Pathology - Topic 32 - Bone and soft tissue

Osteomyelitis

- Osteomyelitis is infection of bone and marrow.

Routes of Bone Infection

- Organisms can arrive through blood, enter after trauma or surgery, or spread from neighbouring infected tissue.

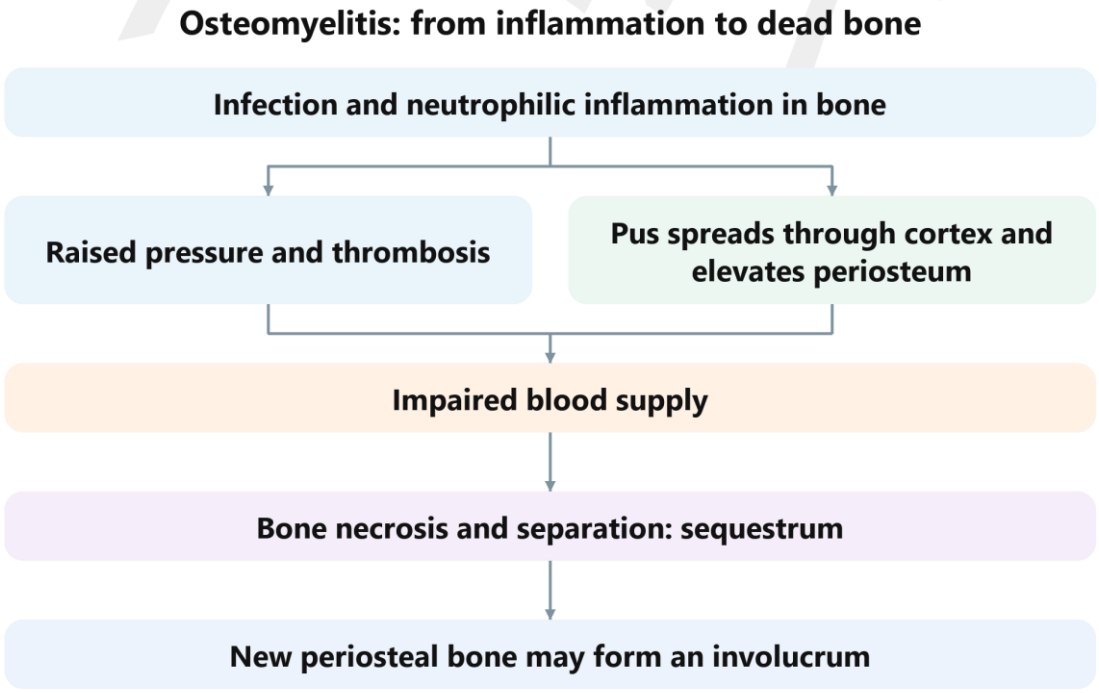
Organisms and Patient Associations

- Staphylococcus aureus is an important cause of pyogenic disease.
- Other organisms depend on age, exposure, immune state and the route of entry.
    - Salmonella is a recognised association in sickle-cell disease, but it is not the only organism that can infect bone in this setting.

Age-related Anatomical Patterns

- Haematogenous disease in children commonly involves the metaphysis of a long bone.
- Adult infections more often involve vertebrae or sites affected by surgery, trauma or vascular disease.

