Microbiology

TEAM WORK 435

Lecture Three

Bone and Joint Infections

Original content
Important point
Team's note

Please note that some mistakes might not be ruled out.
Gently contact Microbiology.435@gmail.com if you have any question/comment.

وقل رب زدني علما

OBJECTIVES

1- Define Osteomyelitis and Arthritis.

2- Know that the two conditions can happen together or separately.

3- Differentiate between acute and chronic osteomyelitis and arthritis.

4- Realize that those infections can be acquired through blood or directly from adjacent affected organs and tissues.

5- Know the pathogenesis and risk factors of each.

6- Know the commonest causative agents of each.

7- Know the laboratory diagnosis and investigation of each.

8- Know the management and treatment of each.

Osteomyelitis

Osteomyelitis: chronic and acute
https://m.youtube.com/watch?v=kaqwrlYacxc

- Bone and joint infections may exist separately or together.
- **Common in** infants and children.
- **Caused by** blood-borne spread, local trauma, or spread from contiguous soft tissue infection**.**
- Contiguous soft tissue infection is Often **associated with foreign body at the primary wound site.**
- Leads to devastating effect if not treated.

Why is inadequate treatment of such infections dangerous?

Infection causes Inflammation and resultant tissue necrosis produce serious damage.

The contamination of pus destroys blood vessels.

If this developed, cartilage or bone becomes totally separated from blood flow, and then, no healing process can be able to occur.

Adults usually undergo car accidents and surgeries more often than children, meanwhile **children** are very susceptible to trauma because they are usually more active.
That explains the different ways of how the infection gets introduced in comparison to the patient's history.
(Age, accidents, recent surgeries... etc.)

Contiguous:
Spreads via surrounding infected tissues.
(Usually after surgeries, fractures and car accidents.)

Blood-borne:
Spread through contamination by blood.
(Usually with systemic infections.)

Acute Osteomyelitis

Link you knowledge with Pathology:
https://www.youtube.com/watch?v=MNkI6Of2PRs

Definition:

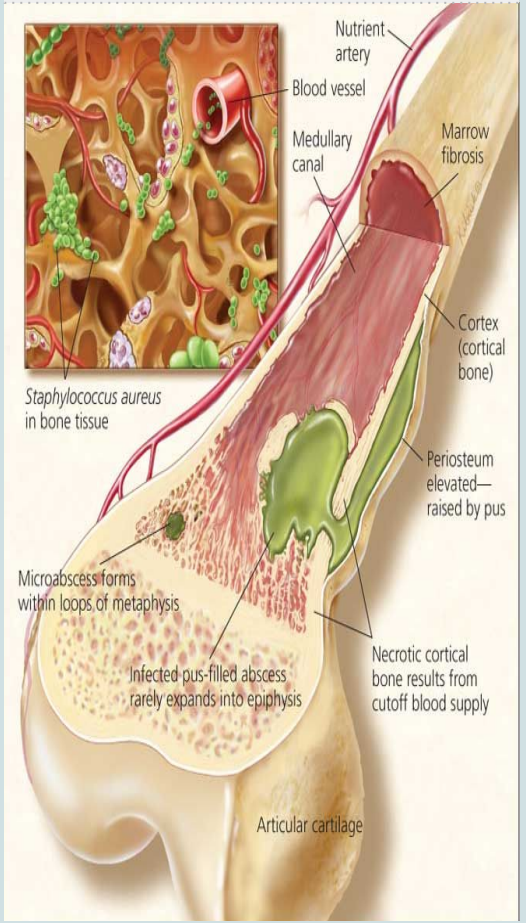
It is an acute infection of the bone and bone marrow.

How does the pathogen reach bones?

- **Hematogenous route**
  - Blood-borne
- **Contiguous soft tissue infections**
  - Postoperative (After surgery) infection.
  - Contaminated open (Compound) fracture.
  - Soft tissue infections.
  - Puncture wounds.
- **In association with peripheral vascular disease:**
  - Diabetes Mellitus.
  - Severe Atherosclerosis.
  - Vasculitis.

