

Bone and Joint Infection



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Objectives



- ❧ The ability to demonstrate knowledge of the following:
 - ❧ Bone and joints infections presentation
 - ❧ Assessment and work up for bone and joint infections
 - ❧ Differential diagnosis for bone and joint infections
 - ❧ Management of bone and joint infections
 - ❧ Complication of bone and joint infections

Red Flag Conditions

☞ Beware of:

- 1) Cauda Equina/severe neurologic injury (perianal numbness, decreased rectal tone, loss of movement in the extremities)
- 2) Tumour
- 3) **Infection**
- 4) Trauma (open fracture, pelvic fracture)
- 5) Joint dislocations
- 6) Compartment syndrome



Acute osteomyelitis



- ❧ Classification
 - ❧ Duration:
 - ❧ Acute
 - ❧ Subacute
 - ❧ Chronic
 - ❧ Route of Infection:
 - ❧ Hematogenous
 - ❧ Exogenous
 - ❧ Host response:
 - ❧ Pyogenic
 - ❧ Granulomatous

Acute osteomyelitis



❧ Definition:

❧ Osteomyelitis is an inflammation of bone caused by an infecting organism.

❧ It may remain:

❧ Localized

❧ Spread to:

❧ Marrow

❧ Cortex

❧ Periosteum

❧ Soft tissue

Acute osteomyelitis



Definition:

Osteomyelitis is an inflammation of bone caused by an infecting organism.

It may remain:

Localized

Spread to:

Marrow

Cortex

Periosteum

Soft tissue



Acute osteomyelitis



❧ Organism:

❧ Neonates: **Staph aureus**, Strep, E coli

❧ Children: **Staph aureus**, E coli, Serratia, Pseudomona (Hem. Infl < 4 yrs, rare now)

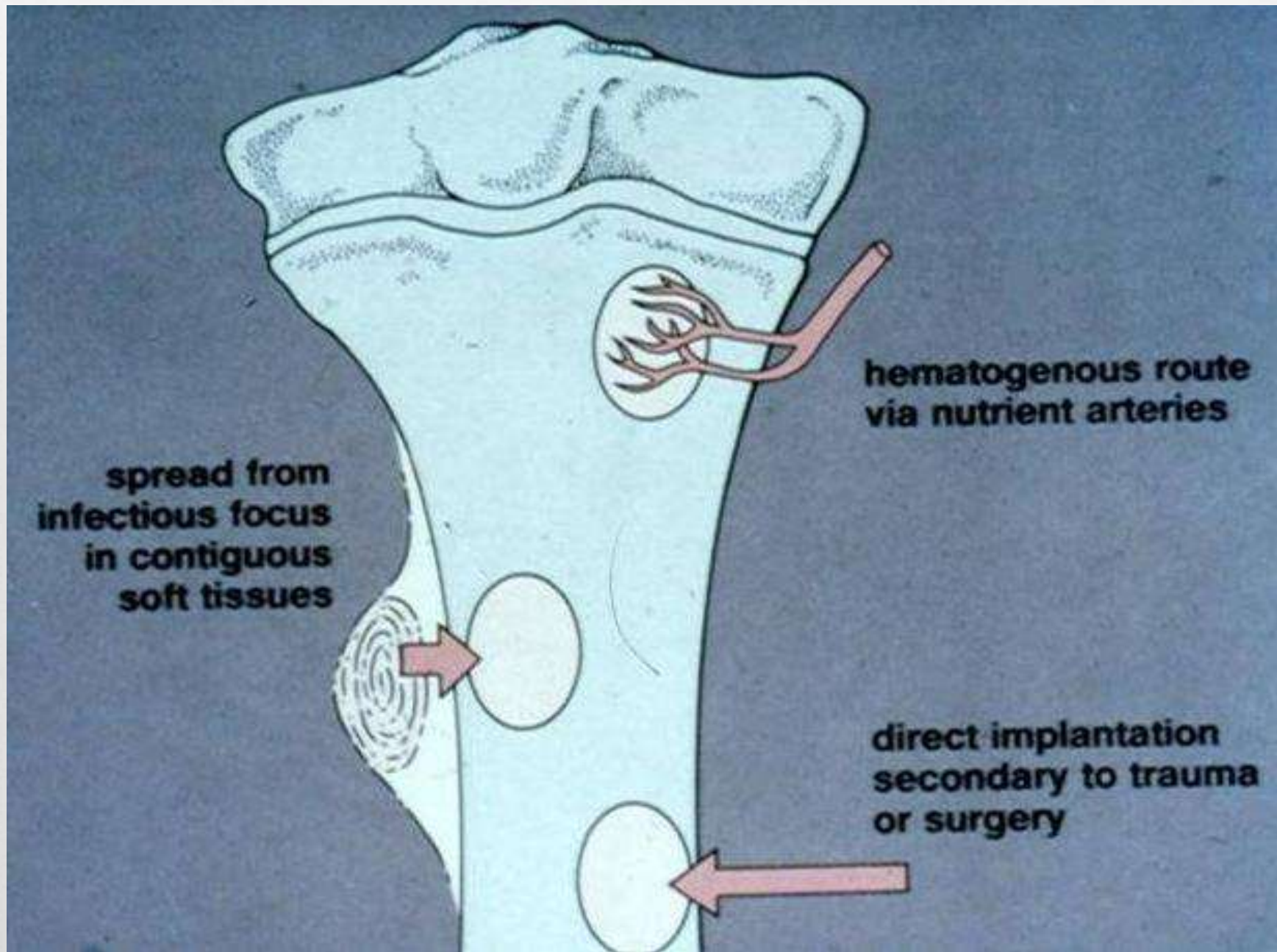
❧ Sicklers: **Staph aureus**, Salmonella (most unique)

