Bone Infection (osteomyelitis)

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Types of organism

- Pyogenic osteomyelitis or arthritis
- Chronic granulomatous reaction
- Fungal infection
- Parasitic infestation

Route of Infection

- Hematogenous system
- Direct invasion: Open Fx, operation, skin puncture
- Direct spreading

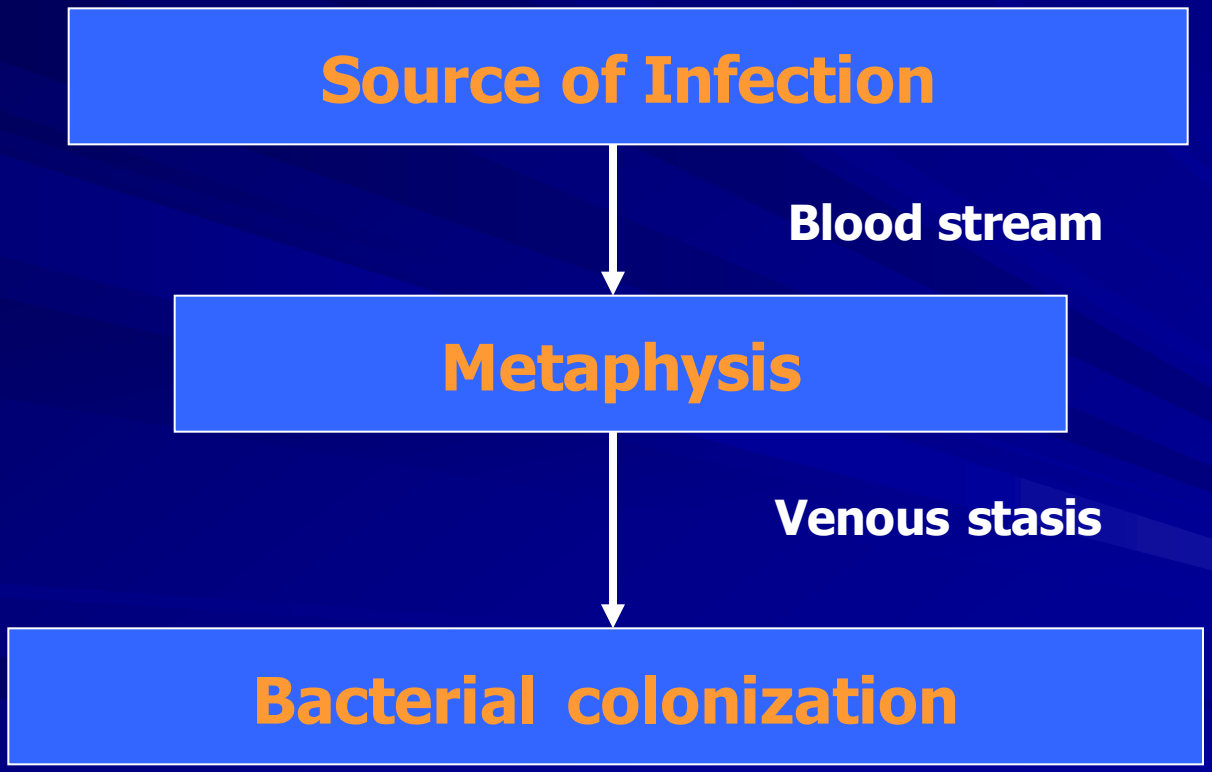
Acute Hematogenous Osteomyelitis

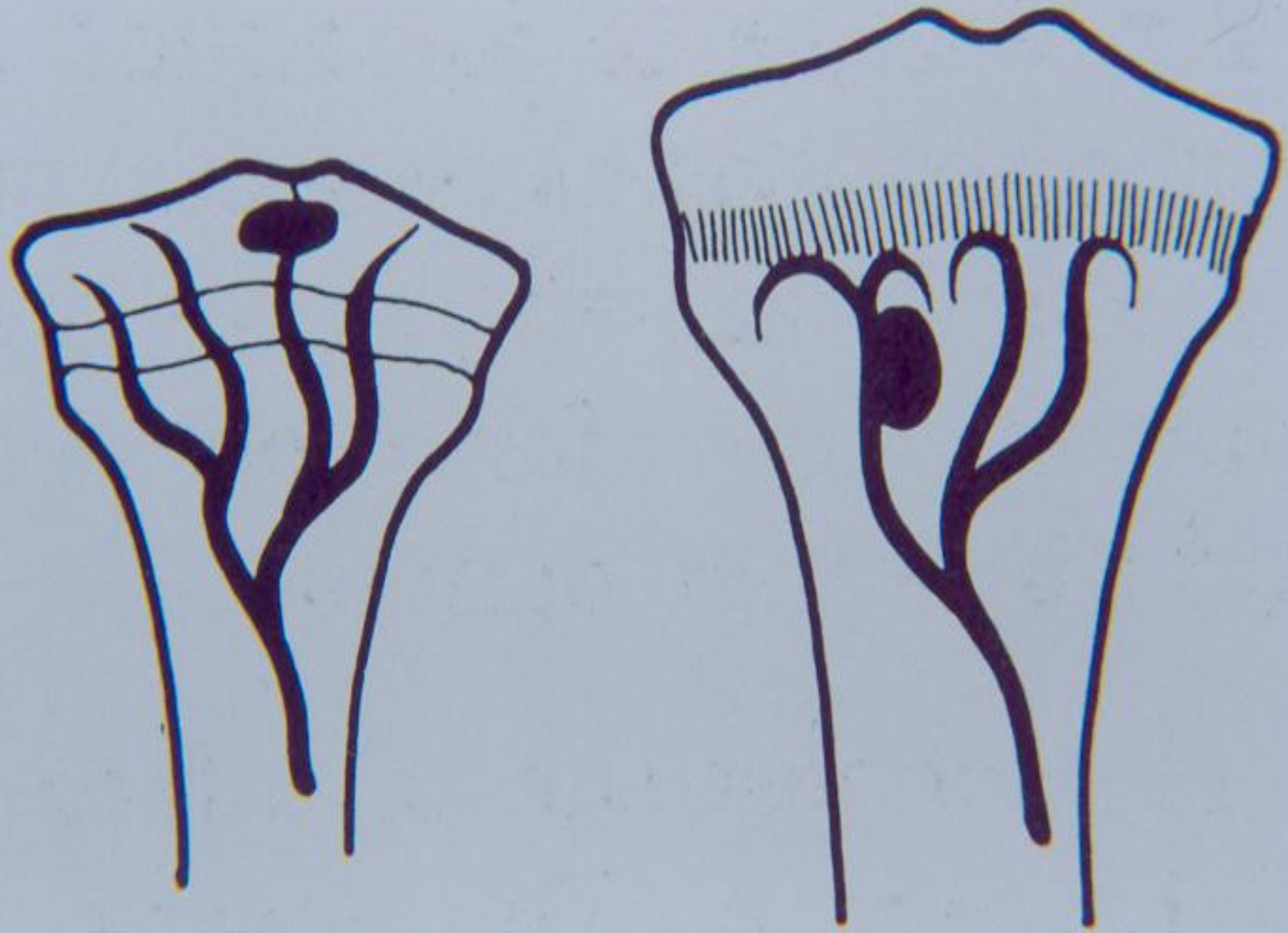
Acute Hematogenous Osteomyelitis

- Common in children
- Adult – lowered resistance by drug: immunosuppressive drug, debility disease: DM, AIDS

  - more common in vertebrae than long bone
- Post-trauma: hematoma or fluid collection in bone

Pathogenesis





Etiology

Aerobic organisms

