

التييم عبارة عن سلايدات المحاضرات بالإضافة إلى شرح الدكاترة

حاولنا تقديم المادة بأفضل ما نستطيع

لذا إن وجدتم أي خلل أو خطأ فاعذرونا وبلغونا حتى يتم تصحيحه

نتمنى لكم التوفيق و السداد

لا تنسونا من دعواتكم

Bone and Joint Infection

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F1 lecture notes added by : **Fatima Alkhashram**

It is the doctor slide + the recorder

The doctor began the lecture with this scenario, it almost summaries the whole lecture:

How to approach to such patient?

You are the emergency doctor, a 6 year boy came to you with fever with hip pain for 2 day, the mother say he developed this symptoms after falling down from مركبة. So what is the further information you need?

- Previous infection >> yes he have URTI 2 week ago, it treated with analgesic & Ab
- Any previous similar presentation>>NO
- It imp to ask about the fever in details
- Hx of trauma" what kind of trauma, it is major" >> fall down is common it just here to track you☺
- After falling down it was difficult to him to walk

In PE: Limited range of movement, inability to weight bear and redness around the hip joint

So know what you ddx?

- Infection (osteomyelitis of proximal femur, septic arthritis of hip)
- Fracture
- Hip dislocation(weak)

Investigation, how does it help?

- CBC
- WBC : look for neutrophil , it will be very high
- ESR "very imp": why? It indicate inflammatory process going on > even in trauma it will be high but not as high as infection
- C reactive protein "very imp": why? Indicate acute infection

Why it imp in orthopedic specially an infection? because it have a very imp characteristic in the treatment of osteomyelitis , it is the most common motoring test but on the other hand the ESR will take long time to go up and go down but the CRP

will be very quickly to respond to Ab, within one week you will start notice it coming down .

In this case it `s simple septic arthritis of the hip.

Rx:

1-Ab> broad spectrum, why? Because we do not know the organism

We send blood culture then after 4-5 day when we know organism we will treat according to the culture result

Just memorize these 3 word broad spectrum Ab (empirical Ab)

2-clean up the joint" orthopedic surgeon wants to do surgery"

Why? because of the destruction of the cartilage, if you wait the joint will be gone within 2-3 day, so you have to be very aggressive in case of septic arthritis, be aggressive in treatment and take the patient to the OR for I&D, do all what you can as early as possible, even if you have atypical presentation take patient to OR.

do we do surgery for all patients?

Yes, for everybody except very small number of them.

Ok, tow things 2 remember:

- Empirical Ab
- I&D

Now let begin the lecture 😊

Introduction

- This is an overview
 - Initial treatment based on presumed infection type clinical findings and symptoms
 - Definitive treatment >> based on final culture
 - **Glycocalyx**
 - exopolysaccharide coating
 - envelops bacteria
 - enhances bacterial adherence to biologic implants
- Note: glycocalyx: it's the polysaccharide present in the area of infection when there is a metal, so if there is infection around the plate (in prosthetic knee, hip, shoulder the infection will not resolve by itself. glycocalyx form protection shell around the bacteria so whatever Ab you give it will never reach the bacteria.

Bone Infection:

According to the host response, infections of the bone are divided into: Pyogenic and granulomatous:

- Pyogenic infections "note: some time they even came together"
- Acute and chronic osteomyelitis
- Septic arthritis
- Granulomatous infections (e.g. TB, syphilis).

Osteomyelitis

• Classification

- Duration:
 - Acute, Sub-acute and Chronic
- Route of Infection: **IMP**
 - **Hematogenous** : blood-borne organisms

Note: it most common route, like sore throat , infection until it settle in the bone or (even joint).

- **Exogenous**: direct inoculation >> Open fractures

Note: like open fracture , injury (stepping), needle break

- **Definition:**

– **Osteomyelitis** is infection of bone and bone marrow.