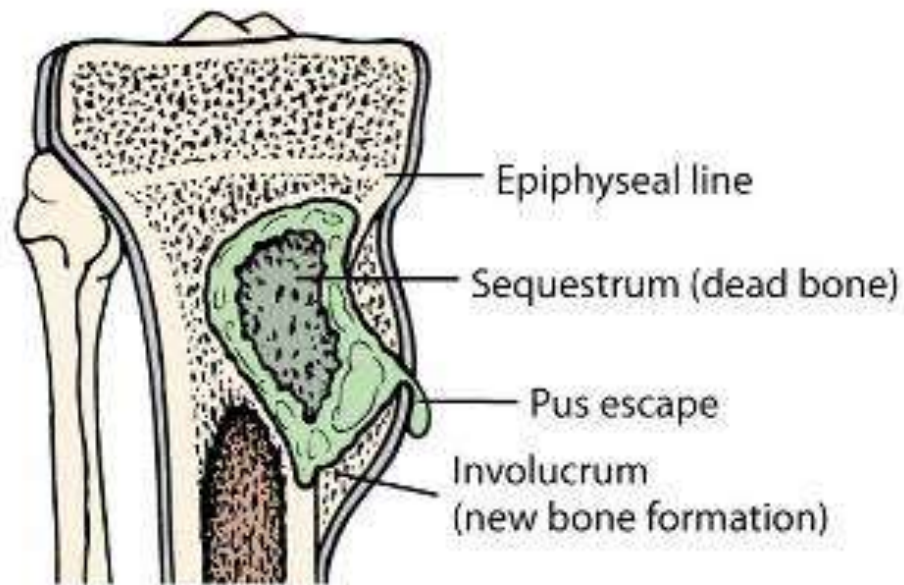
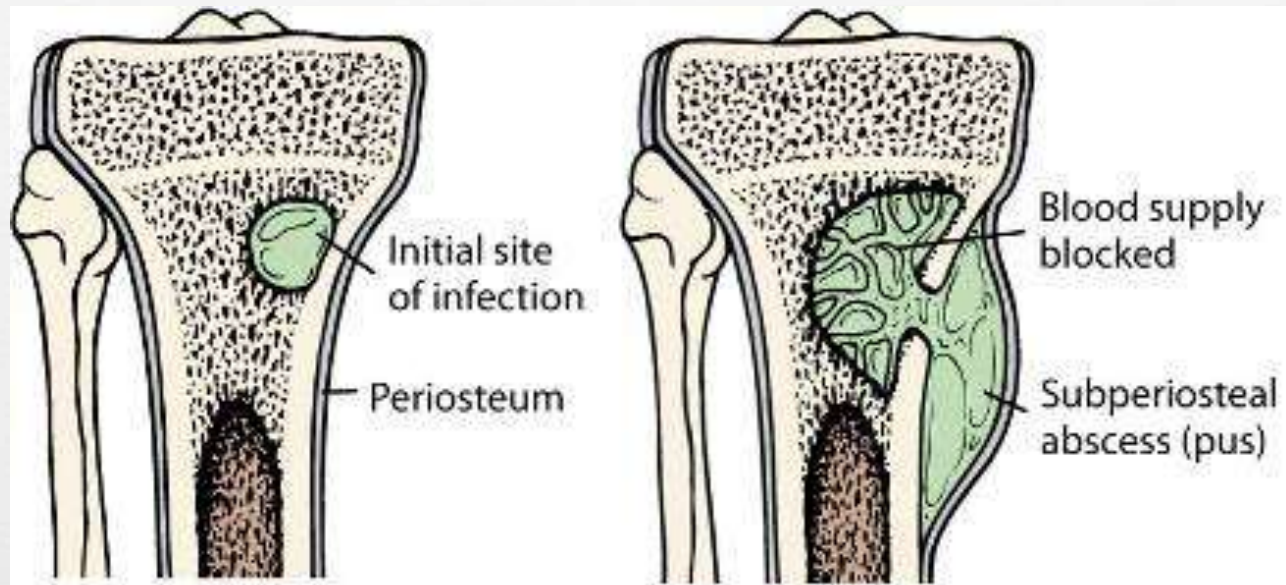
❧ Drug addicts: **Staph aureus**, Pseudomonas (most unique)

Acute osteomyelitis



- ❧ Organism: the commonest is staph. Aureus
- ❧ Source of infection: Hematogenous, direct extension, direct from outside
- ❧ Incidence:
 - ❧ Age: more in children
 - ❧ Sex: Boys > Girls
 - ❧ Site of infection: metaphysis
 - ❧ Bones: LE > UE. commonest are tibia and femur





Pathology



- ❧ Hematogenous colonisation of the bones by bacteria
- ❧ Stage of inflammation
- ❧ Spread of infection with pus formation
- ❧ Formation of subperiosteal abscess
- ❧ Pus tracks towards skin to form a sinus
- ❧ Bone infarction (**Sequestrum**)
- ❧ Subperiosteal new bone formation (**Involucrum**)

Involucrum is seen
in the distal fibula



Involucrum is seen in the distal fibula





This x-rays show sequestra

Pathology and age variation



∞ Neonates:

- ∞ Extensive bone necrosis
- ∞ Increased ability to absorb large sequestrum
- ∞ Increased ability to remodel
- ∞ Epiphysio-metaphyseal vascular connection
- ∞ Secondary septic arthritis
- ∞ Presence of growth plate → growth disturbance

Pathology and age variation



∞ Adults:

- ∞ No subperiosteal abscess
- ∞ Adherent periosteum
- ∞ Soft tissue abscess
- ∞ Vascular connection with the joint
- ∞ Secondary septic arthritis

Clinical Picture



❧ History:

- ❧ Fever
- ❧ Pseudoparalysis, limping, inability to walk
- ❧ Identified potential source
- ❧ Confirm your most likely diagnosis
- ❧ Exclude other diagnosis

Clinical Picture



☞ Symptoms:

☞ Pain

☞ Fever

☞ malaise

☞ Restlessness

☞ Vomiting

☞ The limb is held still, loss of function

Clinical Picture



- ❧ General signs:
 - ❧ Looks ill
 - ❧ Fever
 - ❧ Tachycardia

- ❧ Local signs:
 - ❧ Look, feel and move

Laboratory tests



- ❧ CBC: raised WBC
- ❧ ESR: 24-36hrs
- ❧ C-reactive protein: 4-6hrs (most sensitive)
- ❧ Blood cultures (positive up to 50 %)
- ❧ Aspiration (send for Gram stain and C&S)

Radiography



- ❧ Plain x-rays (Normal in the first ten days, after that resorption of affected bone and sub-periosteal new bone formation)
- ❧ Bone scan (very sensitive but not specific)
- ❧ Ultrasound
- ❧ CT scan
- ❧ MRI

