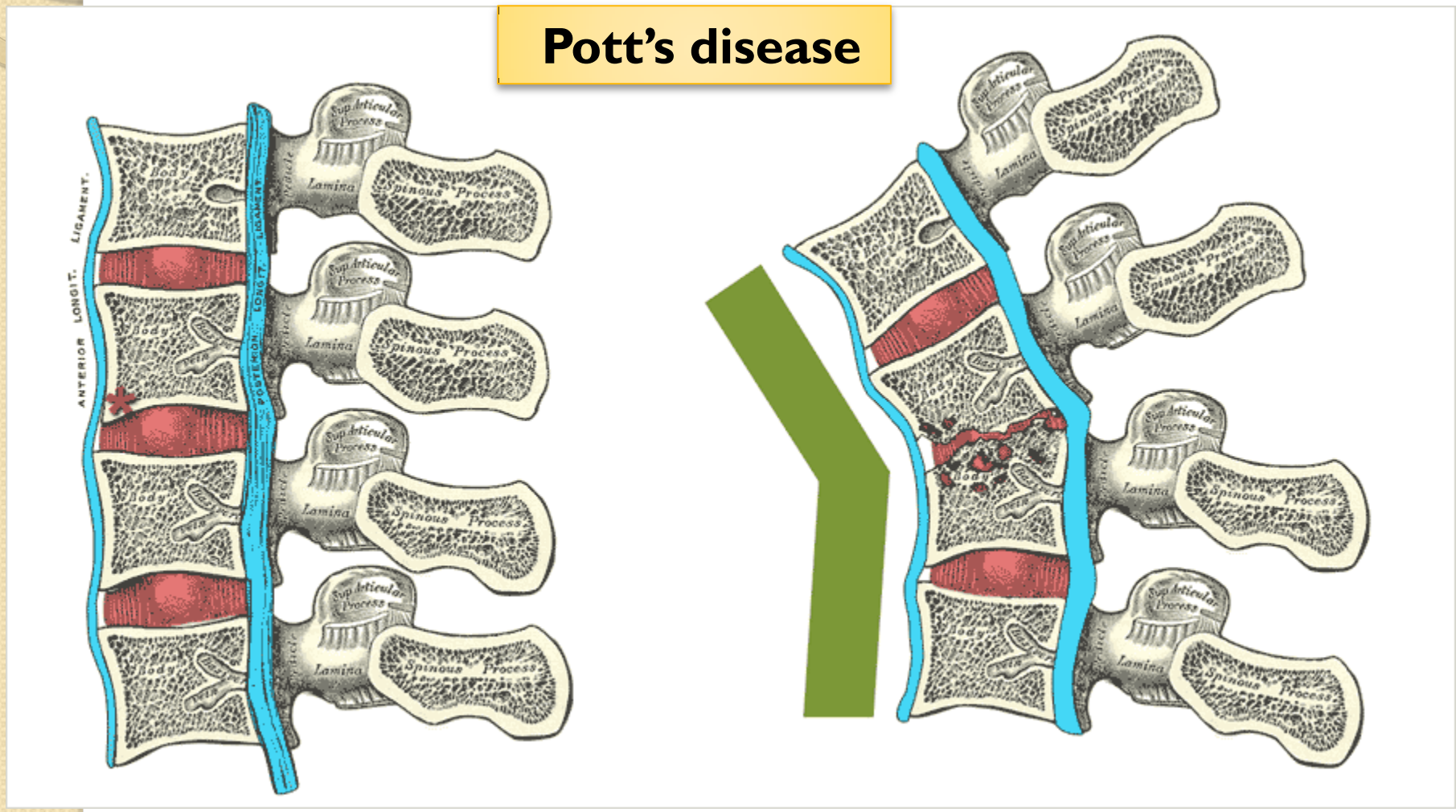
1. Usually blood borne and originate from a focus of active visceral disease.
2. Direct extension (e.g. from a pulmonary focus into a rib or from tracheobronchial nodes into adjacent vertebrae) or spread via draining lymphatics.