Note: bone not like joint we are here not scared of destruction but the problem that

it may progress to chronic osteomyelitis then it disaster, it will not resolve with Ab,

it need long time treatment & multiple surgery , so you want to stop this.

– **Determination of the offending organism**

- Not a clinical diagnosis
- Deep culture is essential

Acute Hematogenous OM

Clinical Features

- caused by blood-borne organisms
- More common in children
 - Boys > girls
 - most common in long bone metaphysis or epiphysis
 - Lower extremity >> upper extremity
- Pain
- Loss of function of the involved extremity
- Soft tissue abscess



Note:

A boy who came to the emergency with swelling hip and unable to walk.

Typically they present sitting in this position " it's the most comfortable sitting for them "As

it give infection more space with the extending , give more relieve for the bone .

So remember fever plus inability to walk >> suspect infection of bone

Proximal femur osteomyelitis can lead to septic arthritis.

Radiographic Changes

- soft tissue swelling (early)
- bone demineralization (10-14 days)

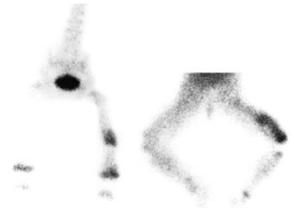
- **sequestra** → dead bone with surrounding granulation tissue >> later
- **involucrum** → periosteal new bone >> later

Note:

- In x-ray most of the time you will see nothing , you might see some soft tissue
Swelling in early >> إذا كنت أورتوبيدك فلتنه يعني , x-ray do not show good soft tissue
but it helpful .
- Helpful in acute
- Why sequestra are important? It a dead bone , we need to take it out , as there is
- no blood supply to fight bacteria so no protection
- Later >> mean it start to enter into chronic stage
- " they are imp in the Rx & Dx , but in our level they are imp to tease us with them " بالعربي يحبون يدوخون الطلاب فيهم"

Diagnosis

- elevated WBC count
- elevated ESR
- Blood cultures >> may be positive
- **C-reactive protein:**
- **most sensitive monitor of infection course in children.**
- short half-life: dissipates in about 1 week after effective treatment
- Nuclear medicine studies >> may help when not sure



Note: Have patient from far area he had URTI one week ago , late he develop pain , went

to primary care gave him Ab then came to you here in Riyadh complain of inability to walk

and have pain ,now what you are going to do?!

Do wbc >> bored line high but not high as typically in infections , it been masked by the Ab given to him , now you are in a dilemma " treat or not , go to OR ?!!WHAT TO DO"

Here we will use other diagnostic modalities:

Bone scan >> easy to book but it not informative as MRI

– **MRI:**

- 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

note:

- You cannot do MRI as first modality if you can Dx simple test.
- And if you do MRI and it indicate patient have infection , you take him to OR ,
clean the joint , give him Ab. then after 2 day he still have fever, Ab is not effective, so know what you will do ?!!! you need to start with basic.
- MRI may even not be done at all. Ok the most important we need to know that MRI
Can be really helpful in dx of osteomyelitis.
- The problem with infection in MRI: that infection mimic every things , if you see infection think about malignancy and if you see malignancy thing about infection .

Treatment Outline

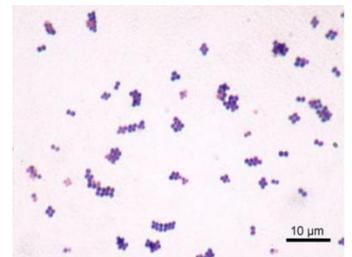
- identify the organisms
- select appropriate antibiotics
- deliver antibiotics to the infected site
- halt tissue destruction

Empirical Treatment:

Note: Each age group will be cover with different Ab , it is not important the type of Ab it is only to give you broad view , what is more importante: that we will use broad spectrum Ab, classically we began with the simple Ab .

