



[Color index : **Important** | **Notes** | Extra] Editing file [link](#)

Bone and Joint Infections

Objectives:

- ★ What is bone and joint infection?
- ★ Why we consider bone and joint infection as a red flag.
- ★ How does the presentation in children and adults differ.
- ★ What are the most involved organisms in children and adults.
- ★ How do we diagnose and confirm diagnosis of bone and joint infection.
- ★ Principles of management of bone and joint infection.
- ★ Complications of bone and joint infection.

Previous OSCE scenarios:

(OM) 6yr old girl presents with R hip pain assoc. w/ painful gait. Take a complete history.

(Septic Arthritis) 49 yr w/ shoulder pain. Take history.

Done by: Malak AlHamdi

Edited By: Bedoor Julaidan

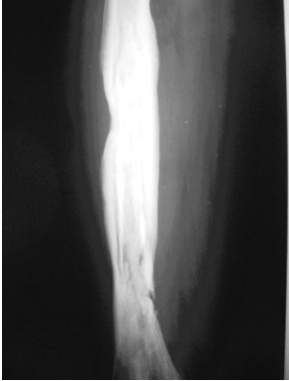
Revised by: Dalal Alhuzaimi

References: 435 Lectures And Notes

Introduction

- ★ Bones and joint infections are red flags. (like open fractures, compartment syndrome...etc) **If we don't diagnose or manage early, the patient may have problems all of his life or it may destroy or deform a limb or a joint**
- ★ We're going to discuss:
 - **Bone infection** = Osteomyelitis which can be acute, sub acute, and chronic. (Osteo means bone, mylitis infection of the bone marrow).
 - Less common bone infections: Tuberculosis, brucellosis, syphilis, and fungal. **Long time ago, TB and brucellosis were common. Nowadays are rare.**
 - **Joint infections.**

★ Fancy Bone terminology we're going to use:

Sequestrum - Dead Bone	Involucrum	Plain x-ray showing: Large sequestrum inside involucrum.
1. separated piece from its surroundings. 2. This happens when blood supply is cut off from area of bone due to infection (bacteria forming a compressive mass). we don't want to reach this stage, bc once we reach it, we need to do surgery to remove sequestrum	New bone formed at site of infection and trapping a cavity of bone. The body tries to attack the bacteria, and prevents the infection from spreading so it forms new callus to trap it and repair.	

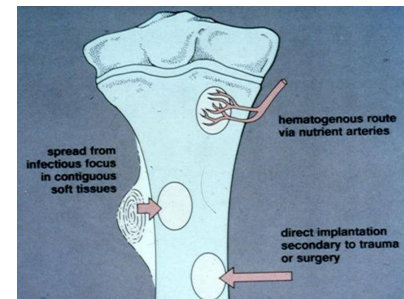
When describing an x ray we use (كلويكا) the term مثل البيت الخربان the bone has multiple areas of discharging pus coming from the cortex.

ACUTE Osteomyelitis

It's a serious condition. Can spread by:

Hematogenous (most common): via bloodstream from the infected focus in the body.

Direct spread: from infected nearby tissues, or following an open fracture, stab wound, or (iatrogenic) during surgery when introducing new non-sterile objects. How does it spread in hematogenous? the pt had pneumonia or tooth abscess so the bacteria enters the bloodstream.

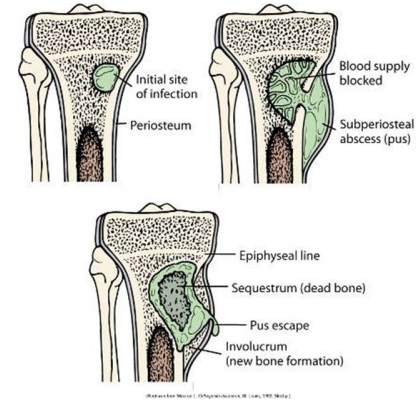


Pathophysiology

These days we usually see it in children. Most common location is the metaphysis (why?) because of the rich blood supply. **Infection starts at the (medulla) bone marrow.** There are many channels inside the bone, so if the bacteria enter there, it can hide and spread easily (infection getting out of control) and this happens within hours. After that the infection starts leaking from inside the bone to outside the bone through haversian canals to cortex **lifting up the periosteum** (which is extremely sensitive thus causes PAIN). The **swelling becomes tense** and this increases the pain. Local **blood vessels get obstructed** (by the bacteria which formed abscess and mass). If we delay the treatment, the periosteum bursts into soft tissues and pus becomes under skin; eventually spontaneous discharge.