-Gram positive : Staphylococcus aureus ,
Streptococcus pyogens
Streptococcus pneumoniae

-Gram negative : Haemophilus influenza,
E.coli, Pseudomonas aeruginosa,
Proteus mirabilis,

Anaerobic organisms

Bacteroides fragilis

Pathology

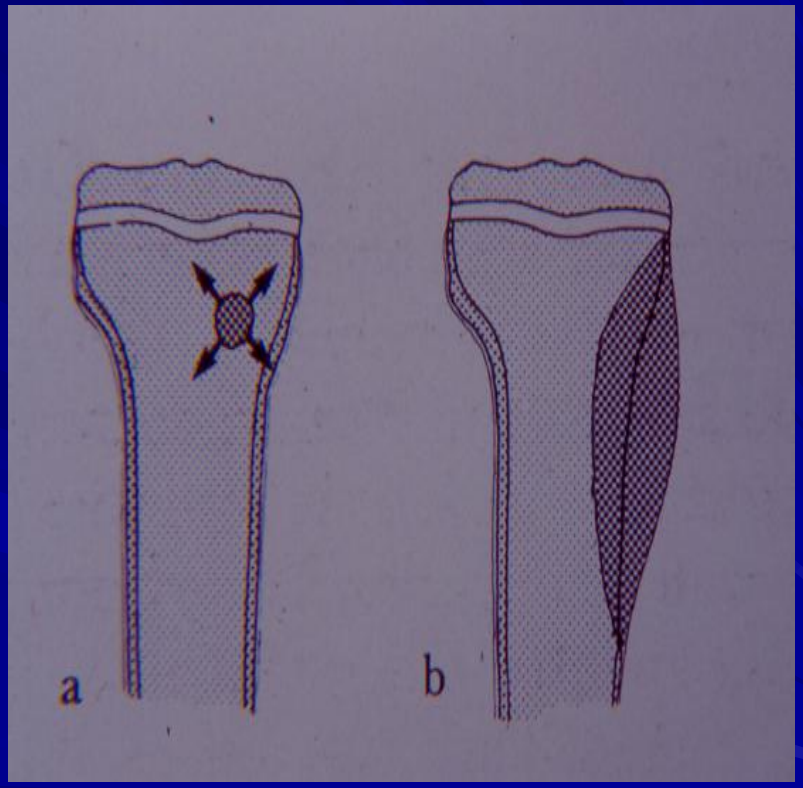
- Inflammation
- Suppuration
- Necrosis
- New bone formation
- Resolution

Inflammation

- First 24 hours
- Vascular congestion
- Polymorphonuclear leukocyte infiltration
- Exudation
- ↑Intraosseus pressure → intense pain → intravascular thrombosis → ischemia

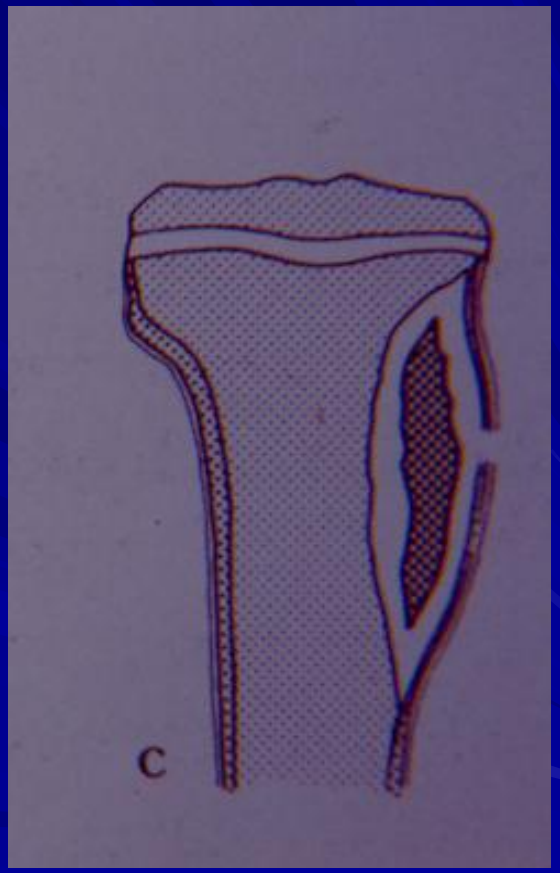
Suppuration

- 2-3 days
- Pus formation
- Subperiosteal abscess via Volkmann canals
- Pus spreading
  - epiphysis
  - joint
  - medullary cavity
  - soft tissue