Duration:

- **Hematogenously acquired infection**: Short.
- **Secondary to contiguous focus of infection**: Lasts for several weeks to months.



Site:

- Begins in the Metaphysis of long bones, then spreads to Diaphysis especially in children.

Etiology, epidemiology, and risk factors:

- Hematogenous cases are **most common** in infants and children.
- Hematogenous cases are **less common** in adults, but may occur due to reactivation of an inactive infection.
- **From infancy to childhood, most cases are due to Staph Aureus.**

- **Infants and Neonates:** Staph. Aureus | Group B streptococci | E. Coli.
- **Children:** Staph. Aureus | Group A streptococci | H. Influenzae.
- **Sexually active young adults:** Gonococcus.
- **Fist injuries, diabetic foot** and **decubitus ulcers:** Streptococci | Anaerobes.
- **Sickle cell patients:** Salmonella | Streptococcus pneumoniae.
- **AIDS patients:** Mycobacterium tuberculosis (MTB) | Mycobacterium avium.

Diagnosis:

- **Blood culture**
- **Aspiration** of overlying abscess; When? **if blood cultures are negative**.
  - Leukocytosis (high WBC's) may or may not occur. **(Because it is an acute inflammation.)**
  - Erythrocyte Sedimentation Rate (ESR) elevated or normal.
- **Imaging**
  - X-RAY
  - MRI
  - CT-SCAN

Treatment:

- **MSSA (Methicillin Sensitive Staph. Aureus)**:
  - Cloxacillin, Clindamycin.
- **MRSA (Methicillin Resistant Staph. Aureus)**:
  - Vancomycin followed by Clindamycin, Linezolid, or TMP-SMX.
- **Polymicrobial infection**:
  - Piperacillin-Tazobactam or Quinolone with Metronidazole.

This culture is associated with hematogenous spread of the infection.

Any serious infection needs blood culture, and we do not culture bacteria directly from the bone because it is not possible.

TMP/SMX: **T**rim**e**thop**r**im/**s**ulfa**m**etho**x**azole
This medicine contains a sulfa drug (sulfonamide).

Staph. Aureus is the most common gram +ve cocci, and is divided into two classes (MSSA & MRSA) based on its sensitivity to methicillin.

When we add methicillin, Staph. Aureus either respond (Sensitive) or resist (Resistant).

As we see, this difference directly affects the chosen treatment because MSSA and MRSA differ in nature.

Chronic Osteomyelitis

Definition:

- It is a chronic infection of the **bone** and **bone marrow**.
- Usually secondary to **inadequately treated** or **relapsed** acute osteomyelitis.

Characteristics:

- Difficult management.
- Poor pathogenesis.
- Infection may not be completely cured.
- May recur (Happen again) many years or decades after initial episode.
- Most infections are secondary to a contiguous focus or peripheral vascular disease.
  - E.g. **diabetes** and **vasculitis** patients commonly have chronic osteomyelitis.
- Chronic infection due to **hematological spread** is rare.
- **PLEASE REMEMBER: Clinically, TB and Fungal Osteomyelitis have indolent (Slow) chronic course.**

Pathogens:

- **<u>The most common pathogen</u>:**
  - **Staph. Aureus.**
- **Other pathogens:**
  - Staphylococcus epidermidis | Enterococci | Streptococci | Enterobacteriaceae | Pseudomonas | Anaerobes.
- **Decubitus ulcers** and **diabetic foot infections:**
  - Polymicrobial infection.
- **Immunosuppressed patients:**
  - Mycobacteria and fungi.
- **Fungi like Candida spp. and Aspergillus spp.** can cause —**Hematogenous osteomyelitis.**
- **Mycobacterium Tuberculosis** (MTB) **Osteomyelitis** result from:
  - Hematogenous spread from lung foci.
  - As an extension from a caseating lymph bone (possibility: 50% in spine).
- **Brucella and TB are common in KSA.**

Diagnosis:

- Blood culture is <u>not</u> very helpful; Why? because **bacteremia is rare** in chronic osteomyelitis.
- Radiologic changes are <u>complicated</u>; Why? because of the presence of bony abnormalities.—
- WBC's are normal.
- ESR (Erythrocytes Sedimentation Rate) is **elevated** <u>but</u> not specific.
- **<u>MRI is the most helpful method for diagnosis and evaluation of extent of disease.</u>**

<u>Spread from lung foci:</u>
The team is not 100% sure, but it is most likely something called a **Pulmonary metastases**, which results from metastatic spread to the lungs from a variety of tumours, and can spread via blood or lymphatics to other sites.

<u>Caseating lymph bone:</u>
Necrosis with conversion of damaged tissue into a soft cheesy substance.

<u>Bacteremia:</u>
The presence of bacteria in the blood.

And what they mean by this statement is that **hematogenous spread** of the infection is **rare** in chronic osteomyelitis, because as we previously mentioned, <u>hematogenous spread lasts for a very short duration</u>, meanwhile contagious infection lasts long.

Treatment and Management:

- Extensive **surgical debridement** with **antibiotic** therapy.
  - **Parenteral antibiotics** for 3-6 weeks followed by long term **oral suppressive therapy.**
  - Some patients may require **life-long antibiotic** and other medications for acute exacerbations.
- **MSSA** (Methicillin Sensitive Staph. Aureus):
  - Cloxacillin.
- **MRSA** (Methicillin Resistant Staph. Aureus) **and** S. Epidermidis:
  - Vancomycin followed by oral Clindamycin or TMP-SMX.
- **Mycobacterium tuberculosis (MTB)**: 4 drugs
  - **INH** (Isoniazid)
  - **RIF** (Rifampicin)
  - **Pyrazinamide** and **Ethambutol** for 2 months, followed by **RIF** and **INH** for additional 4 months.

  (So the total would be 4 drugs in 6 months of treatment.)
- **Brucella** is treated with Tetracycline and RIF for 2 to 3 months.
- —**Other bacteria**: Treat as acute oesteomyelitis.

TB is usually misdiagnosed with **Brucella** at hospitals that does not have MRI or good laboratories because they both have similar appearance and clinical features (Weight loss, fever, loss of appetite… etc.) However, we must not treat for TB unless we are 100% sure because it is more resistant to antibiotics than Brucella and bad treatment can lead to a lot of complications.

We must treat **TB** with all the 4 drugs we have mentioned, otherwise, TB shows resistance and does not go away.

TB = CHRONIC DISEASE

Suppressive therapy:
Long term therapy that reduces infectious outbreaks.

Surgical debridement:
Surgical removal of dead tissue and foreign material from a wound.

Septic Arthritis

Definition:

It is an **inflammation** of the **joint space** and it occurs secondary to infection.

Affects:

- **Single joint:** Result in suppurative inflammation.
- **Hematogenous seeding of joint:** is most common.

Common symptoms:

- **Inflammatory signs:**
  - Pain
  - Swelling
  - Limitation of movement

Causes:

- **Staph. Aureus is the most common cause**.
- Streptococci and aerobic gram negative bacilli.
- **Lyme disease**: in endemic areas. **(Uncommon in KSA)**.
- **Salmonella:** In sickle cell disease patients, just as osteomyelitis.
- **Mycobacterium Tuberculosis** (MTB) or **fungi**: May cause chronic arthritis, just like chronic osteomyelitis.
- Direct trauma, procedures (arthroscopy) or contiguous soft tissue infection.

Different types of Arthritis
https://www.youtube.com/watch?v=IAz9MtyghQw

Suppurative Inflammation:
A type of inflammation marked by pus formation.

Inflammation has lots of types.
Scroll down the following page to read briefly:
http://medical-dictionary.thefreedictionary.com/suppurative+inflammation

Septic Arthritis can affect **more than one joint** at the same time.

Infections can come to the joint the same way it comes to the bone (Blood-borne / Contagious infection.)
Also, it can come secondary to the bone infection itself, which means that Osteomyelitis and Arthritis can both exist together.

