Inflammation is the body’s response to chemical, physical, or microbial injury. First, the inflammatory response destroys the causative agent and walls off the injured area. Second, it sets up an environment for repair of the injured tissue.

Definitions

**Ostetis** – inflammation of bone.

**Osteomyelitis** – Inflammation of bone and bone marrow.

Etymology: Gk *osteon* (bone) + *muelinos* (marrow).

Inflammatory process is rarely confined to the endosteum and therefore definition includes entire bone including the cortex and the periosteum.

True infection of the bone induced by pyogenic microorganisms – though trauma, radiation and chemicals can cause inflammation of the medullary cavity.

Classification – based on Clinical Features

I. Acute/subacute osteomyelitis
II. Secondary chronic osteomyelitis
III. Primary chronic osteomyelitis

Classification – based on Aetiology, Clinical, Radiological features

I. Suppurative osteomyelitis
   1. Acute suppurative osteomyelitis
   2. Chronic suppurative osteomyelitis
      a) Primary chronic suppurative osteomyelitis
      b) Secondary chronic suppurative osteomyelitis
   3. Infantile osteomyelitis
II. Non-suppurative osteomyelitis
   1. Chronic sclerosing osteomyelitis
      a) Focal sclerosing osteomyelitis
      b) Diffuse sclerosing osteomyelitis
   2. Actinomycotic osteomyelitis
   3. Radiation osteomyelitis and necrosis
   4. Garré’s sclerosing osteomyelitis

Topazian, 1996
Definitions of Terms

- **Acute osteomyelitis** – less than 1 month duration
- **Subacute osteomyelitis** – transitional stage from acute to chronic
- **Chronic osteomyelitis** – more than 1 month duration
- **Suppurative osteomyelitis** – presence of pus, fistula, or sequestrum
- **Non-suppurative osteomyelitis** – lack pus, fistula, or sequestrum

**SAPHO syndrome** – syndrome associated with synovitis, acne, pustulosis, hyperostosis, and osteitis – described by Chamot et al, 1986

**Chronic recurrent multifocal osteomyelitis (CRMO)** – characterized by periods of exacerbations and remissions over many years

**Garrès Osteomyelitis (periostitis ossificans)** – periosteal inflammatory reaction to many nonspecific stimuli, leading to the formation of an immature type of new bone outside the normal cortical layer

**Aetiology**

**Infants (<1 year)**
- Group B streptococci, Staph. aureus, E. coli

**Children (1 to 16 years)**
- Staph. aureus, Strep. pyogenes, Haem. influenzae

**Adults (>16 years)**
- Staph. epidermidis, Staph. aureus, Pseudomonas aeruginosa, Serratia marcescens, E. Coli
- Others: Tuberculosis, mucormycosis, aspergillosis, candidiasis

**Aetiology – Microbiological factors**

- **Induced by haematogenous spread**
  - Neonatal, tooth germ associated
- **Extension from a local infection:**
  - Trauma/fracture related - esp compound fractures
  - Odontogenic - infected pulp or periodontal tissue or infected pericoronal tissue from retained teeth, esp 3rd molars
  - Foreign body, transplant/implant-induced
  - Associated with bone pathology and/or systemic disease

**Pathogenesis – predisposing factors**

- **Diabetes mellitus**
- **Autoimmune disorders**
- **AIDS**
- **Agranulocytosis**
- **Anaemia (especially sickle cell)**
- **Leukaemia**
- **Syphilis**
- **Renal or hepatic failure**
- **Chronic hypoxia**
- **Malnutrition**
- **Chemotherapy**
- **Corticosteroid and other immunosuppressive therapy**
- **Alcohol and tobacco**
- **Drug abuse**
- **Prior major surgery**
- **Herpes simplex virus (Zoster) and cytomegalovirus infection**
- **Extremes of age**
Pathogenesis – Mechanism 1

- **Haematogenous or Contiguous (direct entry)**
- **Entry of Organisms into bone**
- **Formation of pus; ↑ed intra-osseous pressure**
- **Ischaemia from slowing of blood flow - Thrombosis**
- **Bone Necrosis (sequestrum) - surrounded by new bone (involucrum)**