Acute Injury and Progression



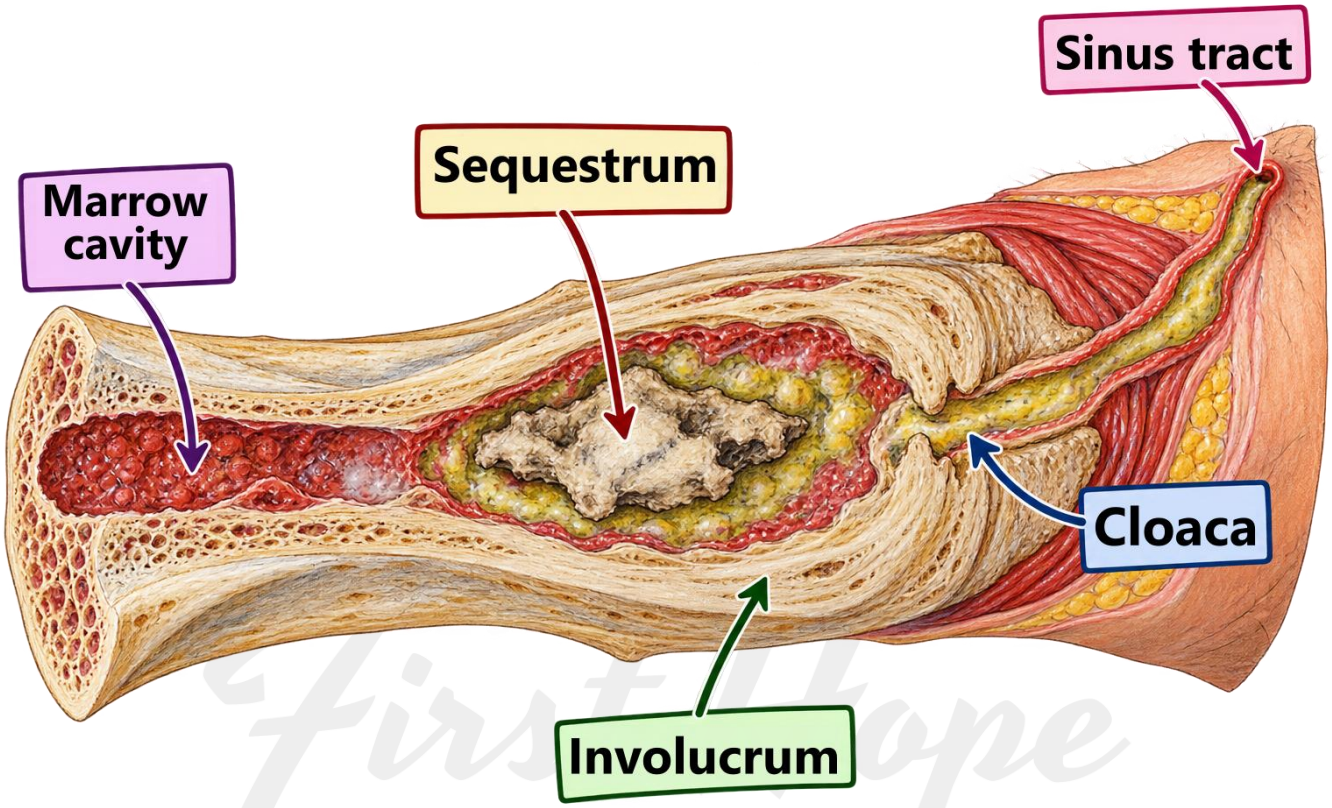
- Neutrophils accumulate in marrow spaces and release destructive enzymes.
- Rising pressure and vascular thrombosis impair blood supply to bone.
- Pus can extend through the cortex and lift the periosteum.
- Loss of both internal and periosteal supply allows a segment of bone to die.

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- The extent of damage depends on organism virulence, perfusion and the speed of host response.

- In growing long bones, metaphyseal vascular loops favour bacterial seeding, while local thrombosis and rising pressure compromise perfusion.

Chronic Morphology



Dead bone and new periosteal bone in chronic osteomyelitis

- A **sequestrum** is a separated piece of dead bone within an infected area.
- New periosteal bone may surround it as an **involucrum**.
- A cloaca is an opening in involucrum through which pus may drain, sometimes reaching skin through a sinus tract.
    - A Brodie abscess is a localised subacute intraosseous abscess with surrounding reactive sclerosis and can mimic a bone tumour radiologically.
- Microscopy shows necrotic bone with empty lacunae, inflammatory cells and granulation tissue.
- Chronic lesions contain fibrosis and reactive new bone as well as residual infection.

Acute and Chronic Clinical Features

- Pain, fever, swelling and reduced limb use are common acute features.
- Chronic disease may present with persistent pain or a draining sinus and less obvious systemic illness.

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Imaging Findings

- Early plain radiographs can be normal.
- Later findings include bone destruction, periosteal reaction and sclerosis, while MRI detects marrow and soft-tissue involvement earlier.

Laboratory Evidence and Diagnostic Correlation

- Inflammatory markers support assessment but are not specific.
- Blood cultures and properly obtained deep tissue or bone cultures are more useful than a superficial sinus swab for identifying the cause.
    - Imaging and sampling are interpreted together because tumour, fracture and infection can overlap in appearance.

Complications and Tuberculous Disease

- Complications include chronic infection, pathological fracture, growth disturbance, septic arthritis and sepsis.
- Long-standing draining sinuses rarely develop squamous carcinoma.
- Tuberculosis produces granulomatous inflammation with caseation and can spread between adjacent vertebral bodies.
- Vertebral collapse may produce angular deformity in Pott disease.
    - A relatively indolent paravertebral collection is often called a cold abscess.
    - Epidural extension can compress the spinal cord.

Paget Disease of Bone

- Paget disease is a focal disorder of excessive and disorganised bone remodelling.

Disordered Remodelling

- It may involve one bone or several bones.
- An initial osteoclast-dominant phase is followed by increased osteoblastic activity and then a more sclerotic phase.
- Genetic susceptibility, including SQSTM1-related changes in some families, contributes.
    - The enlarged bone is structurally abnormal and can be weaker despite its increased mass.

Microscopic and Gross Bone Changes

- Microscopy shows irregular fragments of lamellar bone separated by prominent cement lines, creating a **mosaic pattern**.
- Active lesions contain numerous osteoclasts and vascular fibrous marrow.

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- Affected bones may become enlarged, thickened and deformed.

Imaging and Biochemical Findings

- Radiographs can show mixed lytic and sclerotic areas, cortical thickening and altered trabeculae.
- Serum alkaline phosphatase often rises with active extensive disease, while calcium and phosphate are usually normal. A normal total alkaline phosphatase does not exclude limited disease.