Now the blood supply is cut off so the bone becomes necrotic and forms what we call a **SEQUESTRUM** which is separated from the surrounding. We should not reach this because we need to remove the sequestrum by surgery. If pus bursts into epiphysis; epiphyseal arrest will occur.

We should stop the disease progress during the first phase in the picture on the right. infection → lifts periosteum (pain) → abscess enlarges → vessels obstructed → blood supply cut off → sequestrum.



Diagnosis

1. Clinical picture.
2. Blood investigations
3. Radiological investigations.

Definite diagnosis: Identifying and obtaining organisms **from the site of the infection** (not the blood, because it can be any infection. but we need bacteria from the bone.) . (تقبض على المجرم بمكان الجريمة بالجرم المشهود (قولوها 5 مرات بسرعة) .)

Clinical Picture

Keep in mind, that based on this you'll have a list of differential diagnoses. (Nope, it's written correct. One diagnosis, multiple diagnosEs).

- Usually ill **child**. Even if the child is already ill and has infection somewhere else in the body, if he has acute osteomyelitis he will become more ill.
- Generally they complain of **Pain, fever, malaise, refuse to eat, restlessness, loss of function** (which is weight bearing in lower limbs) the child is not moving involved limb and unable to bear weight on it if it was at lower limb usually.
- Locally there's swelling "Soft tissue abscess" **with pain** at a limb usually near a joint like knee or hip or shoulder, **and if it came near the skin redness** with increased local temperature.

Let's talk specifically about the acute hematogenous osteomyelitis (OM)

- ★ Caused by blood-borne organisms.
- ★ More common in **children (Boys > girls)**.
- ★ most common in long bone metaphysis or epiphysis
- ★ **Lower extremity** > upper extremity **but can happen in the skull, Shoulder basically anywhere.** The child will take position of rest where it's least painful. At the picture assume the infection in the hip. so the there's flexion and external rotation. In upper limb, the child holds the arm to his body (the patient uses his trunk as splint).



Differential Diagnosis


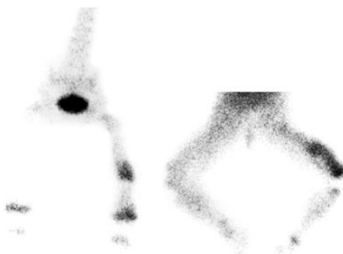
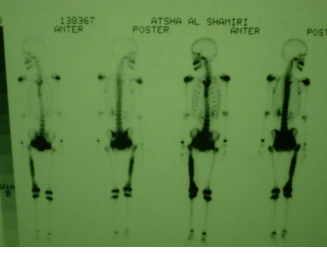
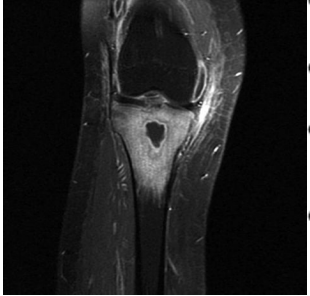
- **Acute septic arthritis,** • **Cellulitis.** (spreading infection of the skin)
- **Ewing's Sarcoma, lymphoma.** Malignant rapidly growing tumor affecting children, in the metaphysis or shaft.
- **Sickle cell bone crisis.** If dehydrated
- **Acute rheumatoid arthritis.** Multiple joint pain usually, but sometimes one joint with NO BACTERIA.