Tuberculous osteomyelitis

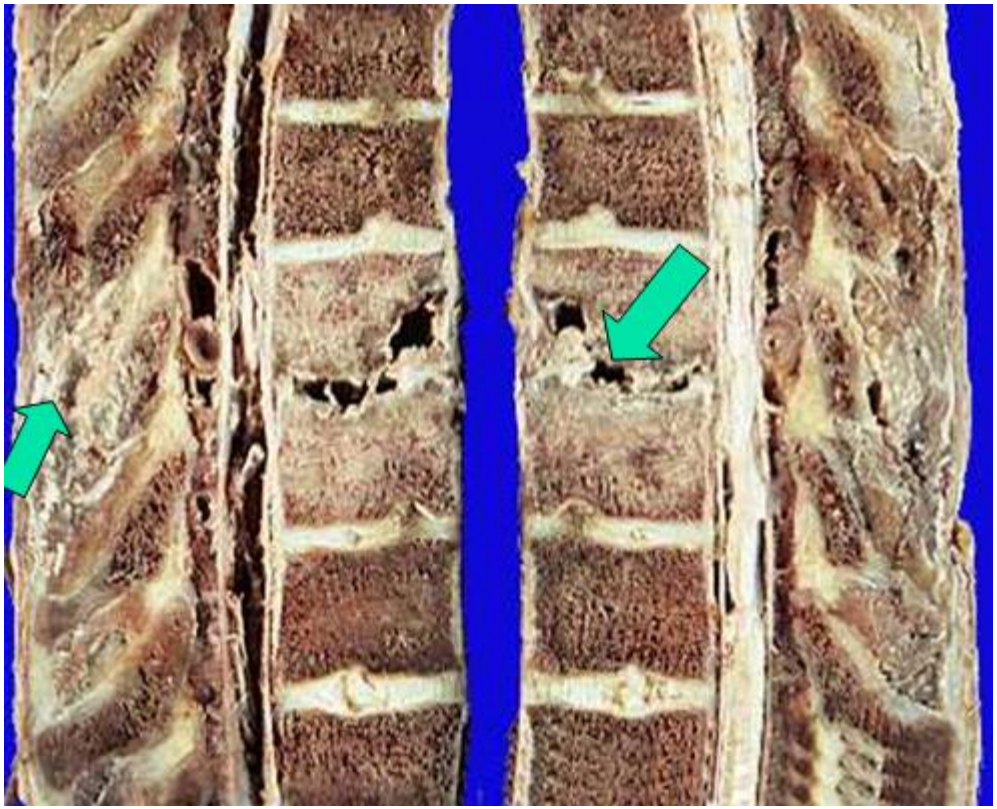
- The most common sites of skeletal involvement are:
  - thoracic and lumber vertebrae followed by the knees and hips
- Pott's disease is the involvement of spine