Newborn (up to 4 months of age)

- **The most common organisms:**
 - *Staphylococcus aureus*
 - *gram-negative bacilli*
 - *group B streptococcus*
- Newborns may be afebrile > best predictors are local signs in the extremity
- Almost 70% of newborn > positive blood cultures
- **Primary** empirical therapy includes



- nafcillin or oxacillin plus
- 3rd -generation cephalosporin >> note: notice here we give 3rd generation because they have poor immunity.

- **Alternative** antibiotic therapy
- vancomycin + 3rd-generation cephalosporin.

Note :Newborn maybe afebrile because they have immature immune, so they present with atypical presentation , you must have high suspicion, ok how they will present ? crying, mom say the baby start to cry(scream) whenever I touch the hip

Children 4 years of age or older

- **most common organisms**
- *S. aureus*
- *group A streptococcus*
- *coliforms* (uncommon)
- **empirical** treatment >>nafcillin or oxacillin
- **alternative** regimens >>vancomycin or clindamycin
- gram-negative organisms >>3rd -generation cephalosporin
- **Haemophilus influenzae bone infections** almost completely eliminated >>due to vaccination note: even in the past it was not the most common organism

Adults 21 years of age or older

- **most common organism**>> *S. aureus*
- wide variety of other organisms have been isolated
- Initial empirical therapy >>includes nafcillin, oxacillin, or cefazolin;
- Alternative initial therapy >>vancomycin

Note:Problem with adult that they have other bacteria and they may present with difficult infection

Sickle cell anemia

- *Salmonella* is a characteristic organism
- The primary treatment fluoroquinolones (only in adults)
- alternative treatment 3rd -generation cephalosporin

Note: Why we separate this group from other?

They are very strange and difficult to Dx, why?

They present with crisis which mimic osteomyelitis and septic arthritis , they scream, have pain, fever , inability to walk, so they came to emergency, treat as a crisis , but at the end you discover that they have osteomyelitis



- Are you going to treat him as crisis or as osteomyelitis? They have different treatment in crisis you will give supporting therapy and you may give Ab but you will not do I&D.
- Good orthopedic will take this patient to OR even if osteomyelitis is not the highest in his suspicion, why? Because save the patient is more important than saving him a trip to the OR.
- In this patient we have to do every things to Dx, Dose MRI help ? yes MRI is very helpful, even the bone scan will show hot spot, why? Inflammatory process because of the dying bone in the crisis (infracture)
- 3rd generation >> difficult patient which are sick

Hemodialysis and IV drug abuser

• Common organisms

- *S. aureus*
- *S. epidermidis*
- *Pseudomonas aeruginosa*

Note: in I.V drug Still the s.aureus is the most common, but also have s.epiderm come from the skin

- **treatment of choice** >> penicillinase- resistant synthetic penicillins (PRSPs) + ciprofloxacin
- **alternative treatment** >> vancomycin with Ciprofloxacin

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

note: ok now after you start broad spectrum ab what the next step?

Surgery (I&d), Why we do debridement? To stop chronic process (infection) .

Ok now we finished the typical of AHO , now we will speak about the direct way:

Acute Osteomyelitis:

Acute OM after open fracture or open reduction with internal fixation

- **Clinical findings** >> similar to acute hematogenous OM

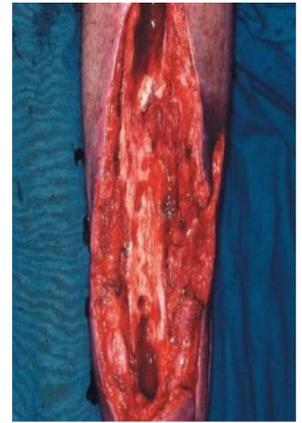
- **Treatment**

- radical I&D

- removal of orthopaedic hardware if necessary:

note>> if it is acute infection you can do only Ab and I&D but if it was chronic you have to take the metal out.