Blood Investigations

- ★ **CBC and differentials:** usually raised white cell count; predominantly polymorphs. Normally WBC 4000-10000. The child comes with 16, 24 thousands.
- ★ **Elevated ESR, and C-reactive protein (CRP is the most sensitive monitor.)**
- ★ **Positive blood culture** in up to 50% of cases; if blood is drawn whilst there is spike of fever. takes 24-48 hrs to grow and sometimes 5 days. BUUUUT we can do direct smear, we see bacteria that means there's so many bacteria in the blood. IMPORTANT: if culture came -ve does that exclude infection? NO! (maybe the patient took antibiotic or the bacteria weren't present in the blood)

Radiological Investigations

- ★ **Early plain x-rays** may not reveal any findings except soft tissue swelling at site of infection. Bony changes like sequestrum take up 10-14 days to show suspected bone involvement, but osteopenia may appear earlier (not diagnostic). We do x-ray even though it doesn't show changes → comparison with subsequent x-ray after 7-14 days
- ★ **Ultrasound:** may diagnose soft tissue swelling or abscess early, but it is operator dependent.
- ★ **Isotope bone scan:** Nuclear medicine isotope bone scan: Tcm99 bone scan (Technetium 99) or Gallium bone scan are diagnostic, as increased local tracer uptake; but take time to appear. Give the child isotope and then wait for 24-48 hours to take the pic. Not useful in acute osteomyelitis
- ★ **MRI: best** tool for radiological diagnosis as it is sensitive and specific, but difficult in young children as they require general anesthesia. shows changes in soft tissue and bone marrow.
- ★ So we either depends on MRI or the clinical picture or go directly to the suspected area and puncture the bone with needle after giving analgesia (The bone is soft in children, you can puncture the bone with thick needle) normally blood will come out. In case of infection → pus (yellowish thick material)
- ★ **CT?** best in chronic OM because it shows the sequestrum.

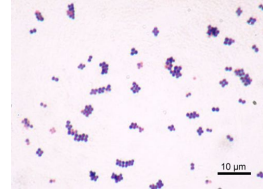
<p style="text-align: center;">Plain X-rays</p>  <p>Could be acute Rickett's</p> <p>In early days: NO bony changes, but soft tissue swelling may be evident.</p>	<p style="text-align: center;">Isotope bone scan</p>  <p>In this scan there is: Increased uptake in the lower left femur</p> <p>useful in delayed cases, when we want to check if there is more than one focus of infection "if we treated one place but the child is not improving"</p>
<p style="text-align: center;">Isotope bone scan</p>  <p>Increased uptake of most of right femur</p>	<p style="text-align: center;">MRI</p>  <ul style="list-style-type: none"> • shows changes in bone and bone marrow before plain films • decreased T₁-weighted bone marrow signal intensity • increased post gadolinium fat-suppressed T₁-weighted signal intensity • increased T₂-weighted signal relative to normal fat

Confirm Diagnosis

- ★ **Ultrasound guided aspiration** from site of swelling or abscess. **children's bone is soft.**
- ★ **X-ray guided aspiration** of suspected bone involvement (according to MRI).
- ★ **Open incision –drainage** procedure (drilling of bone) when there is high suspicion. **مثل التلقيب عن النفط.**
Aspirated or obtained material at open incision are **sent urgently for Direct Smear and C&S** including anaerobic, TB (**ziehl-neelsen stain**) and Fungal. **Early results of smear doesn't give the exact bacteria but it will say yes there is infection**
- ★ **Histopathology** examinations are recommended as well.

Definite Diagnosis

By **histopathology**, depends on seeing organisms at direct smear, or culturing organisms. It's important but usually result is late. **Most common (90%) is staph aureus.** We start treatment as staph aureus but if the child is very ill we add antibiotic that covers gram negative.



Management of Acute Osteomyelitis

1. **Admit Immediately!** When there is suspicion of acute OM.
2. **Adequate hydration and pain relief (analgesia, splintage)** at the same time as investigations.
3. **Obtain material for culture** or sending blood culture when there is fever..
4. **Broad spectrum IV antibiotic** **why IV? because children can vomit the abx if orally.**
5. **Surgery, if indicated.** (drain pus and curette infected material from inside medulla.)

→ Empirical Antibiotic Treatment

- When patient is acutely ill; empirical IV antibiotic treatment to be started immediately after sending samples for culture.

-This empirical treatment depends on suspected organisms according to:

1) Age: Newborn, young or adult.

2) Presence of other circumstances: sickle cell disease or Hemodialysis or drug addicts.

To make it simple: always suspect staph aureus: (oxacillins) except sicklers.

3rd generation IV antibiotics for special cases.

→ Empirical Antibiotic treatment for Sickle Cell Anemia

Salmonella is a characteristic organism.

The primary treatment fluoroquinolones (only in adults).

alternative treatment 3rd -generation cephalosporin.