Pathogenesis – Mechanism 2

- **Spread of Pus / Infection**
- **Spread thru' Haversian system / Nutrient canals**
- **Elevation of periosteum**
- **Ischaemia from disruption of blood supply**
- **Bone Necrosis (sequestrum) - surrounded by new bone (involucrum)**

Stages of Osteomyelitis

- **INFECTION & INFLAMMATION**
- **SUPPURATION**
- **SEQUESTRUM**
- **INVLUCRUM**
- **RESOLUTION**

Demographics

- **More in developing countries**
- **No race predilection**
- **More in males than females (M:F ➔ 2:1)**
- **Age predilection:**
  - Acute haematogenous osteomyelitis – children
  - Contiguous focus osteomyelitis – adults and adolescents
- **More common in mandible than maxilla**
  - In children more common in maxilla! Why?

Why mandible is more affected than maxilla?

- The maxillary blood supply is more extensive.
- Thinner cortical plates and the paucity of medullary tissues in the maxilla prevent confinement of infections within the bone
- Permit dissipation of edema and pus into the soft tissues

Clinical Features

- Abrupt onset of high fever
- Fatigue, Irritability, Malaise
- Restriction of movement
- Local edema, erythema, and tenderness
- Paresthesia or anesthesia of the lower lip may occur (Vincent’s symptom)
- Presence of sinus with purulent discharge may be present
- A fetid oral odor (due to anaerobic pyogenic bacteria) often present.
- ↑ed mobility of teeth ➔ lead to malocclusion and show decreased or loss of sensitivity.
Clinical Features – pus in the sulci

Osteomyelitis – Clinical features & Gross Pathology

Lab investigations

- WBC: May be elevated. Usually normal
- C-Reactive Protein (CRP)
- ESR: usually elevated initially, falls with successful therapy
- Blood culture +ve > 50%

Radiological features

- Not usually present, because nearly 60% of bone has to be destroyed to be seen clearly on the radiograph
- If present, diffuse rarefaction (radiolucency)
- Radiographic evidence of aetiology

Radiological features

Other Imaging methods

- MRI: early detection
- Scintigraphy: Radionuclide bone scan – Technetium 99m
  - +ive within 24 hrs of infection
  - Can detect multiple areas of involvement
  - False +ive: tumour, cyst, abscess, cellulitis
- CT scan
  - Useful for localization of lesion for biopsy
- Ultrasonography
  - Simple and inexpensive; +ive within 1-2 days of onset
Histopathology

Presence of
- pus in the bone marrow spaces
- osteoclastic activity
- sequestrum – bone with empty lacunae

Histopathology – Acute

Histopathology – Acute

Histopathology – Acute

Management

- Antibiotics
- Drainage
- Sequestrectomy and bone replacement

Secondary Chronic Osteomyelitis

Osteomyelitis greater than 1 month duration
Acute & Secondary chronic osteomyelitis

Features
- Dull pain
- Painful swelling caused by local edema and abscess formation in the acute stage is subsided by a harder palpable tenderness caused by periosteal reaction
- Fetid odour is less frequent
- Disturbed occlusion
- Pathological fracture
- Sequestra, pus and fistulae may be present
- Radiologically may show a diffuse sclerosis with little to no osteolysis

Radiological features
- Soft tissue swelling
- Periosteal elevation
- Lytic changes – subtle, irregular, ill-defined, predominantly radiolucent – Moth-eaten appearance
- Sclerotic changes – due to stimulation of surrounding bone
- Widening of the periodontal ligament space
- Sequestrum more often identified at surgical exploration than at radiography
**Histopathology**

**Management**
- Antibiotics
- Drainage
- Sequestrectomy and bone replacement

**PRIMARY CHRONIC OSTEOMYELITIS**
Non-suppurative chronic inflammation of the jawbone with the absence of pus formation, extra- or intraoral fistula, or sequestration. No previous acute phase.