Acute Hematogenous OM

Radiographic Changes



- ☞ soft tissue swelling (early)
- ☞ bone demineralization (10-14 days)
- ☞ **sequestra** → dead bone with surrounding granulation tissue → late
- ☞ **involucrum** → periosteal new bone → late



❖ **Sequestrum and involucrum are signs of chronic osteomyelitis**

Acute osteomyelitis



Subacute osteomyelitis



[REDACTED]
ANTER

POSTER

ANTER

POST



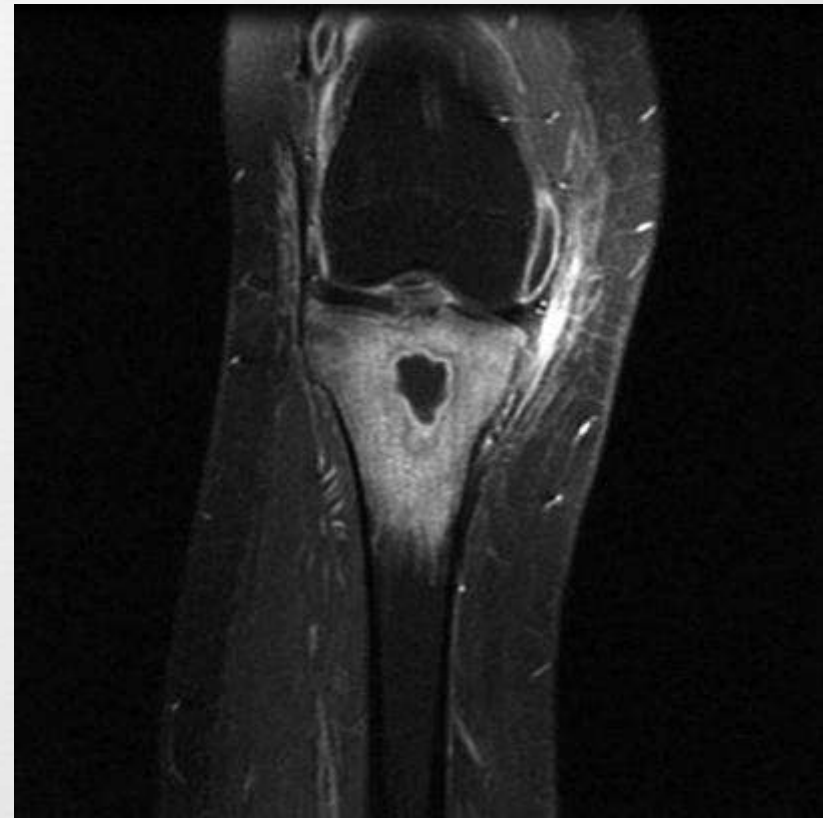
Min
B

Diagnosis



❧ MRI

- ❧ shows changes in bone and bone marrow before plain films
- ❧ decreased T_1 -weighted bone marrow signal intensity
- ❧ **increased post gadolinium fat-suppressed T_1 -weighted signal intensity**
- ❧ increased T_2 -weighted signal relative to normal fat





Differential Diagnosis



- ❧ Acute septic arthritis
- ❧ Cellulitis
- ❧ Ewing's Sarcoma, lymphoma
- ❧ Sickle cell bone crisis
- ❧ Acute rheumatoid arthritis

Differential Diagnosis



Treatment Outline



- ❧ Select appropriate empirical antibiotics
- ❧ Deliver antibiotics to the infected site
- ❧ Identify the organisms
- ❧ Halt tissue destruction

Treatment



∞ General:

- ∞ Admission
- ∞ Hydration
- ∞ Correction of electrolyte imbalance
- ∞ Analgeics
- ∞ Immobilization

∞ Specific:

- ∞ Broad spectrum intravenous antibiotic till final culture
- ∞ Surgery if indicated

Empirical Treatment



- ∞ Initial treatment based on presumed infection type
→ clinical findings and patient's age
- ∞ Definitive treatment → based on final culture

Operative Treatment



- ❧ Started after cultures
- ❧ Indications for operative intervention
 - ❧ Drainage of an abscess
 - ❧ Débridement of infected tissues to prevent further destruction
 - ❧ Refractory cases that show no improvement after nonoperative treatment

Complication



- ❧ Septicemia and distant abscesses
- ❧ Septic arthritis
- ❧ Growth disturbance in skeletally immature
- ❧ Pathological fracture
- ❧ Chronic osteomyelitis

Complication

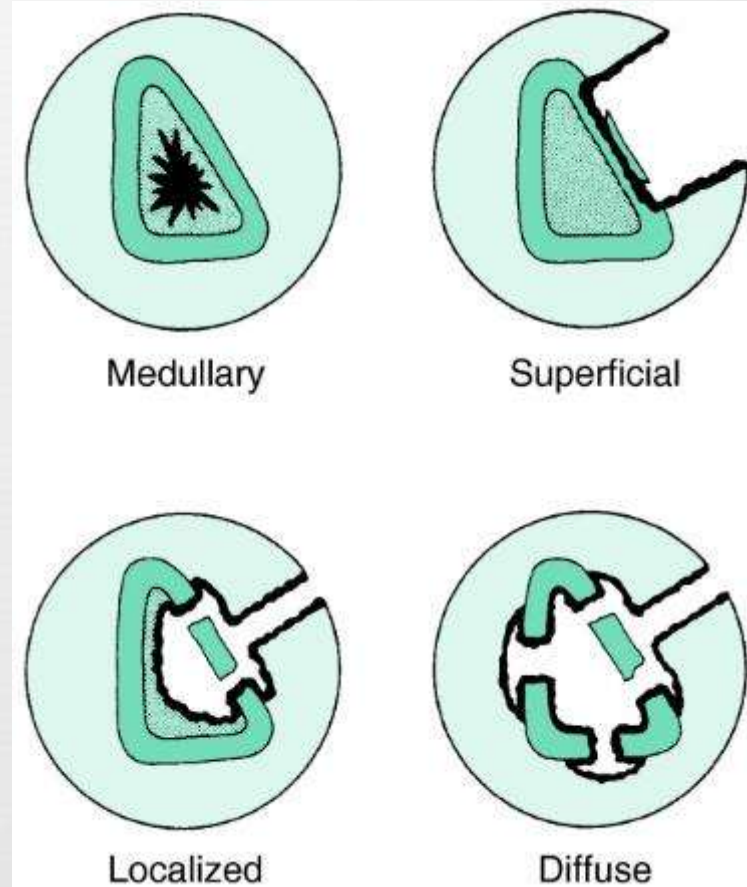


Chronic OM



- Common in
 - Inappropriately treated acute OM
 - Trauma
 - Immunosuppressed
 - Diabetics
 - IV drug abusers