→ Definitive Antibiotic Treatment

Depends on result of culture of isolated organisms. Always consult ID (Infection Department).

When To Consider Surgery, why, and how is it done?

- ★ If we're sure (from investigations) there is **pus** or highly suspect that there is pus inside the bone or in the soft tissues near bone. We have to drain the pus out to stop bone and tissue destruction and improve the general condition by getting rid of source of infection in the body.
- ★ Patient should be prepared well for surgery. It is done under GA usually.
 - **X-ray guidance** (image intensifier) is used usually to help exact location of site of drainage.
 - **Soft tissue abscess drainage.**
 - **Bone is drilled in the cortex to drain pus and we irrigate with NS, iodine, chlorhexidine (mechanical decontamination) and curette infected material from inside medulla. Then send it to histopathology**
In case of presence of sequestrum it has to be removed.
Drain is to be left at site of drainage till discharge is minimal.

Keep in your mind, most of the time you have to do surgery. Except in certain cases that presented early (no pus)! where treatment with broad spectrum antibiotics was successful

Post Operative Management

- **Definite** antibiotic should be continued via IV route **for 6 weeks usually.**
Monitoring of general condition and blood investigations should be done frequently as in patient, especially CBC, ESR and CRP.
- Repeat follow up plain X-rays or CT or MRI may be required.
- Patient should be pain free and generally well before discharge.
- Long term follow up should be done to exclude late complications.

Complications

Complications of Acute Osteomyelitis

Septicemia	Distant abscesses	Septic arthritis
Growth disturbance in skeletally immature	Pathological fracture	Chronic OM



Destruction of epiphysis with bone changes



Pathological fracture

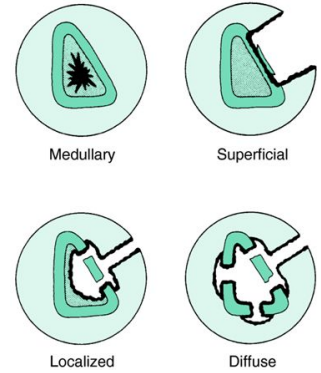


Chronic osteomyelitis with sequestrum

Chronic Osteomyelitis

Anatomical classification (Cierny-Mader classification)

- ★ **Type I: Medullary** Confined to medullary bone
- ★ **Type II: Superficial** Confined to Surface of bone
- ★ **Type III: Localized** Full thickness cortical sequestration
- ★ **Type IV: Diffuse** Loss of bone stability



Features

- Common in Inappropriately treated acute OM **presences of sequestrum “source of bacteria”** antibiotics cannot reach it, trauma, immunosuppressed, diabetics, IV drug abusers.
- **PUS DISCHARGE** أكثر فيتشر! Maybe after surgery.
- 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, **anything that wasn't useful in acute is useful here: plain x rays, CT scans.**
- Best test to identify the organisms → Operative sampling of deep specimens from multiple foci
- **Most common organisms:** S. aureus, Enterobacteriaceae , P. aeruginosa.

Treatment

Empirical therapy is not indicated. and IV antibiotics must be based on **deep cultures**.

- ★ **Glycocalyx** (the sneaky bacteria when there's a cell coming to attack them or when they sense an Abx, they form a circular shield around them. Most commonly under the plate and screws, so if it happened we have to remove them). This happens **after surgery and after total knee replacement**.

exopolysaccharide coating that envelops bacteria and enhances bacterial adherence to biologic implants

What to do? Hardware has to be removed, but stability should be maintained (consider Ex-Fix)



Surgical Debridement :

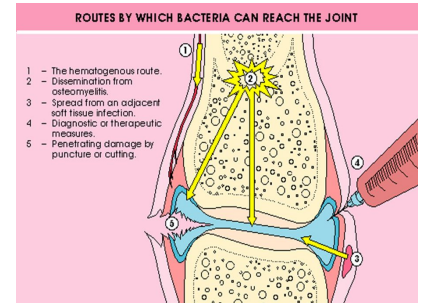
- complete removal of compromised bone and soft tissue. **using curette.**
- **Hardware**
 - most important factor
 - **almost impossible to eliminate infection without removing implant.**
 - organisms grow in a glycocalyx (biofilm) shields them from antibodies and antibiotics.
- bone grafting and soft tissue coverage is often required.
- amputations are still required in certain cases.