**Features**

<table>
<thead>
<tr>
<th>Type</th>
<th>Aetiology</th>
<th>Clinical Features</th>
<th>Radiographic Features</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Focal sclerosing (Condensing osteitis)</td>
<td>Low-grade focal bone irritation (pulpitis)</td>
<td>Asymptomatic, found on routine examination</td>
<td>Opaque mass at root apex</td>
<td>Treat the cause</td>
</tr>
<tr>
<td>Diffuse sclerosing</td>
<td>Low-grade infection (pulpitis, periodontalitis)</td>
<td>Occasional pain, swelling, drainage</td>
<td>Opacification throughout jaw</td>
<td>Treat the cause; Antibiotics</td>
</tr>
<tr>
<td>Garré’s</td>
<td>Periapical infection</td>
<td>Assoc with lower molar; children</td>
<td>Periodontal new bone in layers</td>
<td>Extraction or Endodontic Rx</td>
</tr>
</tbody>
</table>

**Garré’s osteomyelitis**
- **Synonym:** Chronic osteomyelitis with proliferative periostitis
- 1st described by Carl Garré in 1893 – controversial
- **Aetiology:**
  - Long standing carious lesion assoc with periapical infection
  - Secondary to periodontal infections, cysts, fractures
  - Microorganisms – Staph, pyogenes/aureus/albus; various Streptococci & other mixed organisms
  - Pathogenesis attributed to high osteogenetic potential in young patients which allows an osteoblastic process rather than osteolytic one.

**Chronic osteomyelitis: Features**
- Insidious course
- Dull to severe pain
- Limitation of jaw opening &/or myofacial pain
- Swelling variable
- Regional lymphadenopathy
- Reduced sensation of the inferior alveolar nerve (Vincent’s symptom)
PATHOGENESIS

Periapical infection in the young

Stimulation of osteoblasts of periosteum (rather than osteoclasts)

Deposition of new layers of cortical bone (neoperiosteitis)

Garrè's osteomyelitis: Features

Age predilection: <20yrs; mean 13 yrs
Sex predilection: None
Site: Mandible; molar-premolar region; unilateral
Swelling – asymptomatic, bony hard with normal appearing overlying skin & mucosa; occasionally slight tenderness

Radiographic features

- Intraoral radiographs would show a carious tooth, and/or periapical infection
- Cortex is expanded through deposition of new bone – proliferative periostitis (neoperiosteitis)
  - appears as "onion peel"
  - 1-12 layers maybe seen
  - Within the new bone, areas of sequestra or osteolytic radiolucencies may be seen

Occlusal radiograph

CT scan – Garrè's osteomyelitis

Histopathology

- Formation of new bone, or osteoid tissue, with bordering osteoblasts
- Trabeculae of lamellated bone separated by connective tissue, more or less close together, and arranged radially or nearly at a right angle to the cortical bone.
- Some areas of bone resorption.
- Lymphocytes are commonly seen in marrow spaces.

Histopathology – Garrè's osteomyelitis

Histopathology – Garrè's osteomyelitis

Histopathology – Garrè's osteomyelitis

Differential diagnosis

- Infantile cortical hyperostosis (Caffey's disease)
- Ewing's sarcoma
- Osteogenic sarcoma
- Fibrous dysplasia
- Cherubism - bilateral
- Histopcytosis X

Management

- Eliminate the focus of infection either by
  - Extraction of the offending tooth, or by
  - Endodontic therapy
- Within 6-12 months the bone may remodel. If it does not, bone recontouring can be done.
Chronic condensing osteitis - Radiological features

Chronic Condensing Osteitis
(Focal Sclerosing osteomyelitis)

Histopathology – Chronic

Management
- Antibiotic therapy
- Debridement – sequestrectomy, saucerization
- Dead space
  - replace with viable tissue; complete wound closure when possible
  - suction/irrigation systems
  - cancellous bone grafts
  - antibiotic impregnated beads
- Stabilization
  - plates, screws, rods
- Soft tissue coverage
  - skin grafts
  - local muscle flaps & free vascularized muscle transfers

Summary

THANK YOU