Necrosis

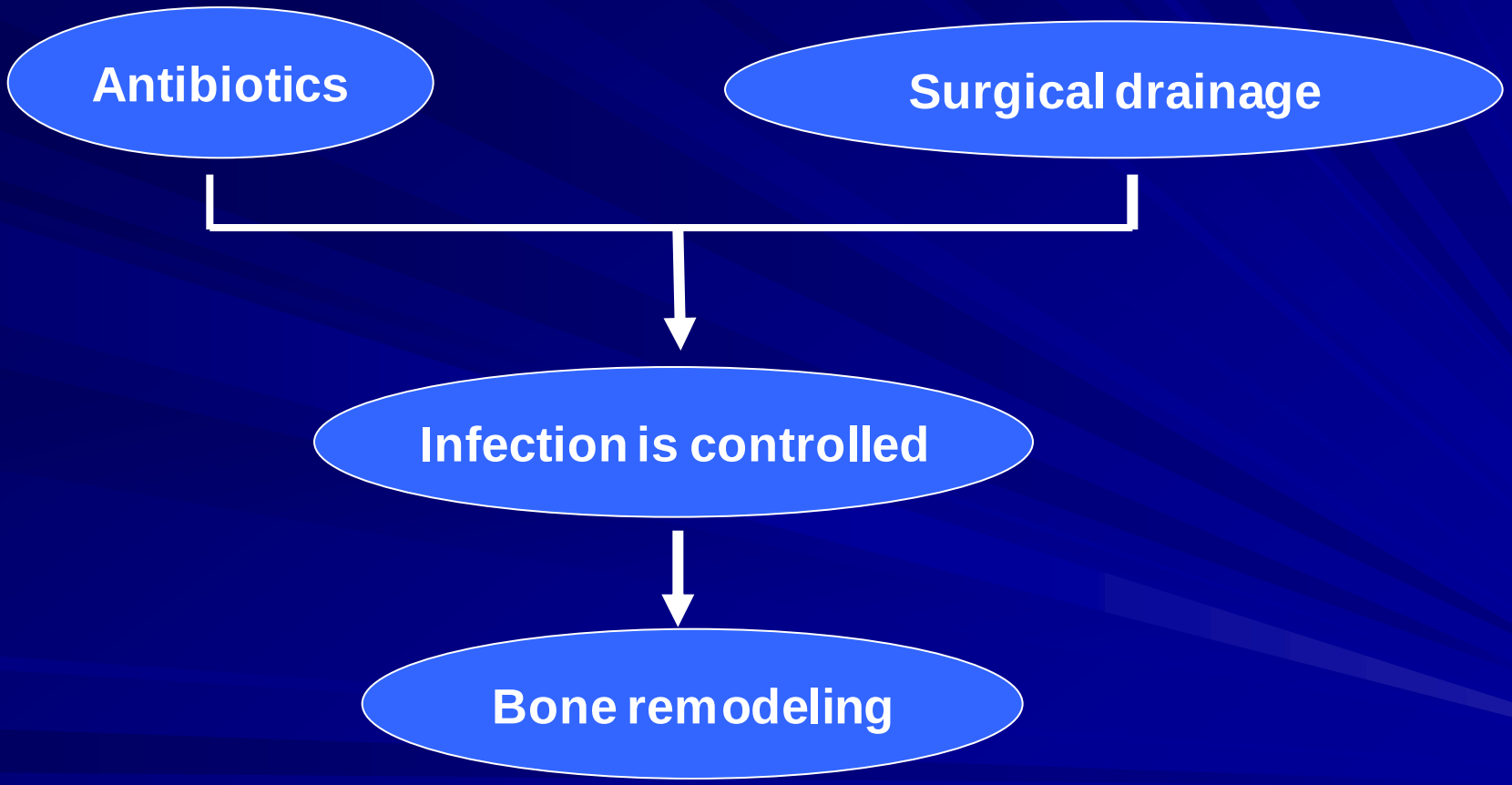
- Bone death by the end of a week
- Bone destruction ← toxin
  ← ischemia
- Epiphyseal plate injury
- Sequestrum formation
  - small → removed by macrophage,osteoclast.
  - large → remained