Slide 3

Lyme disease (Whitetail deer) occurs usually in people who live in Scandinavian countries due to tick-bite.
Patients are present with skin rash and arthritis.

Further read:
http://www.cdc.gov/lyme/

Types:

Gonococcal Arthritis (Gono- from gonads.)	Nongonococcal Arthritis (Any other organism)
● It is the most common cause in young & sexually active adults caused by the sexual transmission of **Neisseria gonorrhoeae** that leads to: - Disseminated infection secondary to urethritis in men. - Cervicitis in women. ● Initially present with polyarthralgia (several joint pain), tenosynovitis, fever, skin lesions. ● If untreated leads to suppurative monoarthritis.	● Occurs in older adults. ● **Results from:** Introduction of organisms into joint space as results of bacteremia or fungemia from infection at other body sites.

Prognosis and Complications:

- **Gonococcal arthritis** has an excellent outcome.
- **Non Gonococcal arthritis** may result in scarring with limitation of movement, ambulation is affected in half the cases.

Risk factors:

Age | Prior Rheumatoid Arthritis | Polyarticular joint involvement | Hip or shoulder involvement | Virulent pathogens | Delayed initiation or response to therapy.

Diagnosis:

- **History and examination** to exclude systemic illness.
  - Pay attention to any history of tick exposure in endemic areas.

- **Arthrocentesis** to obtain **synovial fluid** for analysis.
  - Gram stain, culture and sensitivity tests should be done to it.
    1. Synovial fluid will be cloudy and purulent.
    2. Leukocytes count is high. (Generally >50,000/mm3, with >75% neutrophils)
    3. Gram stain and culture are positive in most cases. (>90% of cases)
    4. These tests are done to Exclude non-infectious Arthritis like Rheumatoid.

- **Blood cultures** indicated.
- **Culture of joint fluid and skin lesions** indicated.

- **If gonococcal infection suspected**:
  - Take **specimen** from cervix, urethra, rectum and pharynx for culture or DNA testing for **Neisseria Gonorrhoeae**.

In Arthritis, we can't wait 3 days for the blood culture result to occur because the microbial inflammation is able to ruin the joint in less than that duration, therefore, knowing the most common organisms for each infection is really important in your career because it is an immediate indicator of which treatment you should use.
We will know this in details insha'allah once we start taking Medicine and Surgery.

Why do we have to aspirate?

To know weather the Arthritis is Rheumatoid (Autoimmune) or Septic (Infectious), therefore, treat the patient properly. Septic Arthritis' result will show foreign organisms within the synovial fluid of the joint. If Septic Arthritis was positive, the patient must be directly taken to the OR.

Treatment:

- **The most important managements are drainage and antimicrobial therapy.**

- **Arthrocentesis with drainage** of infected synovial fluid (Repeated therapeutic dose often needed).
- Occasionally, **arthroscopic or surgical drainage/debridement**.

- **Gonococcal arthritis:**
  - IV Ceftriaxone, Ciprofloxacin or Ofloxacin then **switch to** oral Quinolone or Cefixime for 7-10 days.

- **Non Gonococcal arthritis:**
  - **MSSA**: Cloxacillin or Cefazolin.
  - **MRSA**: Vancomycin.
  - **Streptococci:** Penicillin or Ceftriaxone or Cefazolin.
  - **Enterobacteriaceae:** Ceftriaxone or Fluoroquinolone.
  - **Pseudomonas**: Piperacillin and Aminoglycoside.
  - **Animal bite:** Ampicillin-Sulbactam.
  - **Lyme disease arthritis:** Doxycycline for 1 month.

Other ways of nomenclature:
Gram -ve diplococci = Gonococcus
Gram +ve in cluster = Staph. Aureus

While taking the patient's history:
Sickler = Salmonella
Associated with animals = Brucella

Infections of Joint Prosthesis

(Prosthetic Arthritis)

- Occurs in 1-5% of total joint replacements.
- Most infections occur within 5 years of joint replacement.
- Often caused by normal skin flora.
- Diagnostic aspiration of joint fluid necessary.
- Result in significant morbidity and health care costs.
- Successful outcomes results from multidisciplinary approach.