Anatomical classification →



Chronic OM



❧ Features

- ❧ Skin and soft tissues involvement
- ❧ Sinus tract → may occasionally develop squamous cell carcinoma
- ❧ Periods of quiescence → followed by acute exacerbations

❧ Diagnosis

- ❧ Nuclear medicine → activity of the disease
- ❧ **Best test to identify the organisms → Operative sampling of deep specimens from multiple foci**

Treatment



- ❧ **Empirical therapy is not indicated**
- ❧ **IV antibiotics → must be based on deep cultures**
- ❧ **Most common organisms**
 - ❧ *S. aureus*
 - ❧ Enterobacteriaceae
 - ❧ *P. aeruginosa*

Chronic osteomyelitis



Glycoalkalix

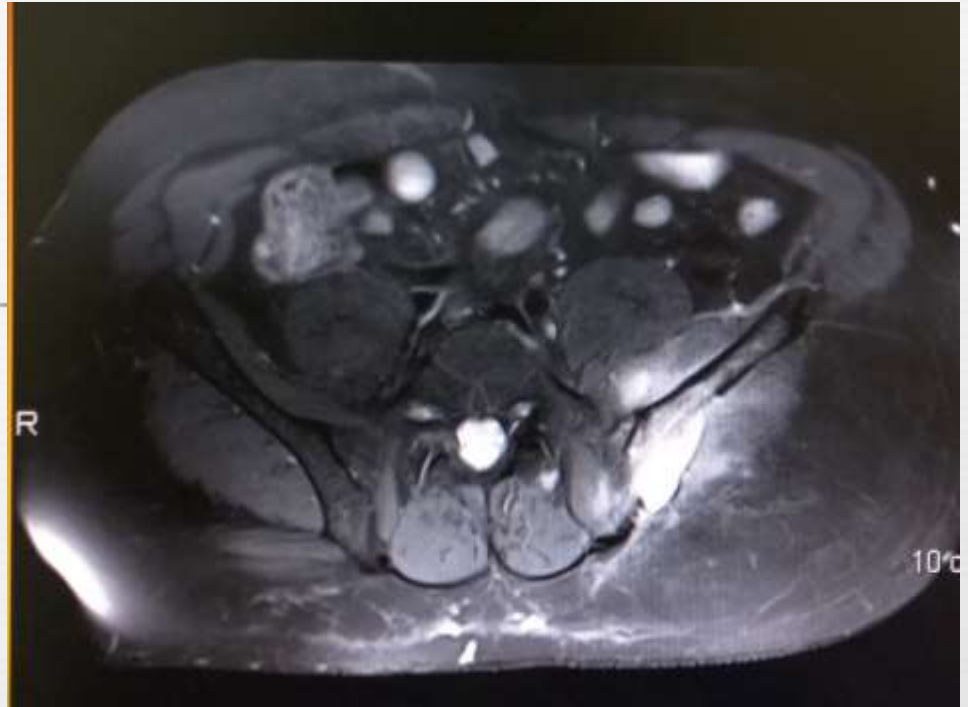
exopolysaccharide
coating
envelops bacteria
enhances bacterial
adherence to biologic
implants



Chronic osteomyelitis







Complications



- ❧ Recurrence
- ❧ Pathological fracture
- ❧ Growth disturbance in skeletally immature
- ❧ Squamous cell carcinoma transformation (fistula)
- ❧ Amputation