- rotational or free flaps for open wounds >> if needed



Note: Radical I&D: mean you have to be very aggressive , take out every things if you suspect the present of dead tissue , just take it out. It different than conservative I&D

- **Most common** offending organisms are

- *S. aureus*
- *P. aeruginosa*
- Coliforms

- **Empirical** therapy >> oxacillin + ciprofloxacin

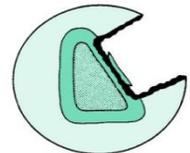
Chronic Osteomyelitis

- **Common in**

- inappropriately treated acute OM (imp)
- trauma
- immunosuppressed
- diabetics
- IV drug abusers



Medullary



Superficial



Localized



Diffuse

Anatomical classification: It is not imp

Note: inappropriate Rx or untreated, why?

- Like for example: patient from A7rymla, you give him Ab for week , but he still have fever on and off, unable to walk , swelling , so now he enter in chronic osteomyelitis ?!!!!!!

- **Features**

- Skin and soft tissues involvement
- Sinus tract >> may occasionally develop squamous cell carcinoma

Why there is sinus? Because there is pus which >> *يَضْغَطُ يَضْغَطُ لِيْنِ فَتْحِ طَرِيقِ وَطَلَعُ*

- Periods of quiescence >> followed by acute exacerbations

Note:

- Usually they came acute phase then it subside for period then suddenly came back, it is typical of chronic
- Typical presentation they will come with one leg shorter than the other and the skin cover it is not normal, and because of the sinus they have discharge.
- Patient will present with difficulty to walk not inability to walk , discharge, no fever, skin cover it is not normal and there is sinus tract, some time they present with acute presentation((because they had discharge then it cover by skin and that stimulate the acute)).
- **Diagnosis**
 - Nuclear medicine >>activity of the disease
 - **Best test to identify the organisms >> Operative sampling of deep specimens from multiple foci**note: blood will be negative

- **Treatment**
 - **empirical therapy is not indicated**
 - Note: Because they are in a chronic infections for long time,wait for definitive tx will, not hurt the patient
 - **IV antibiotics >> must be based on deep cultures**
- **Most common organisms**
 - *S. aureus*
 - Enterobacteriaceae
 - *P. aeruginosa*

- **surgical debridement**

Note:Pic>>One with fracture , treated by plate, people whose did the operation were dirty,now he came with chronic osteomyelitis, know what to do ?



- **complete removal of compromised bone and soft tissue>>**
- note: first stage>> complete is what we mean by radical I&D
- **Hardware**

- **most important factor.**
- **almost impossible to eliminate infection without removing implant.**
- **organisms grow in a glycocalyx (biofilm) >> shields them from antibodies and antibiotics.**

Note:

2nd stage : here we have open fracture, infection and plates

So we have to take it out ,not always but most of the time, **what we mean by most of the time?**

Patient with open fracture 3 month ago, Rx with plate , now the patient present with sinus? how u will treat it? The Rx include:

- empirical Ab>> NO
- Removal of the hardware>> YES
- Aggressive I&D>> YES

– **bone grafting and soft tissue coverage is often required. Note: Bone grafting**

Why we need it ? Because of the gap result after the debridement ,when we took all the dead tissue out, so we need to cover it with bone taken from other area also need soft tissue coverage.

– **amputations are still required in certain cases**

Note: Patient 25yrs present with com after open fracture , you enter him to operation 10 time!! What to do now??!!>> amputation

Subacute OM

- **Diagnosis >> Usually**
 - painful limp
 - no systemic and often no local signs or symptoms
 - Signs and symptoms on plain radiograph
- May occur in
 - partially treated acute osteomyelitis
 - Occasionally in fracture hematoma
- Frequently normal tests
 - WBC count
 - blood cultures
- Usually useful tests

- ESR
- bone cultures
- radiographs >> **Brodie's abscess** >> localized radiolucency seen in long bone metaphyses >> difficult to differentiate from Ewing's sarcoma



- note:
- Brodie's is not always there
- Ewing sarcoma : is one of the DDX, it is aggressive tumore , no skin change. But 60-70% have Rx
- How we can different subacute from chronic OM?
in chronic: there are abnormal skin changes, discharge and sinus most of the time.
In the subacute: it atypical presentation, the atypicality it differe from time to time for example if the patient was Immunocompromised >> you will find him more toward acuteOM
Immunocompetent >>have only treble complaine , with very minaret limp, it a dilemma it can stay for years undiagnosed.
- You may do CT, MRI , bone scan every things and you may get a hint, so no one will blame you as it is atypical presentation.
- Some time they present with limp or low grade fever ., that may increase your suspicion.