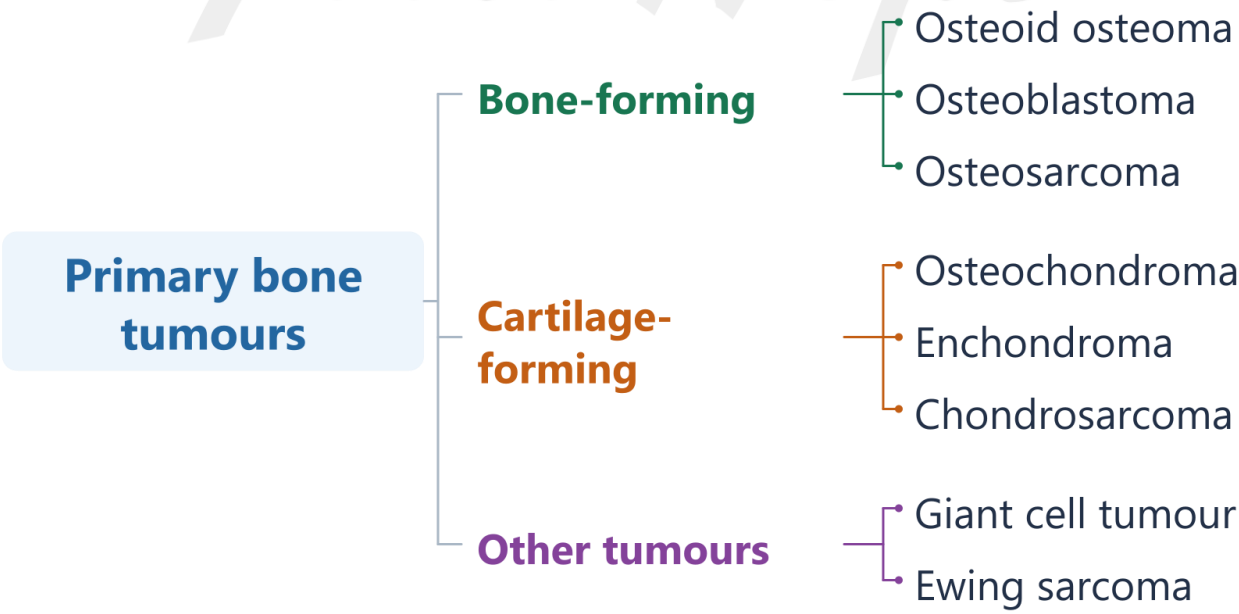
Clinical Effects and Complications

- Pain, deformity, fracture and nerve compression may occur.
    - Skull involvement can contribute to hearing loss.
- High-output cardiac strain is uncommon and mainly associated with extensive active disease.
- Rarely, a sarcoma develops in affected bone.

Bone Tumours

- Bone tumours are classified by the tissue or cell type they produce, their molecular features and their behaviour.

Principles of Classification and Assessment



Classification and Metastatic Disease

➢ Metastatic carcinoma is more common than primary malignant bone tumour in adults.

Age, Location and Imaging Assessment

➢ Age, exact bone location and imaging pattern are essential parts of pathological interpretation. A biopsy should not be interpreted without this information.

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- Epiphysis, metaphysis and diaphysis have different common tumour patterns.
- Matrix mineralisation and the border of the lesion provide further clues.

Growth-pattern Clues and Diagnostic Limits

- A sharply defined lesion with a sclerotic rim often grows slowly.
- An ill-defined destructive lesion, cortical breach and aggressive periosteal reaction raise concern for aggressive disease but are not tumour-specific.
- Metaphyseal lesions in adolescents suggest a different differential from epiphyseal lesions after physeal closure or diaphyseal round-cell tumours.
- Osteosarcoma commonly involves the metaphysis, chondroblastoma the epiphysis of an immature skeleton and giant-cell tumour the epiphysis of a skeletally mature patient.
  - These distributions guide probability and sampling rather than proving histology.

Bone-Forming Tumours

1. Osteoid Osteoma and Osteoblastoma

- Osteoid osteoma is a small benign bone-forming tumour with a central nidus surrounded by reactive sclerosis.
- It commonly causes night pain that improves with anti-inflammatory medication.
- The nidus contains woven bone and osteoid lined by osteoblasts within vascular stroma.
- Osteoblastoma has related histology but is generally larger and often affects posterior spinal elements.
  - Pain in osteoblastoma is less characteristically relieved by anti-inflammatory medication.
  - Size and location help distinguish the lesions.

2. Osteosarcoma

Definition and Predisposition

- Osteosarcoma is a malignant mesenchymal tumour in which tumour cells directly produce osteoid.
- Inherited RB1 and TP53-related predisposition are important associations in some patients.

Primary and Secondary Osteosarcoma

i. Primary Conventional Disease

- Conventional high-grade tumours often occur during adolescent skeletal growth and show destructive metaphyseal growth with soft-tissue extension.
- A sunburst periosteal reaction or Codman triangle supports aggressive bone injury but is not specific for osteosarcoma.

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