Microbiology of joints and bone infection

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-Girls Slides
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-Extra

Any future correction will be in the editing file , so please check it frequently

Objectives :

- Recognize the difference between osteomyelitis and arthritis
- Recall the route of infection of bone and joint
- Describe how infections reach the bone or joint
- Discuss the epidemiology, risk factors and pathogenesis of both osteomyelitis and arthritis
- Recall the commonest causative organisms of acute and chronic osteomyelitis and arthritis

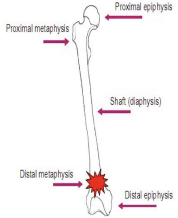
Objectives :

- Recall the differential diagnosis of both conditions
- Describe the laboratory diagnosis and investigation of osteomyelitis and arthritis
- Recognize the management and treatment of both osteomyelitis and arthritis
- Recall the complications of both osteomyelitis and arthritis
- Discuss the causative organisms, diagnosis, management and treatment of infection of the joint and prosthetics

Click (Simple Schedule For (Gram +/- Lecture) From Foundation Block)

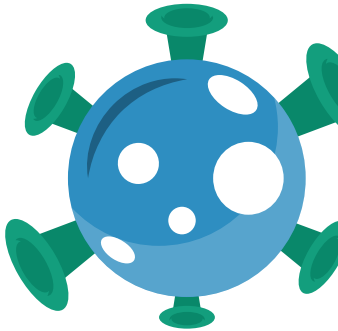
Introduction

- Bone & joint infections may exist separately or together.
- Both are more common in infants and children.
- Usually caused by blood borne spread, but can result from local trauma or spread from contiguous soft tissue infection.
- Often associated with **foreign body** at the primary wound site.
- If not treated can lead to devastating effect.



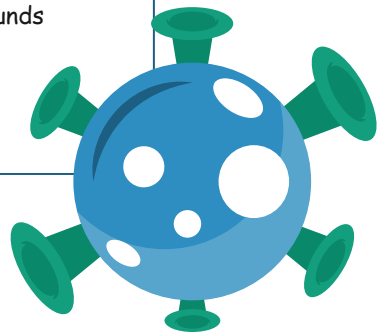
will be covered

- Acute Osteomyelitis
- Infections of Joint Prosthesis
- Chronic Osteomyelitis
- Septic Arthritis



1) Acute Osteomyelitis :

Definition	Acute osteomyelitis is an acute infectious process of the bone and bone marrow.
Duration	May have **short** or **long duration**:: • Short duration (few days for hematogenous acquired infection). • Lasts several weeks to months (if secondary to contiguous focus of infection).
How the pathogen reaches the bone?	1- Hematogenous route (through blood) 2- Contiguous soft tissue focus post operative infection, contaminated open fracture, soft tissue infection, puncture wounds 3- In association with peripheral vascular disease (diabetes mellitus, severe atherosclerosis, vasculitis)

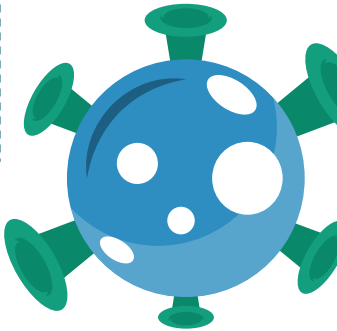


1) Acute Osteomyelitis cont.. :

1- Causative Organism

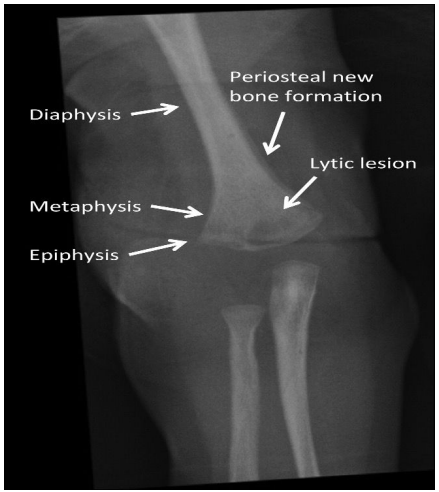
Age	Common organism	Site
Neonates (primary hematogenous)	1-Staph Aureus 2- Group B Streptococcus 3-Ecoli	Metaphysis of long bones (tibia, femur, humerus…)
Infants/ Children (primary hematogenous)	1-Staph Aureus 2- Group A Streptococci 3-H.influenzae	
Adult	1-Most cases due to Staph Aureus 2-Hematogenous cases are less common due to reactivation of quiescent focus of infection from infancy or childhood.	it's usually in the back

- Septic arthritis is common as the infection begins in the metaphysis



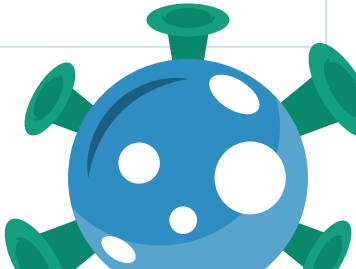
1) Acute Osteomyelitis cont.. :