Septic Arthritis

▶ [Osmosis video!](#)

- ★ Infection of the joint. starts in the synovium eventually producing pus.
- ★ May affect any age and any joint. (the joint's function is movement)
Infections starts at the synovium swollen synovium producing pus
- ★ The knee, hip and shoulder are most affected.
- ★ Sometimes when taking a history, there's a history of fall (trauma).



Pathophysiology

- Hematogenous
- Or infection from the bone acute OM
- Direct Injury
- Nearby infection
- Iatrogenic by inserting injections with inadequate sterility. this is unique to the joint. **We could bring this in OSCE.**

In neonates: transphyseal vessels

In joints where the metaphysis is intracapsular (**Hip, shoulder, knee**, proximal radius and distal fibula) Large joint, why? rapidly growing with good blood supply.

Clinical Picture

Symptoms

like Acute Osteomyelitis. General, and local **REDUCED mobility. Position of rest even more here.** He refuses any movements to the joint.

Signs

hot swollen joint which is **painful** to any motion, inability to bear weight.

Joint is fixed in the position of ease. In the pictures we have septic arthritis of the shoulder and left hip. **Rest position in the shoulder is internal rotation and adduction. The hip is flexion and external rotation.**

Differential Diagnosis

- Acute osteomyelitis.
- Transient synovitis (<10 years). Perthes disease
- Reactive arthritis. Gout, psoriasis
- Vasculitis, eg: Henoch-Schonlein purpura.
- Traumatic hemarthrosis.
- Haemophilic arthritis

Main Differential Diagnosis is transient synovitis of the hip.



Investigation

- ★ **Basic lab for infection** (CBC,ESR and CRP) and Blood cultures.
- ★ **Plain films and Ultrasound.** **ULTRASOUND in SA is more useful** here than in OM.
- ★ **Joint aspiration:** WBC >50,000 (>90%PMNL), damaged WBC and No crystals. **We look at the fluid first, then we send for direct smear, ziehl neelsen smear, and culture for aerobic and anaerobic.** "+ biochemistry lab "crystals"
If single joint, to differentiate between SA and RA we have to do Rheumatoid arthritis factor and nuclear antibody factor.
 - **Organisms:** similar to Acute Osteomyelitis.
 - **Definitive Diagnosis:** isolation of joint bacteria.



Management of Septic Arthritis

- ★ **Emergency drainage of the septic joint:** either arthroscopic, Or Open.
 Joint should receive lavage (10 L of NS) and debridement, and a drain should be left at joint till discharge is clear and minimal. **In suprapatellar pouch, in 2 places**
We start with empirical until we confirm the organism then IV antibiotics should be administered for 4 weeks.

Complications

Complications of Septic Arthritis

Septicemia	Abscess	Osteomyelitis	Joint destruction
Joint subluxation and dislocation ¹	Avascular necrosis of the femoral head	Ankylosed joint ²	Growth disturbance

¹ With destructed articular cartilage. In children, after definite treatment of septic arthritis we put them in hip spica to prevent hip dislocation

² If the infection lasts for several days without treatment, synovium starts to secrete fibrin "fibrous tissue" → ankylosed joint. Even if we treat it, the whole ROM will not come back completely

Tuberculosis (Granulomatous bone infection)

- Tuberculosis is chronic bone infection that may affect any age. **reactivation of infection usually.**
- **Causative organism is: Mycobacterium Tuberculosis.** It is acid fast bacillus. When bacillus is seen it is diagnostic of TB. Can be diagnosed sometimes by direct smear.
- It takes up to **6 weeks** to culture.
- **In current time it's** Endemic in poor underdeveloped countries. Still present sporadically at Saudi Arabia.
- In developed countries TB patients are immunocompromised patients. (AIDS and drug addicts)

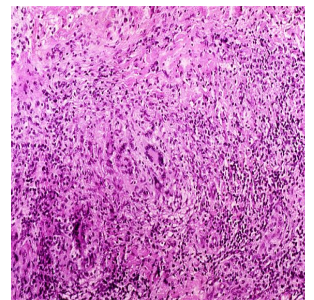
To Confirm Diagnosis

★ Histopathology

- **We need to see acid fast bacillus.** Also to see: Langhans giant cells.
Or to see: caseation in a bed of lymphocytes and monocytes. **Multinucleated cells, stroma of lymphocytes.**

We can diagnose TB either by direct smear, or by culture which takes 6wks.