Prosthetic Arthritis:
Inflammation at the replaced joint due to infection.

The most common organisms are normal skin flora, specially **Staph. Epidermidis.**

Multidisciplinary:
Combining or involving several academic disciplines or professional specializations in an approach to a topic or problem.

Joint Prosthesis:
Replacement of a member(s) or of structural elements within a joint to improve and enhance the function of the joint.

Diagnosis of Prosthetic Arthritis:

- Aspiration, surgical exploration to obtain specimen for culture, sensitivity testing and histopathology.
- Skin flora regarded as pathogens if isolated from multiple deep tissue cultures.
- Plain X-ray may not be helpful.
- Bone scan is not specific for infection.
- ESR and C-reactive protein may be high.
- **Arthrography may help define sinus tracts.**

Treatment:

- **Surgical debridement and prolonged antimicrobial therapy.**

- **Surgery:** removal of prosthesis.
- **Antibiotic:** Impregnated cement during re-implantation.
- **Antimicrobial:** for 6 weeks:
  Begin empiric IV antibiotic to cover **MRSA** and **Gram negative rods**
  (Vancomycin with Cefepime, Ciprofloxacin, or Aminoglycoside)

- **Chronic therapy with oral drug if removal of prosthesis not possible.**

Surgical debridement
https://www.youtube.com/watch?v=ZlbanGBgecc

Summary:

- The most common cause of osteomyelitis is Staphylococcus aureus.
- MSSA is treated with Colxacillin or Clindamycin.
- MRSA is treated with Vancomycin followed by Clindamycin, Linezolid or TMP-SMX (Trimoxazole.)
- Polymicrobial infection is treated with Piperacillin-Tazobectam, Quinolone with Metronidazole.
- Mycobacteria and fungi may be seen in immunosuppressed patients.
- The primary site of MTB (mycobacterium tuberculosis) infection is the lung but also it can cause osteomyelitis especially in the spine.
- TB and Brucella are common in Saudi Arabia.
- Arthritis inflammation of the joint occurs secondary to infection.
- Most common cause of arthritis is Staph. Aurous.
- Gonococcal infection most common cause in young & sexually active adults caused by the transmitting of Neisseria gonorrhoeae.
- Non gonococcal arthritis Occurs in older adults.
- Treatment of arthritis drainage & antimicrobial therapy.
- Gonococcal arthritis treat with IV Ceftriaxone or Ciprofloxacin or Ofloxacin.
- Non-gonococcal treat with MSSA: Cloxacillin or Cefazolin & MRSA: Vancomycin.
- Infections of Joint Prosthesis caused by normal flora of the skin.
- In infections of Joint Prosthesis Diagnostic aspiration of joint fluid necessary.
- Treatment of infections of Joint Prosthesis Surgery: removal of prosthesis & Antimicrobial for 6 weeks or Chronic therapy with oral drug.

Great job, now take an online quiz:

1- https://www.onlineexambuilder.com/bone-and-joints-infections/exam-51873
2- https://www.onlineexambuilder.com/bone-and-joints-infections-2/exam-51878

FEMALES

Leader: Sara Alenezy

- Nouf Altwaijri
- Afnan Almalki
- Suha Alenezi
- Nojood Alhaidri
- Deemah Alrajhi
- Kowthar Almousa
- Aisha Alsabbagh
- Johara Almalki
- Alanoud Alsalman
- Sara Alkhalifah
- Shahad Albeshr
- Lina Alshehri
- Lina Ismael
- Nurah Alqahtani
- Reema Alluhaidan

MALES

Leader: Ali Alzahrani

Microbiology

TEAM WORK 435

DREAM BUILDERS

"The best preparation for great work tomorrow is to do great work today."

Please note that some mistakes might not be ruled out.
Gently contact Microbiology.435@gmail.com if you have any question/comment.