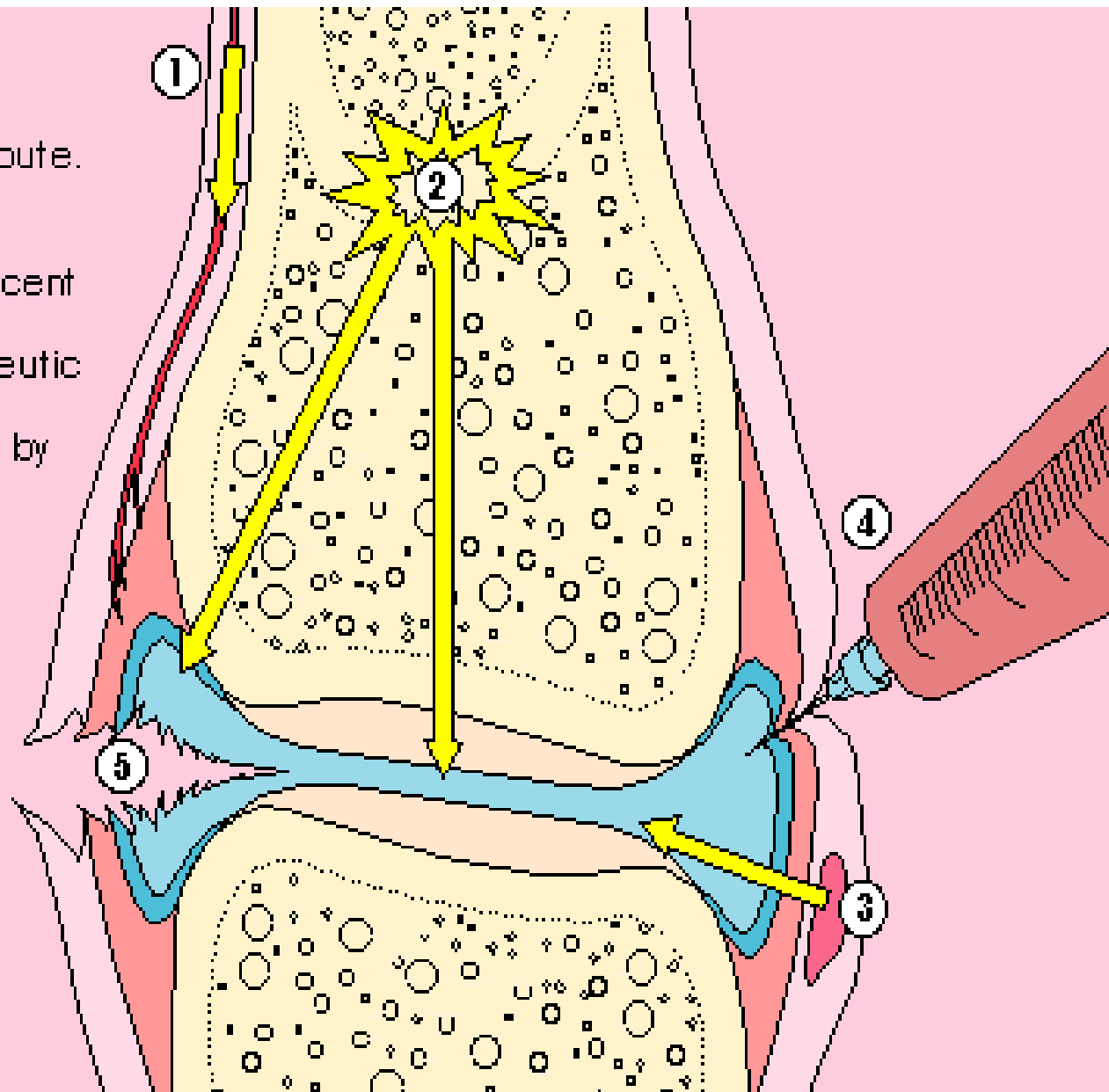
Septic Arthritis



- ❧ May affect any age and any joint
- ❧ The knee and hip are most affected
- ❧ Pathology: hematogenous or from the bone
 - ❧ In neonates: transphyseal vessels
 - ❧ In joints where the metaphysis is intracapsular (Hip, shoulder, proximal radius and distal fibula)

ROUTES BY WHICH BACTERIA CAN REACH THE JOINT

- 1 - The hematogenous route.
- 2 - Dissemination from osteomyelitis.
- 3 - Spread from an adjacent soft tissue infection.
- 4 - Diagnostic or therapeutic measures.
- 5 - Penetrating damage by puncture or cutting.



Septic Arthritis



- ❧ Symptoms : like AO
- ❧ Signs: hot swollen joint which is painful to any motion, inability to bear weight
- ❧ Joint is fixed in the position of ease

Septic Arthritis



Investigation



- ❧ Basic lab for infection (CBC,ESR and CRP) and Blood cultures
- ❧ Plain films and Ultrasound
- ❧ Joint aspiration: WBC $>50,000$ ($>90\%$ PMNL), damaged WBC and No crystals
- ❧ Organisms: similar to AO
- ❧ Rx: Admission for Emergency arthrotomy and washout, broad spectrum IV antibiotics and splintage
- ❧ Main DDx: transient synovitis of the hip

Acute Monoarthritis

Sepsis workup

Synovial Fluid Aspiration

Positive B/C :
50-70%

Leukocytosis
↑ ESR & CRP

Smear- Culture

Positive Gram stain:
75% in s. aureus
30-50% in gram (-)

Positive Fluid culture: 90%

PCR: partially treated or culture negative

Light microscope

Turbid - Purulent
Leukocyte > 50,000/ μ l
(> 90% PMN)
Damaged WBC
Crystal (-)



For simulated cases



Differential diagnosis



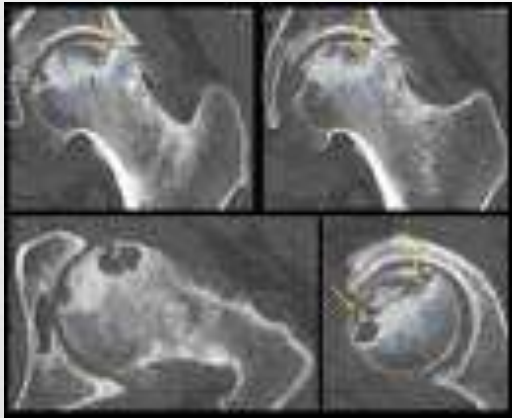
- ❧ Acute osteomyelitis
- ❧ Transient synovitis (<10 years)
- ❧ Reactive arthritis
- ❧ Vasculitis eg: Henoch-Schonlein purpura
- ❧ Traumatic haemarthrosis
- ❧ Haemophilic arthritis

Complication



- ❧ Septicemia
- ❧ Abscess
- ❧ Osteomyelitis
- ❧ Joint destruction
- ❧ Joint subluxation and dislocation
- ❧ Ankylosed joint
- ❧ Avascular necrosis of the femoral head
- ❧ Growth disturbance

Complication



Reactive arthritis



- ❧ Sterile inflammation secondary to bacterial infection
- ❧ 80% have HLA type B27
- ❧ 1-3 weeks after bacteria in genitalia eg: Chlamydia, or bowel eg (Shigella, Salmonella)
- ❧ Oligoarthritis (large joint of lower limb)
- ❧ Sometimes eye redness and irritation
- ❧ Synovial fluid: WBC <50,000 (PMNL <60%)
- ❧ Treatment: NSAID

Transient Synovitis



- ❧ Benign, self-limited disorder
- ❧ Associated with recent URI in 32-50% of children
- ❧ 30-40% of all non-traumatic limps
- ❧ Sterile inflammation causing joint effusion
- ❧ Lasts 2-7 days without intervention
- ❧ Male: Female is > 2:1
- ❧ Ages 2-6 (typically <4)

Transient Synovitis



- ❧ Sudden onset of hip pain (Don't forget knee pain!!)
- ❧ Afebrile/low-grade fever (<38.5)
- ❧ *Usually* able to ambulate with a limp
 - ❧ Antalgic gait
- ❧ Hip is flexed and externally rotated with mildly decreased ROM
- ❧ 5% bilateral presentation
- ❧ 25% with unilateral presentation with effusion on contralateral hip by ultrasound

Transient Synovitis



- ❧ Laboratory Evaluation
 - ❧ WBC count <12,000
 - ❧ Mildly elevated ESR (<40), CRP (<2)
- ❧ X-Ray
 - ❧ Joint space widening
 - ❧ Discrepancies >2mm between sides
- ❧ Ultrasound:
 - ❧ Joint effusion and/or synovial swelling
 - ❧ Bilateral joint effusions in up to 25% of cases of asymptomatic contralateral hip