Treatment:

- **Most commonly** involves femur and tibia
- it can cross the physis even in older children

Note: We know that acute infection do not penetrate the physis(growth plate)
why? Because it have a rich blood supply, but in subacute it can cross it

- Metaphyseal Brodie's abscess >> surgical curettage
Note:You will not give Ab , at first you will only do curettage and after you confirm Dx , start Ab

Very important subject, it a common presentation and its consequence is very disaster

- Route of infection:
 - **hematogenous spread**
 - **extension of metaphyseal osteomyelitis in children**

Note: extension from the bone (in children proximal femur osteomyelitis) Because the proximal with the capsule of the joint, it consider part of the intrarticular structure, so it can lead to septic arthritis

- **complication of a diagnostic or therapeutic joint procedure**

Note: iatrogenic or therapeutic: like one with early osteoarthritis came for injection and you do not follow sterile technique you induce septic arthritis, also like in knee swelling aspiration

- Most commonly in infants (hip) and children.
Note: S.A is more in young age specially the hematogenous route

- **metaphyseal osteomyelitis can lead to septic arthritis in**
 - **proximal femur >> most common in this category >> imp**
 - **proximal humerus**
 - **radial neck**
 - **distal fibula**

As they are part of the intrarticular

- Adults at risk for septic arthritis are those with
 - **RA :**
 - tuberculosis >> most characteristic, **not most common**
 - *S. aureus* most common
 - **IV drug abuse >> Pseudomonas** most characteristic

- **Empirical therapy >>** the only reason the doctor put the empirical Ab First, to let us know that S.A it treated with Ab.
 - prior to the availability of definitive cultures
 - Based on the patient's age and/or special circumstances

Note: They will not ask about the type of Ab, most imp to know its broad spectrum And that each age group have their own organism

- **Newborn (up to 3 months of age)**
 - **most common organisms :**

- *S. aureus*
group B streptococcus

– **less common organisms :**

- Enterobacteriaceae
- *Neisseria gonorrhoeae*
 - 70% with adjacent bony involvement
 - Blood cultures are commonly positive
 - Initial treatment >>> PRSP + 3rd –generation cephalosporin

• **Children (3 months to 14 years of age)**

– **most common organisms**

- *S. aureus*
- *Streptococcus pyogenes*
- *S. pneumoniae*
- *H. influenzae* >> **markedly decreased with vaccination**
- gram-negative bacilli

– **Initial treatment** >> PRSP + 3rd –generation cephalosporin

– **alternative treatment** >> vancomycin + 3rd –generation Cephalosporin

• **Acute monarticular septic arthritis in adults:**

– **The most common organisms:**

- *S. aureus*
- Streptococci
- gram-negative bacilli

– **Antibiotic treatment** >> PRSP + 3rd –generation cephalosporin

– **Alternative treatment** >> PRSP plus ciprofloxacin

• **Chronic monarticular septic arthritis:**

– **most common organisms**

- *Brucella*
- *Nocardia*
- *Mycobacteria*
- fungi

• **Polyarticular septic arthritis:**

– **most common organisms**

- Gonococci
- *B. burgdorferi*
- acute rheumatic fever
- viruses

The other imp treatment here is the surgical:

Septic Arthritis – Surgical treatment:

- **mainstay of treatment**
 - Surgical drainage >> open or arthroscopic>> here the surgery is more imp than in AHO
 - Daily aspiration
- Tuberculosis infections >> pannus>> similar to that of inflammatory arthritis
- Late sequelae of septic arthritis >>soft tissue contractures ☒ may require soft tissue procedures (such as a quadricepsplasty)

Note:

- What is the other important Rx here :
Surgical debridement: you will open the joint take all the infected synovial
- How to approach a patient with septic arthritis of the knee , have swelling , high fever and you want to take him to the OR?
Before take him to the OR you have to confirm the dx by aspiration (it not a Rx it is only a dx test)
- Patient, 4yrs, hip pain, unable to walk, high WBC, CRP and ESR, patient look very sick, x-ray don't show any thing. First you want to dx then to Rx :
- To dx you have one of 2 solutions:
- Aspirate from hip, send it for culture , now you are happy and can give empirical Ab
- Or you can take patient first to OR and aspirate for culture

Infected TJA

Note:

- If patient had total knee one year ago, 4 week ago pt start to have discharge, pus, swelling, he was in جيزان where they gave him A b, now he come to you , what to do?

- We have to take the prosthetic out, but if he show for period less than 3 week of infection you can do debridement and give Ab
- But if 3 week and above take the prosthetic out (imp)
- What matter here from how long the infection inside the joint.

Prevention

- **Perioperative intravenous antibiotics:** most effective method for decreasing its incidence.
- **Good operative technique.** Note: Minimize bleeding, be quick, gentle manipulation of soft tissue to not leave dead tissue behind, reduce traffic in the OR.
- **Laminar flow:** avoiding obstruction between the air source and the operative wound Note: Air is direct towered the patient to push the debris away from pt.
- **Special “space suits”:** To reduce the dirt that shift from the surgeon body during the procedure
- Most patients with TJA do not need prophylactic antibiotics for dental procedures
- Before TKA revision >> knee aspiration is important to rule out infection
- **Most common pathogen:**
 - *S. epidermidis* >> most common with any foreign body
 - *S. aureus*
 - Group B streptococcus
- **ESR** >> most sensitive but not specific
- **Culture** of the hip aspirate >> sensitive and specific
- **CRP** may be helpful
- Preoperative skin ulcerations >> increase risk
- **Most accurate** test >> tissue culture

Treatment

- **Acute infections >> within 2-3 weeks of arthroplasty >> Treatment**
 - prosthesis salvage >> stable prosthesis
 - Exchange polyethylene components
 - Synovectomy >> beneficial
- **Chronic TJA infections: >3 weeks of arthroplasty**
 - Implant and cement removal
 - staged exchange arthroplasty

–Glycocalyx:

- Formed by polymicrobial organisms
- Difficult infection control without removing prosthesis and vigorous debridement

–Helpful steps

- use of antibiotic-impregnated cement
- antibiotic spacers/beads

Note:

Patient you did to him a total knee, now he came with knee replacement loosening) it life time ended and the polyethylene started to يتآكل), you want to do revision for him.

- First we need to rule out the infection >> aspirate, blood test why?
 - عشان ماتحط جديد وهو عنده أنفيكشن فتتآكل وشغلك كله يروح وتظطر تدخل المريض >>things you can avoid early
- Polyethylene if there is infection take it off, even if it was stable
- Unstable with or without infection take it off
- Today you take him to OR , implant removed , do not put the new polyethylene right away , first treat with Ab for 3-4 week until the infection is gone , do all investigation then put the new one .

Summary:

- In **acute osteomyelitis** and septic arthritis the pts are sick , loss of function, fever and swelling:
- first do blood test, ESR & CRP
- Then do other investigation: x-ray then MRI(the best one) and ct
- Rx:
Take blood culture>> then take pt to OR do I &D (send biopsy to histopathology, micro and for culture)
- Then start empirical Ab until the result of the culture sensativity, if pt was improve do not change the Ab.
- In **chronic situation** it different you are more relaxes, the infection already there for long time.
- Cbc may be positive
- Part of the treatment is to admit the pt.