New bone formation

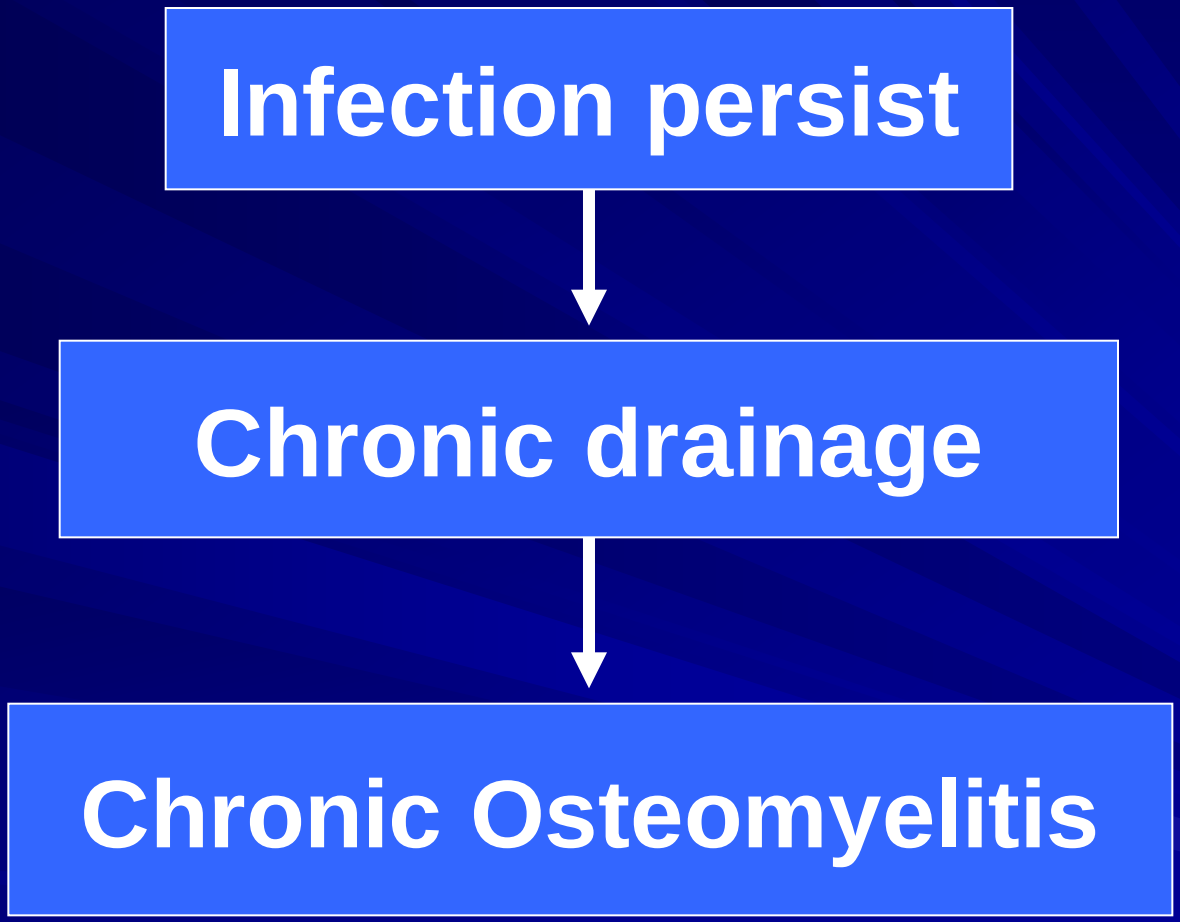
- By the end of 2nd week
- Involucrum (new bone formation from deep layer of periosteum) surround infected tissue.
- If infection persist- pus discharge through sinus to skin surface →Chronic osteomyelitis

Resolution


Antibiotics
Surgical drainage
Infection is controlled
Bone remodeling

Resolution

- Infection is controlled
- Intraosseous pressure release
- With healing – new bone formation + periosteal reaction → bone thickening and sclerosis
- Remodeling to normal contour or deformity


Infection persist
Chronic drainage
Chronic Osteomyelitis

Signs and Symptoms in infant

- Drowsy
- Irritable
- Fails to thrive
- history of birth difficulties
- History of umbilical artery catheterization
- Metaphyseal tenderness and resistance to joint movement

Signs and Symptoms in child

- Severe pain
- Malaise
- Fever
- Toxemia
- History of recent infection
- Local inflammation → pus escape from bone
- Lymphadenopathy

Acute osteomyelitis in adult

1. Uncommon
2. History of DM.
3. Immunosuppressive drug
4. Drug addict
5. Elderly patients.

Signs and Symptoms in adult

- Fever
- Pain
- Inflammation
- Acute tenderness
- Common site is thoraco-lumbar spine

Radiographic studies

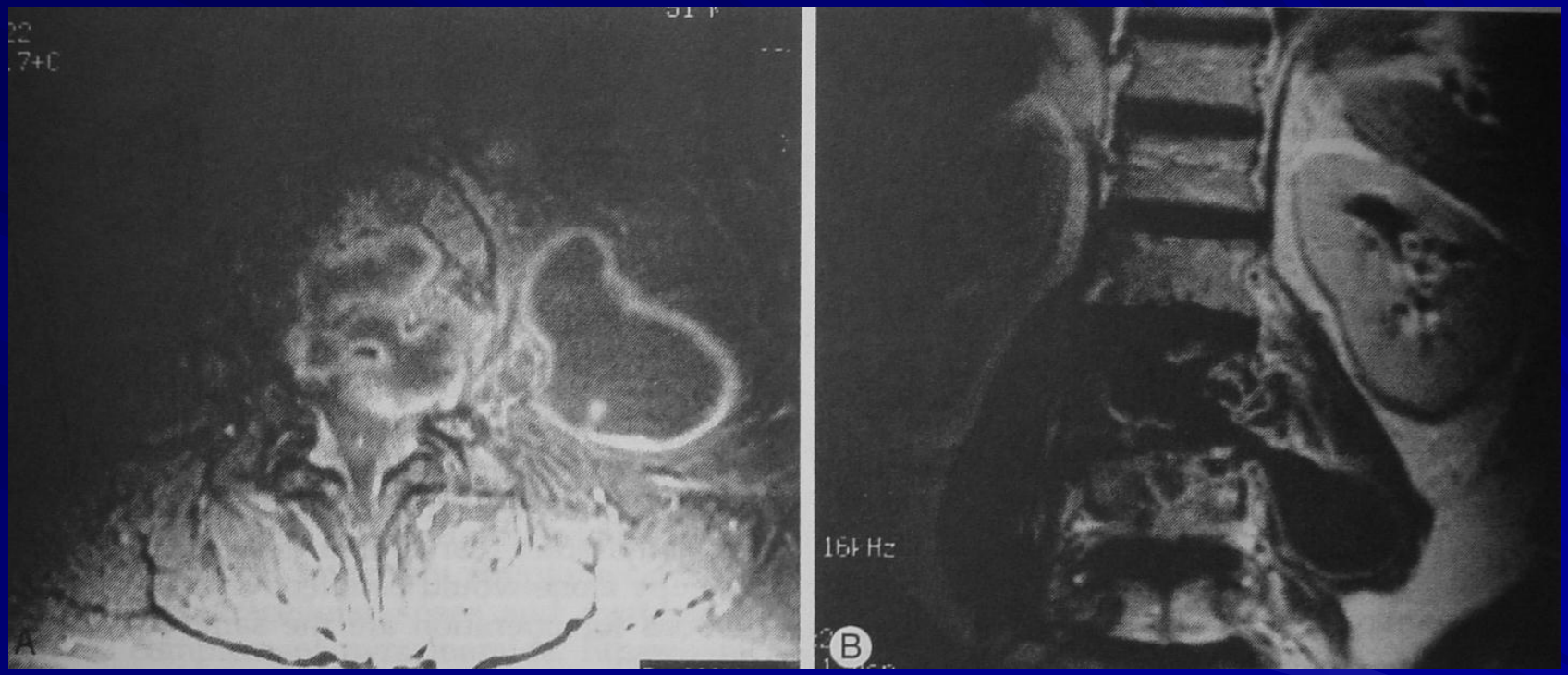
- มักจะเปลี่ยนแปลงหลังจากการติดเชื้อนานกว่า 10 วัน
- เริ่มจาก **rarefaction, area of lytic and sclerotic lesion, sequestrum and involucrum.**
- ควรเริ่มให้การรักษาทันทีก่อนจะเห็นการเปลี่ยนแปลงในภาพถ่าย **X-ray**