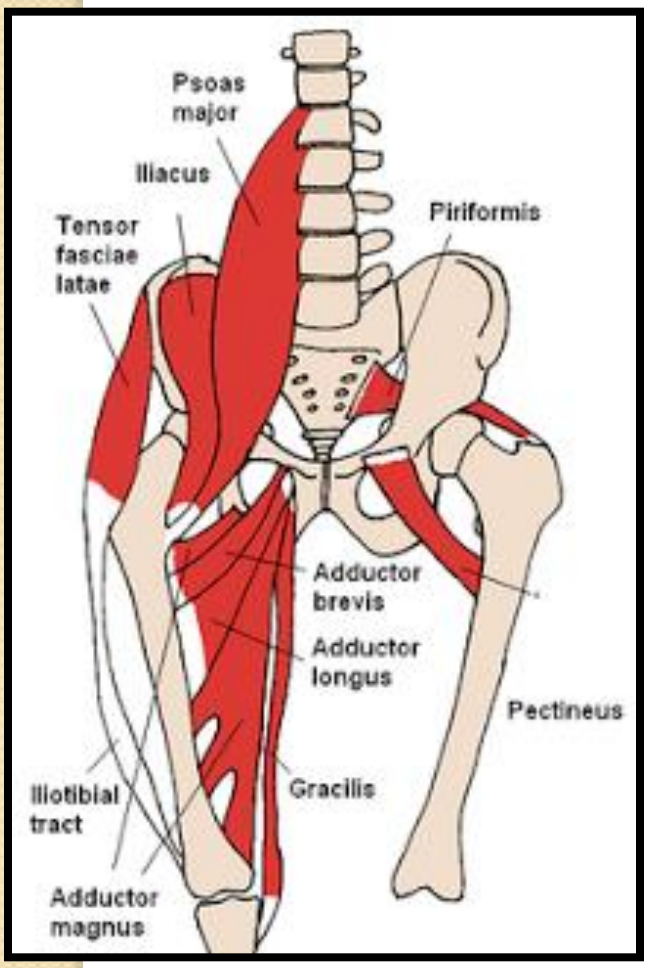
In patients with AIDS frequently multifocal

- The infection breaks through the intervertebral discs and extends into the soft tissues forming abscesses.



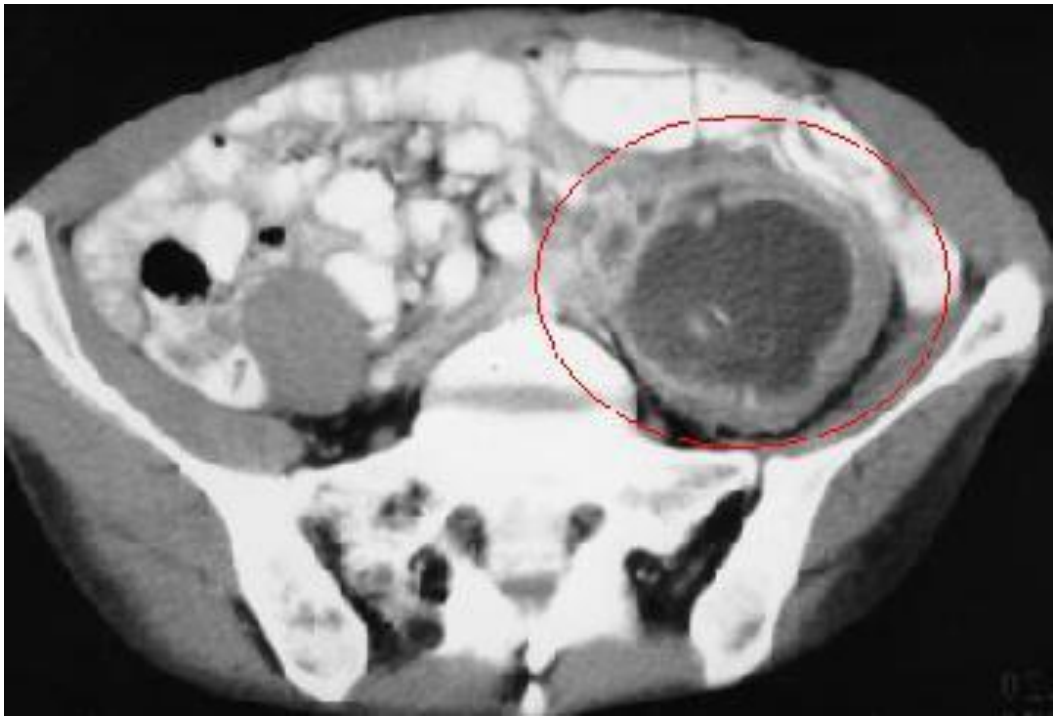
Tuberculous osteomyelitis
Pott's disease