Transient Synovitis



Treatment

- ∞ Self-limited after 2-7 days
- ∞ Bed rest
- ∞ (NSAIDS):Ibuprofen
 - ∞ Mean duration of pain
 - ∞ ibuprofen: 2 days
- ∞ 80% of all patients has resolution by 7 days

Vasculitis



- ❧ Henoch-Schonlien purpura: systemic IgA vasculitis
- ❧ Primarily affect children
- ❧ Classic triad: purpura, arthritis and abdominal pain
- ❧ Usually able to ambulate, but with antalgic gait
- ❧ Ankle , knees and elbow mostly affected
- ❧ Purpura starts at posterior aspect of lower limb, buttocks, but can affect rest of the body

Henoch-Schonlein purpura



- ❧ Vasculitis: ecchymosis, petechiae
- ❧ Arthralgia: transient and migratory
- ❧ Abdominal pain:
 - ❧ Within 8 days of rash (colicky)
 - ❧ 20-30% GI bleeding
 - ❧ Intussusception is common
- ❧ Renal: hematuria and proteinuria



Henoch-Schonlein purpura



- ⌘ High urea and creatinine
- ⌘ Raised IgA
- ⌘ Raised ESR and/or CRP
- ⌘ Diagnosis confirmed by biopsy

Chronic Non-Specific Bone and Joint Infection

Outline:



1. Tuberculosis
 - ∞ Causative organism
 - ∞ Target
 - ∞ Pathology
 - ∞ Location of infection
 - ∞ Spine T.B
 - ∞ Clinical presentation
 - ∞ Diagnosis
 - ∞ Treatment

2. Other less common infections
 - ∞ Brucellosis
 - ∞ Syphilis
 - ∞ Fungal infection

Tuberculosis



☞ Causative organism:

1. Mycobacterium tuberculosis
2. Mycobacterium Bovine
3. Mycobacterium africanum

Tuberculosis



☞ Causative organism:

1. **Mycobacterium tuberculosis**
2. Mycobacterium Bovine
3. Mycobacterium africanum

Mycobacterium Tuberculosis



- ❧ Thin non-motile rod
- ❧ Strictly aerobic
- ❧ Acid fast bacillus
- ❧ Requires enriched culture medium to grow
- ❧ Takes as long as 4-6 weeks to see the colonies

Mycobacterium Tuberculosis



- ❧ Known to affect humans from about 5000 BC
- ❧ Discovered by Laennec in the early 18th century
- ❧ Common in our region and other developing countries
- ❧ Endemic in poor non-developed countries
- ❧ Increasing in developed countries along with the increase in AIDS

Tuberculosis



☞ Affects:

1. Anyone at any age!!
2. More common in the immunocompromised (AIDS, chronic renal failure, substance abuser)
3. Usually affects young individuals in developing countries while it affects the older in developed countries

TB Pathology



∞ Inflammation Hyperemia

∞ TB Follicles (tubercle):

LYPHOCYTE – MONOCYTES

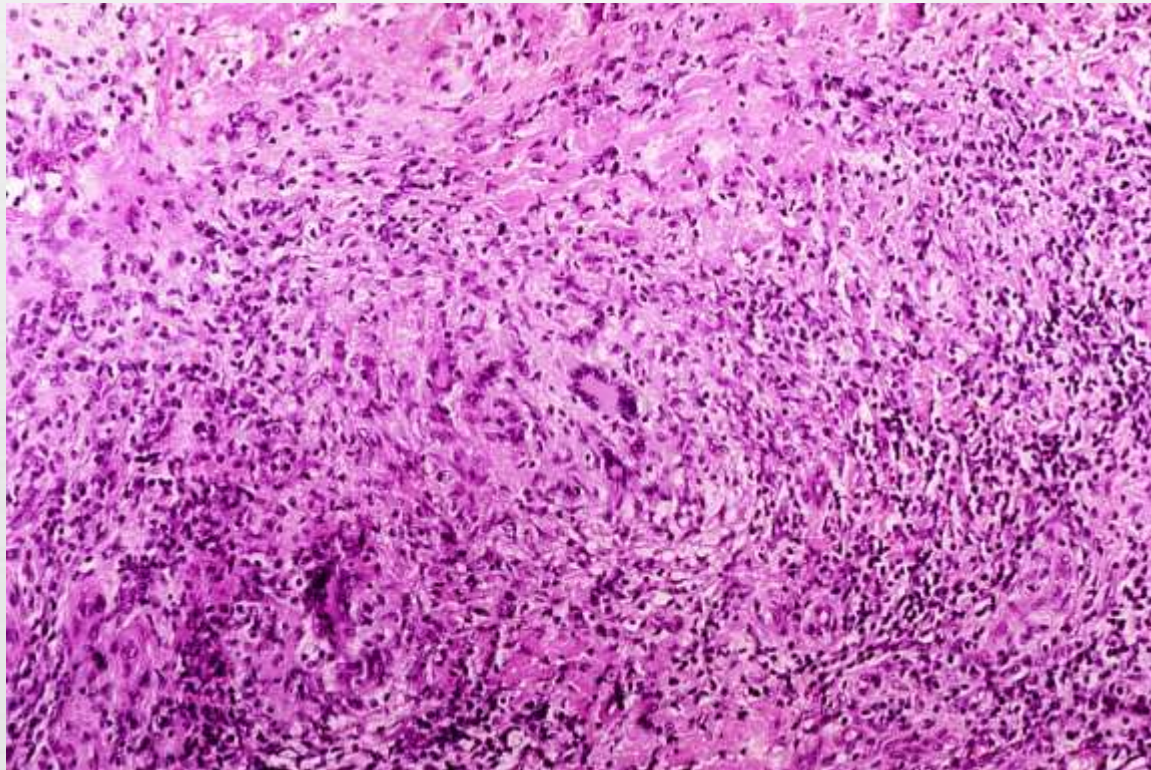
ENDOTHELIAL CELLS

LANGHANS GIANT CELLS


∞ Coalesce

∞ Caseation

TB Follicle



Musculoskeletal TB

- 
- ❧ Secondary to other primary TB lesions
 - ❧ (Pulm., Renal, LN)
 - ❧ 1-8% of all T.B
 - ❧ 50% associated with pulmonary primary site
 - ❧ Route of spread:

Hematogenous ****

Direct (much less)

* bone to joint

* soft tissue to bone

- ❧ The primary lesion

Quiescent

Active: (Apparent, Latent)

Musculoskeletal TB



☞ MSK targets:

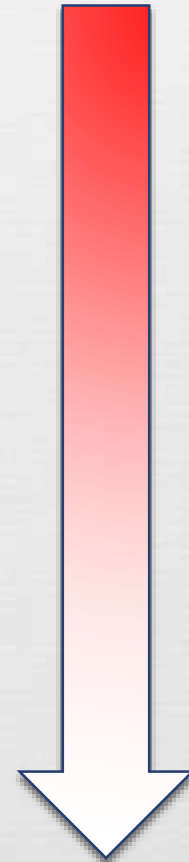
1. Spine (50%)
 - ☞ Thoracic (50%)
 - ☞ Lumbar (25%)
 - ☞ Cervical (25%)
2. Pelvis
3. Hip
4. Knee
5. Ankle and shoulder

Musculoskeletal TB



☞ MSK targets:

1. Spine (50%)
 - ☞ Thoracic (50%)
 - ☞ Lumbar (25%)
 - ☞ Cervical (25%)
2. Pelvis
3. Hip
4. Knee
5. Ankle and shoulder



MSK Tuberculosis



- ∞ Spine:
 - ∞ Deformity (gibbus, kyphus)
 - ∞ Neurological compromise (motor>sensory)
 - ∞ Muscle spasm
- ∞ Joints:
 - ∞ Swelling
 - ∞ Stiffness
 - ∞ Locking
 - ∞ Loss of function
- ∞ Bones:
 - ∞ Ulcers
 - ∞ Sinuses
 - ∞ Swelling
 - ∞ deformity

MSK Tuberculosis



- ❧ Presentation:
 - ❧ Constitutional symptoms
 - ❧ Fever
 - ❧ Wt loss
 - ❧ Night sweats
 - ❧ Anorexia
 - ❧ Pain
 - ❧ Stiffness
 - ❧ deformity

Diagnosis



❧ Radiology:

❧ Plain x-rays:

❧ Joints: usually monoarticular

❧ Peri-articular osteopenia

❧ Subchondral and peripheral erosions affecting both sides of the joint

❧ Loss of joint space

PHEMISTER'S
TRIAD





T.B of The Spine: (Pott's disease)



- ❧ Usually secondary to hematogenous spread
- ❧ Can affect two or more adjacent vertebrae
- ❧ May skip levels
- ❧ Primarily does not affect the disc but eventually the disc is affected

T.B of The Spine: (Pott's disease)



- ❧ Affects most commonly the anterior part of the vertebral endplates
- ❧ Causing erosion and destruction and finally anterior wedging of the vertebrae
- ❧ The disc herniates into the weakened and destructed body and narrowing of the disc height follows

T.B of The Spine: (Pott's disease)



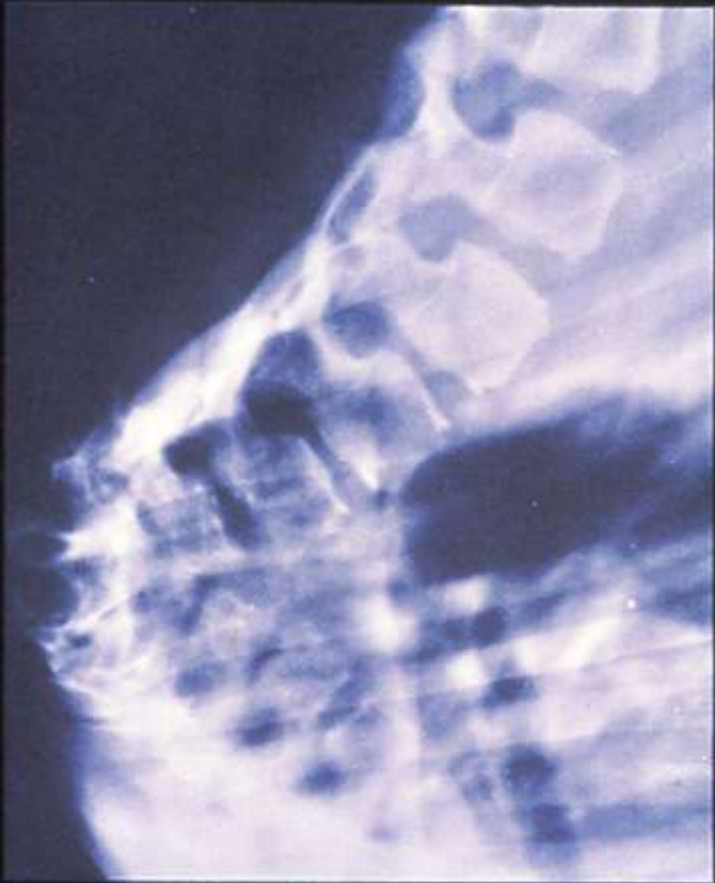
- ❧ Infection spreads to adjacent level under the longitudinal ligaments and hematologically
- ❧ Eventually a kyphotic deformity occurs
- ❧ Para vertebral abscess is common and may be distant as well
 - ❧ Cervical > retropharyngeal abscess
 - ❧ Lumbar > psoas abscess
- ❧ Compression of the spinal cord is more likely to occur at the thoracic level

T.B of The Spine: (Pott's disease)