Bone Scan

- ^{99m} TC-HDP → - sensitive
  - not specific
- ^{67} Ga-citrate or ^{111} In-labeled leukocyte → more specific


A

MRI



ช่วยแยก pus กับ blood ได้

Aspiration pus

- confirm diagnosis
- smear for cell and organism
- culture and sensitivity test

Investigations

- CBC
- ESR
- Hemoculture positive ~ 50%
- Antistaphylococcal antibody titer (in doubtful case)

Differential diagnosis

- Cellulitis
- Acute suppurative arthritis
- Acute rheumatism
- Gaucher's disease – Pseudo- osteitis, resembling osteomyelitis, enlargement of spleen and liver. Because of predisposing to infection, antibiotics should be given.
- Sickle-cell crisis – mimic osteomyelitis, in endemic area of Salmonella, it is wise to treat with antibiotics until infection is excluded

Treatment for acute osteomyelitis

- Supportive treatment
- Splint
- Antibiotic therapy
- Surgical drainage

Supportive treatment

- Analgesics
- Correction of dehydration

Splint

- Plaster slab
- traction
- Prevent joint contracture

Surgical drainage

- **Early treatment** → **no need surgery**
- **Late treatment** → **surgical drainage about 1/3 of cases. If pus found and release no need to drill bone. But drilling one or two holes if no obvious abscess.**

Antibiotics

Initial antibiotics " BEST GUESS "

- **according to smear findings**
- **according to incidences , age.**

Proper antibiotics

- **according to culture and sensitivities test**

Guideline for initial antibiotics

Age	Pathogen	Drugs
1.Older children and previously fit adults	-Staphylococcal infection	- Fluclaxocillin and fusidic acid IV 3-4 day oral 3-6 wks
2.Children <4 years	-Gram neg. infection -Haemophilus infection	-2nd generation Cephalosporins or Amoxycillin with clavulanic acid
3.Sickle-cell patient	-Salmonella infection	- Co-trimoxazole - Amoxycillin with clavulanic acid
4.Heroin addicts and immuno-compromised patients	-Unusual infection : pseudomonas , proteus, bacteroides	-3rd or newer generation Cephalosporins

Acute osteomyelitis

- When infection subside, movement is encourage. Walk with crutches and full weight bearing is possible after 3-4 weeks.

Complication

- lethal outcome – rare
- metastatic infection (multifocal infection)
- suppurative arthritis
  - very young patient
  - metaphysis is intracapsular
  - metastatic infection

Complication

- altered bone growth
- chronic osteomyelitis
  - delay diagnosis and treatment
  - debilitated patients
  - compromised host

Chronic Osteomyelitis

Chronic osteomyelitis

- Sequel to acute hematogenous osteomyelitis
- Usual organisms are staph. aureus, Escherichia coli, Strep. pyogens, Proteus and Pseudomonas (always mixed infections)
- In the presence of foreign implants : Staph. Epidermidis is the commonest pathogen.