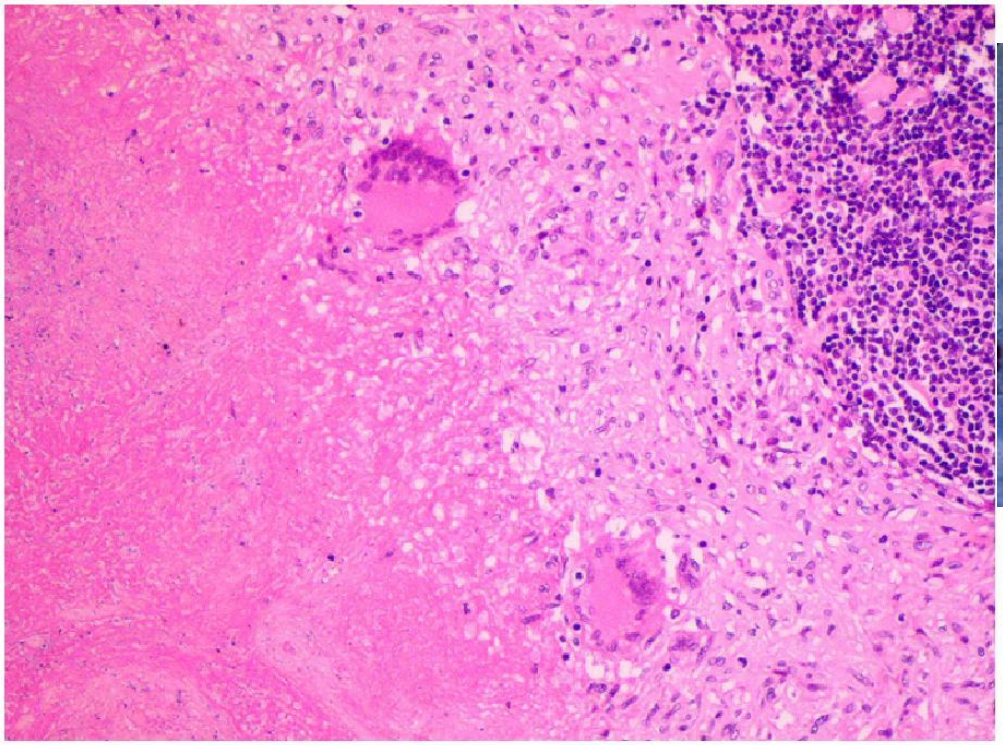
In Pott's disease, the infection may breaks through the intervertebral discs and extends into the muscle forming

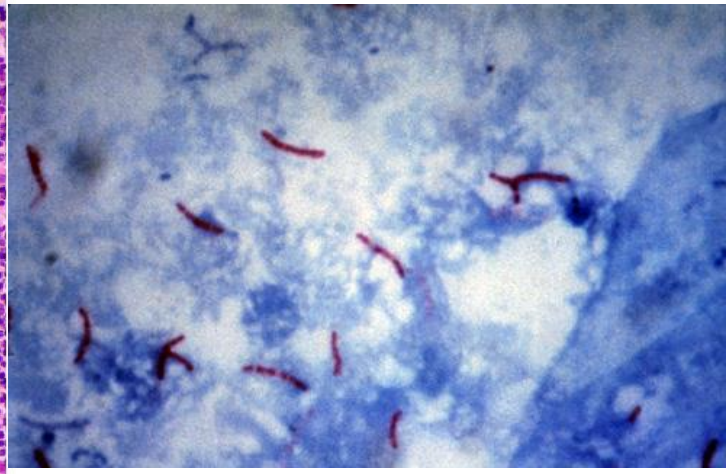
Psoas abscesses



Tuberculous osteomyelitis

- Histopathology: collections of epithelioid histiocytes and lymphocytes with caseation necrosis





Ziehl Neelsen stain

Tuberculous osteomyelitis

Clinical features :

- Pain
- Fever
- Weight loss
- May form an inguinal mass " psoas abscess".

Tuberculous osteomyelitis

Complications

- Bone destruction
- Tuberculous arthritis
- Sinus tract formation
- Amyloidosis