TB Follicle



Pott's disease (TB in the spine)

- Affect any part of spine; **most commonly dorsal spine. Sacroiliac joint.**
- Can lead to **dorsal kyphosis.** **Destruction of vertebral body, there will be collapse.**
- Famous for causing psoas abscesses and paraspinal abscesses.
- TB spinal abscess may compress spinal cord= Pott's paraplegia.
- Compression of the spinal cord is more likely to occur **at the thoracic level.** Neurological deficits occur due to the compression secondary to the deformity or compression from the abscess.
- Infection spreads to adjacent level under the longitudinal ligaments and hematologically.
- Eventually a kyphotic deformity occurs
- Compression of the spinal cord is more likely to occur at the thoracic level
- Neurological deficits occur due to the compression secondary to the deformity or compression from the abscess
- Paravertebral abscess is common and may be distant as well, Cervical > retropharyngeal abscess, Lumbar > psoas abscess.
- **Reversible if treated early. Mostly treated non-surgically.**

TB spine, Dorsal kyphosis



Diagnosis

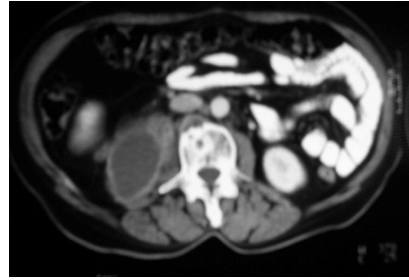
★ Radiology - Plain x-rays (Spine)

- Erosion and destruction of end plates.
- Narrowing of disc space.
- Soft tissue mass shadow.
- Anterior wedging of vertebrae.
- Kyphus deformity.

★ Special tests

- Tuberculin (Mantoux) skin test.
- Spine - **CT guided** needle biopsy
- Joints - Synovial aspiration, but it's low yield.
 - Should get bone/soft tissue. Send for aerobic/non-aerobic bacteria, fungal, AFB, enriched culture media **Takes up to 4-6 weeks**

TB spine with Psoas abscess



MRI: TB lesion of dorsal spine



TB of the musculoskeletal system (parts other than the spine)

Clinical Picture:

Secondary to TB at lung, kidney, bowel and lymph nodes.

- ★ **Symptoms:** Fever, malaise, weight loss and night sweat → May not be present these days.
- ★ Suspicion of disease by previous history of TB presence of osteopenia and loss of joint space.



Management of TB

★ Usually non surgical by Triple or Quadruple drugs=

- Isoniazid (INH), Rifampicin, Ethambutol, Pyrazinamide. We don't use streptomycin because it causes ototoxicity
- Drug therapy to continue up to **18 months.**

★ Surgery in TB is done to relieve pressure

Surgery to be done to evacuate abscess, or decompress spinal cord, or to stabilize joint or spine.

Brucellosis

- Milk and milk products.
- Now less incidence in Saudi Arabia due to milk pasteurisation and awareness about not consuming unboiled camel's milk.
- Less destructive than TB.
- Affects **Sacroiliac** joint.

★ **Symptoms:** Back pain and stiffness, Muscle spasm, Fever (mild).

★ **Diagnosis:** CT guided aspiration, Brucella titer: **Diagnostic if > 1/640**)

★ **Treatment:** Antibiotics (Rifampicin – Doxycycline- Septrin)

★ Case - A patient suspected of having Brucellosis Right Sacroiliac joint

Young patient= 17 years old.

Complaining of severe Low Back Pain radiating to right buttock.

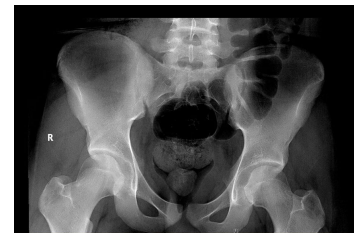
Has antalgic gait right lower limb.

Very tender over Right S-I joint.

ESR= 35mm/1st hour

CRP= 45

Drinks camel milk every weekend.



After 4 weeks

Patient is pain free.

Normal gait.

ESR=4

CRP=2



CT guided needle Aspiration
Right Sacro-Iliac Joint