Pathology of chronic osteomyelitis

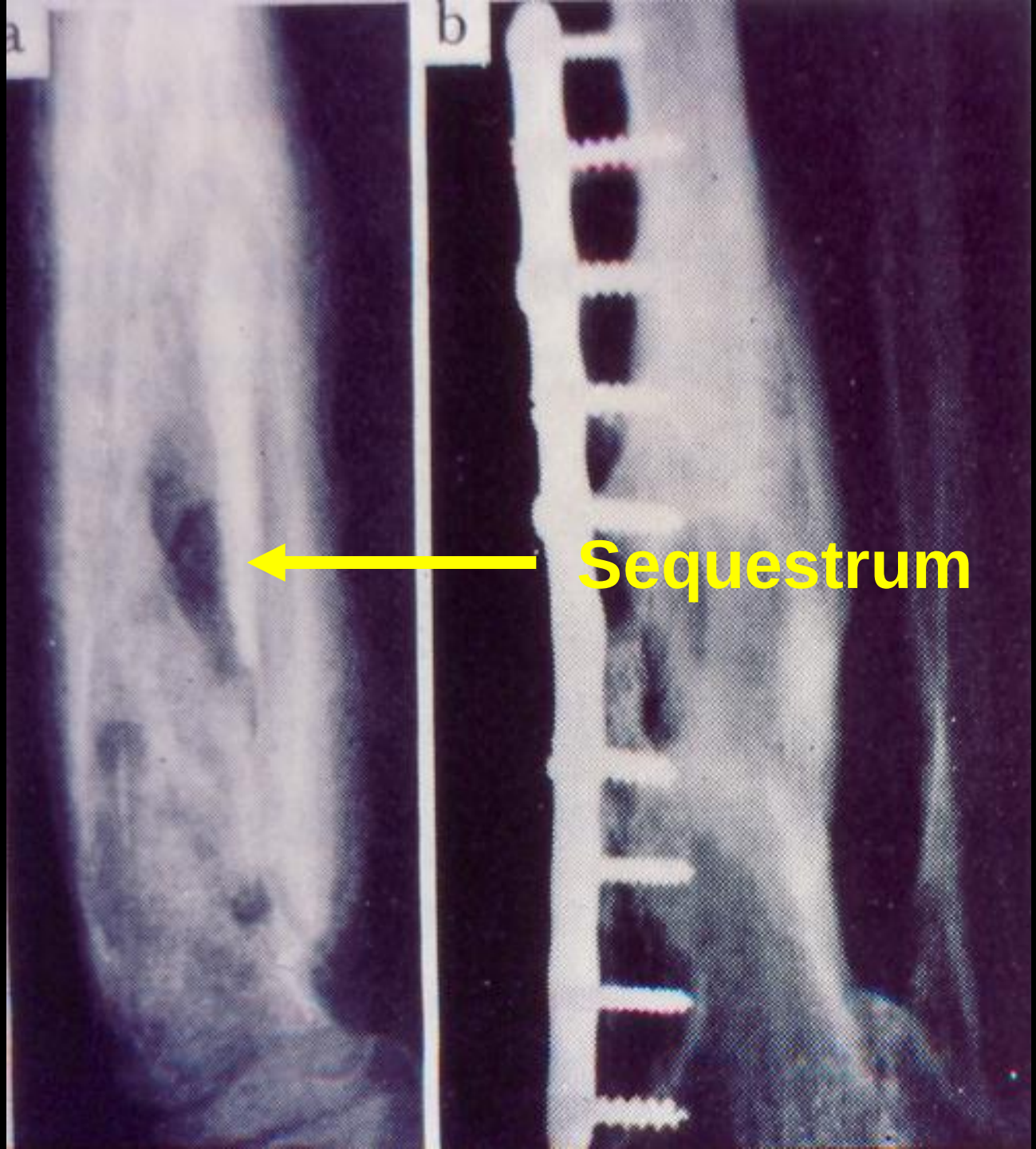
- Bone is destroyed in a discrete area or diffuse
- Cavities containing pus and sequestrum are surrounded by vascular bone and sclerosis bone resulted from reactive new bone formation
- Sequestra, foreign implants act as substrates for bacterial adhesion, ensuring the persistence of infection and sinus drainage
- Pathological fracture

Signs and Symptoms of chronic osteomyelitis

- Pain
- Pyrexia
- Redness
- Tenderness
- Draining sinus
- Excoriation of skin

Radiographic study

- A patchy loss of bone density with thickening and sclerosis of the surrounding bone
- Sequestra : dense fragment in contrast to surrounding vascularized bone
- Sinogram may help to localize the site of infection


a
b
Sequestrum

Radioisotope scanning

- ^{99m} TC-HDP ⟶ ↑ Up take
- ^{67} Ga-citrate or ^{111}In-labelled leukocyte ⟶ more specific

CT – Scan and MRI

- Show extent of bone destruction and reactive edema, hidden abscess and sequestrum
- Pre-op planning investigation

Other Investigations

- CBC
- ESR
- Antistayphylococcal antibody titers – Dx hidden infection and tracking progress to recovery
- C/S from draining discharge R/O resistance bacteria

Treatment for chronic osteomyelitis

- Medical treatment
- Local treatment
- Surgical treatment

Antibiotics

- To stop spreading of infection
- To control acute flare
- Capable of penetrating sclerotic bone and non-toxic to body

Surgical treatment

- Sequestrectomy : sulphan blue stained only vital tissue
- Continuous irrigation 3-6 weeks.
- Gentamicin beads

Space filling techniques

- Papineau technique (Papineau et al 1979)
- Muscle flap + skin graft (Fitzgerald et al 1985)
- Myocutaneous island flap. (Yoshimura et al 1989)

Prognosis

- Local trauma must be avoided
- Any recurrent of symptoms should be taken seriously and investigated