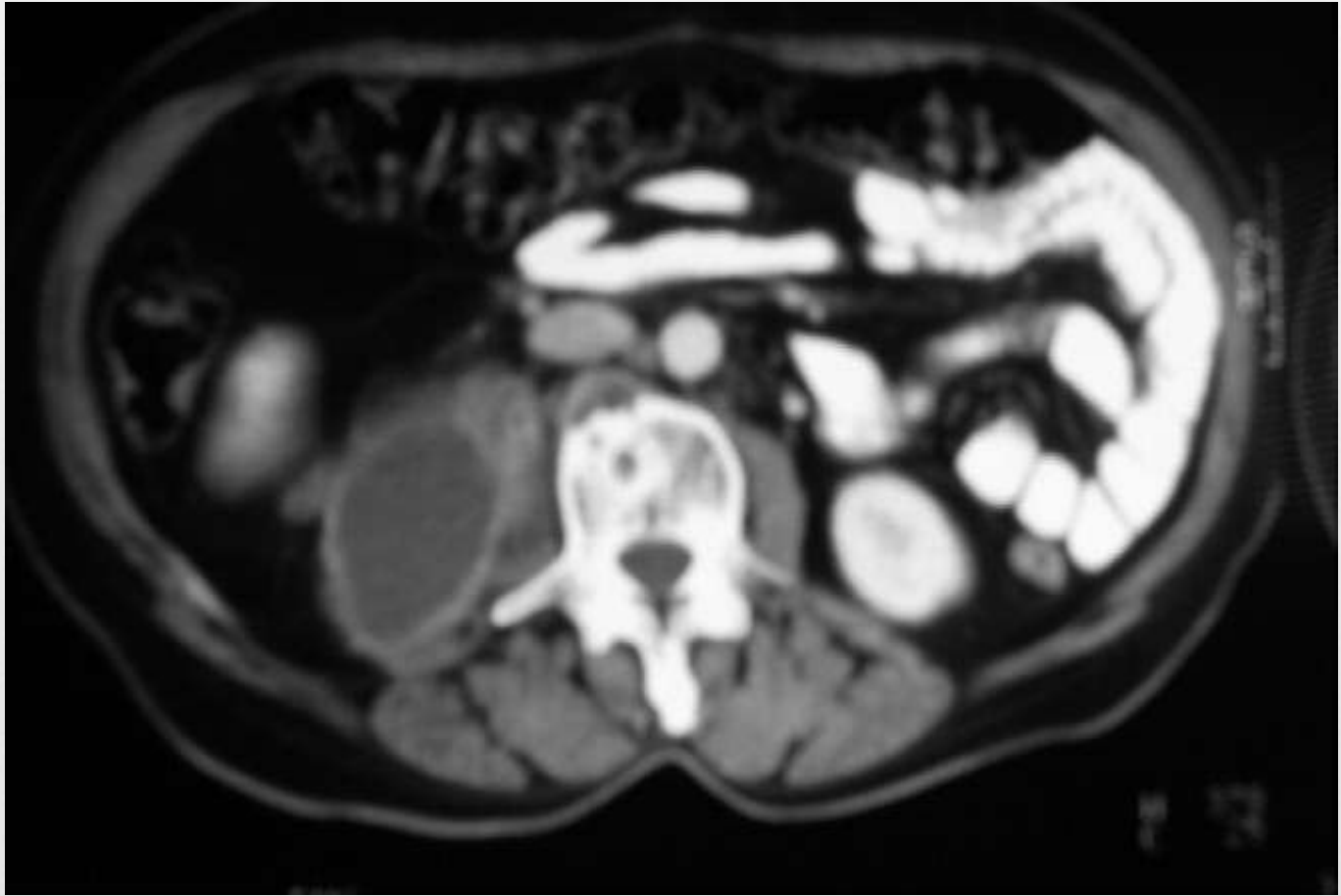
- ❧ Neurological deficits occur due to the compression secondary to the deformity or compression from the abscess
- ❧ Paraplegia may occur
- ❧ Reversible if treated early
- ❧ Mostly treated non-surgically











Diagnosis



- ❧ History and physical
 - ❧ High risk
 - ❧ Constitutional symptoms
 - ❧ Atypical clinical picture

- ❧ Blood work:
 - ❧ Lymphocytosis
 - ❧ Anemia
 - ❧ Elevated ESR
 - ❧ ELISA
 - ❧ PCR
 - ❧ Brucella titre

Diagnosis



- ❧ Radiology:
 - ❧ Plain x-rays:
 - ❧ Spine:
 - ❧ Erosion and destruction of end plates
 - ❧ Narrowing of disc space
 - ❧ Soft tissue mass shadow
 - ❧ Anterior wedging of vertebrae
 - ❧ Kyphus deformity

Diagnosis



- ❧ Radiology:
 - ❧ Computerized tomography:
 - ❧ Further delineate bony destruction and sequestrum
 - ❧ Magnetic resonance imaging with contrast:
 - ❧ Soft tissue mass, abscess
 - ❧ Nerve root, cord status
 - ❧ Distant abscess
 - ❧ Non-enhanced cold abscess with enhanced peripheral ring

Diagnosis



- ❧ Special tests:
 - ❧ Mantoux skin test
 - ❧ Spine:
 - ❧ CT guided needle biopsy
 - ❧ Joints:
 - ❧ Synovial aspiration---- low yield
 - ❧ Should get bone/soft tissue

Send for aerobic/non-aerobic bacteria, fungal, AFB,
enriched culture media

Takes up to 4-6 weeks

Treatment



- ❧ Mainstay of treatment is combination anti-microbial agents.
- ❧ Usually 3-4 medications needed
- ❧ Isniazide, Rifampin, Ethambutol, Pyrazinamide are commonly chosen
- ❧ Modify according to culture results
- ❧ Given for prolonged period of time (6 months up-to 18 months)

Treatment



∞ Indications of surgery:

1. Marked and progressive neurological deficit not responding to medical treatment requiring decompression
2. Spinal instability requiring stabilization
3. Tissue biopsy to confirm diagnosis
4. Joint lavage and removal of rice bodies
5. Abscess drainage if resistant to conservative treatment

Brucellosis



∞ Milk and milk products

∞ Back pain and stiffness

Muscle spasms

Fever (mild)

∞ **Sacro-iliac joint**

∞ Less destructive than TB

∞ **Brucella titer**

∞ Antibiotics:

e.g. Septrin - Oxytetracycline

Take home messages



- ❧ Be aware about red flags
- ❧ Acute osteomyelitis: Empirical wide spectrum IV Abx till final culture
- ❧ Chronic osteomyelitis: IV Abx according to C/S
- ❧ Septic arthritis:
 - ❧ Joint aspiration under GA for children
 - ❧ Emergency Joint washout
 - ❧ Required Immediate wide spectrum IV Abx till final culture
- ❧ Bone and joint infection requires prolonged antibiotic