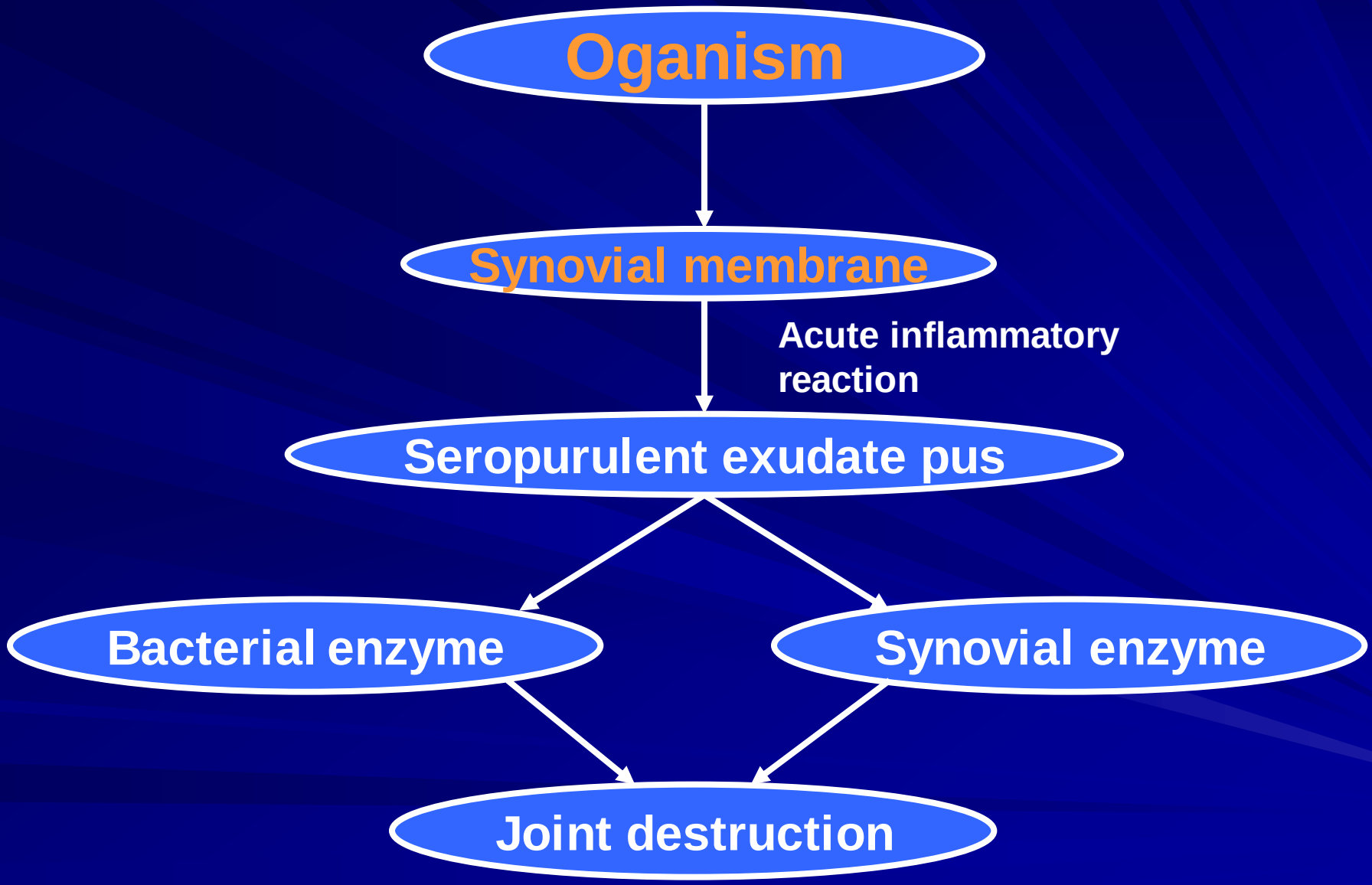
Acute Suppurative Arthritis

Route of infection

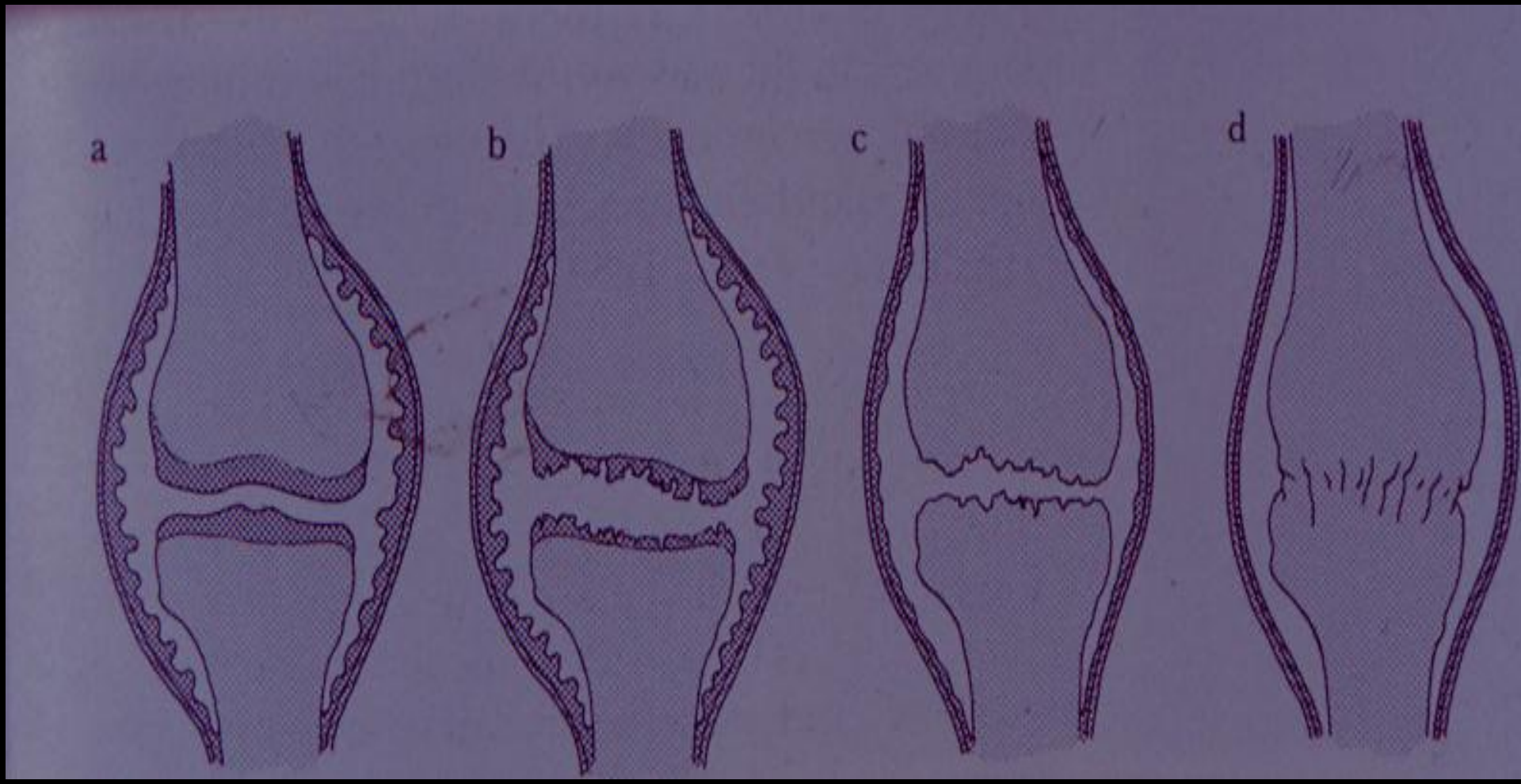
1. direct invasion
2. eruption of a bone abscess
3. hematogenous spreading

Causal Organisms

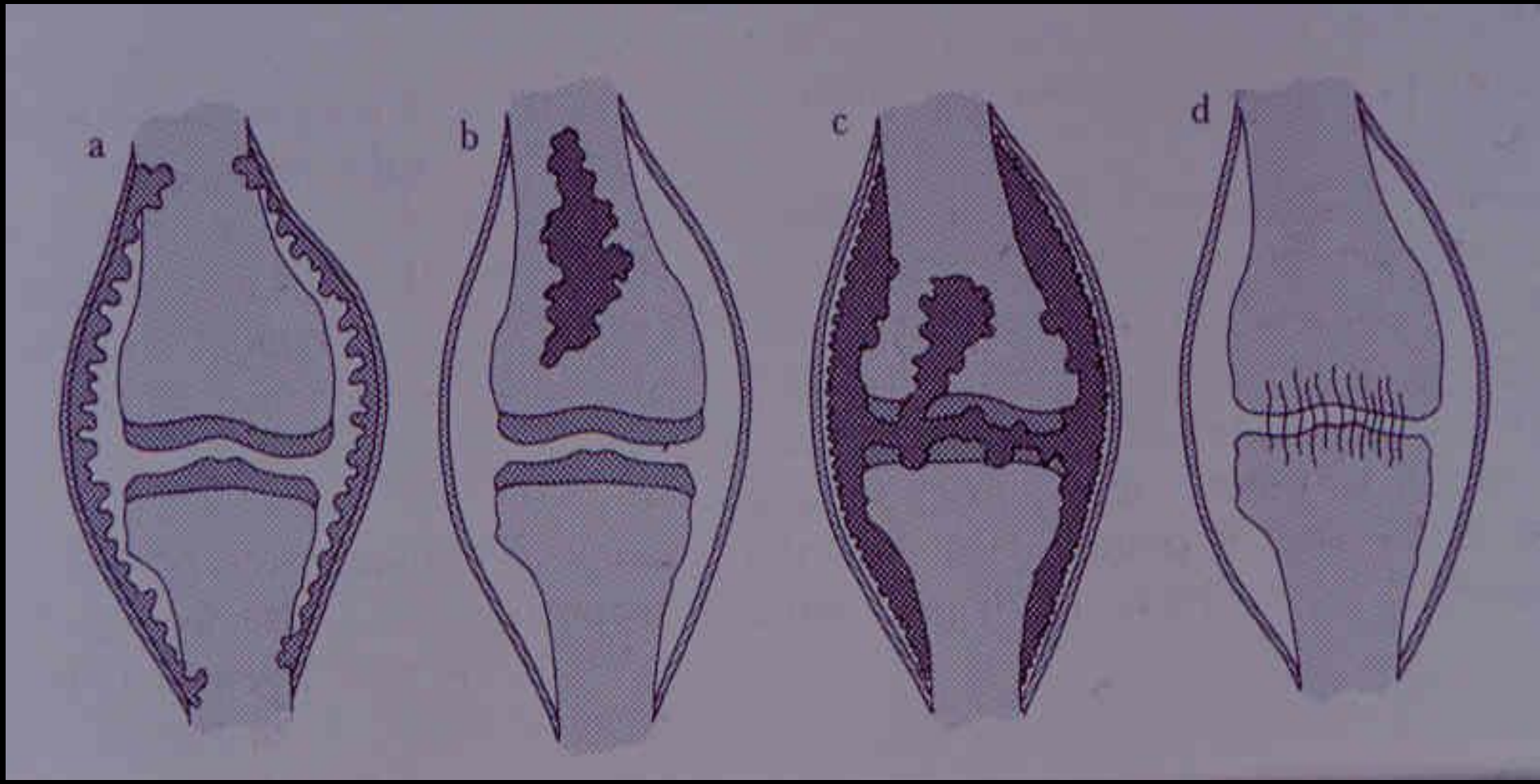
- Staphylococcus aureus
- Hemophilus influenza
- E. coli
- Streptococcus
- Proteus


Oganism
Synovial membrane
Acute inflammatory reaction
Seropurulent exudate pus
Bacterial enzyme
Synovial enzyme
Joint destruction

Septic Arthritis



TB Arthritis



Signs and symptoms in newborn

- Clinical of septicemia : irritable, refuses to feed, rapid pulse
- Joint swelling
- Tenderness and resistance to movement of the joint
- Look for umbilical infection

Signs and symptoms in children

- acute pain in single joint : hip.
- Pseudoparesis.
- Swelling and inflammation of the joint.
- Child looks ill.
- Limit movement of the joint.
- Look for a source of infection : toe, boil, otitis media

Signs and symptoms in adult

- Often superficial joint : knee, wrist, ankle
- Pain
- Swelling and inflammation
- Restricted movement
- Examined for gonococcal infection or drug abuse.

Radiographic study

Early : usually normal , joint space may seem to be widened (because of fluid in the joint)

Late : osteoporosis ,narrowing and irregularity of the joint apace.

with E. coli infection there is sometime gas in the joint

Investigation

- CBC
- ESR
- Gram stain of synovial fluid
- C/S

Differential diagnosis

- Acute osteomyelitis: in children indistinguishable from septic joint
- Trauma: traumatic synovitis
- Irritable joint : the patient does not look ill
- Hemophilic bleeding
- Rheumatic fever
- Gout and pseudogout

Treatment of septic arthritis

- Supportive care
  : analgesics, fluid supplement , splint, traction
- Antibiotics
  : same as acute osteomyelitis
- Drainage
  : Aspiration, arthrotomy

Treatment of septic arthritis

- Once the conditions improved, if the articular cartilage is preserved – gentle and gradually increasing active motion
- If articular cartilage is destroyed – the joint is immobilized in optimal position until ankylosis is sound

Outcome After Healing

- Complete resolution
- Partial loss articular cartilage and fibrosis of joint.
- Loss of articular cartilage and bony ankylosis
- Bone destruction and permanent deformity of the joint.

Complication

- Cartilage destruction
- Growth disturbance
- Bone destruction