2- X-ray of Acute Osteomyelitis:



3- Other causes-Special Clinical Situations

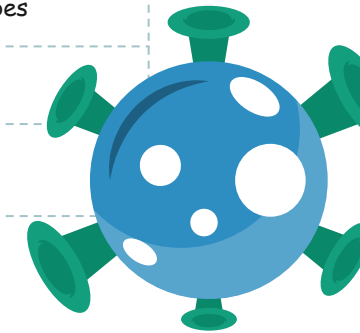
Fist injuries, diabetic foot, decubitus ulcer patients	Streptococci and anaerobes (Usually Polymicrobial)
Sickle cell patients	Salmonella Or Streptococcus pneumonia
Immunocompromised (AIDs) patients	Mycobacterium tuberculosis Or mycobacterium avium



1) Acute Osteomyelitis cont.. :

4- Common causes of Acute Osteomyelitis:

Age/ Special Condition	Common causative organisms
Neonates	S.aureus, Group B Streptococcus, Gram negative rods (eg. E.coli, Klebsiella)
Infants / children	S.aureus, Group A Streptococci, H.influenzae.
Adults	S.aureus
Sickle cell disease	S.aureus, S. pneumonia, Salmonella species
Infection after trauma injury or surgery	S.aureus, group A Streptococcus, Gram negative rods, anaerobes
Infection after puncture wound of foot	Pseudomonas aeruginosa, S.aureus
AIDs patients	Mycobacterium tuberculosis or mycobacterium avium

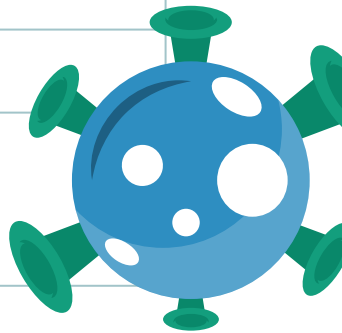


1) Acute Osteomyelitis cont.. :

5- Clinical presentation & Investigation

(Acute Osteomyelitis Usually abrupt rapid onset i.e symptoms appear quickly)

Clinically	Limping Fever, localized pain, heat, swelling, tenderness of affected site (one or more bones or joints affected in Hematogenous spread), local tissue infection (abscess or wound)
Blood test	Leukocytosis, high ESR and C-reactive protein.
X-ray	**Normal at early stages**, Swelling of soft tissues, followed by elevation of periosteum ,demineralization and calcification of bone later on.
Ultrasound	Fluid collection (abscess) and surface abnormalities of bone.
CT scan	Reveal small areas of osteolysis in cortical bone.
MRI (Most sensitive imaging technique)	Early detection, helps in unclear situations. Defines bone involvement in patients with negative bone scan.



1) Acute Osteomyelitis cont.. :

6- Diagnosis of Acute Osteomyelitis

1. **Blood culture :** bacteremia common

Most important test

2. **Biopsy of periosteum or bone, needle aspiration** of overlying abscess if blood culture is negative

3. **Blood test**: Complete blood and differential counts Erythrocyte sedimentation rate (ESR), C-reactive protein

4. **Imaging studies :** x-ray, MRI, CT-SCAN

7- Differential diagnosis

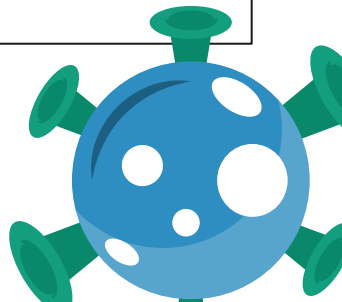
Diseases that have the same symptoms as osteomyelitis

A. Rheumatoid arthritis

B. Septic arthritis

C. Fractures

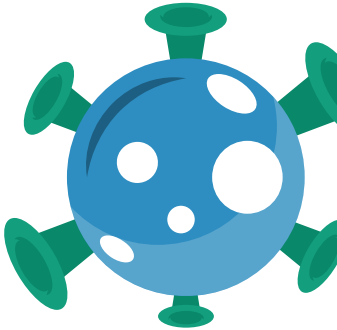
D. Sickle cell crises



1) Acute Osteomyelitis cont.. :

8- Complications of Acute Osteomyelitis:

- Septic arthritis is common
  as the the infection reaches the diaphysis
  If the osteomyelitis site was close to a joint
- Chronic osteomyelitis
  If acute osteomyelitis was not treated, might become chronic
- Metastatic infection to other bone or organ
  Spread through blood stream (bacteremia) to other bones.
- Pathological fracture



1) Acute Osteomyelitis cont.. :

9- Management & Treatment:

1- Bed rest and analgesia,splint

2- surgical drainage (as needed) if there is local purulent process

3-Antimicrobial therapy:
Duration for 4-6 weeks to ensure cure and prevent progression to chronic osteomyelitis

MSSA
methicillin sensitive S.aureus

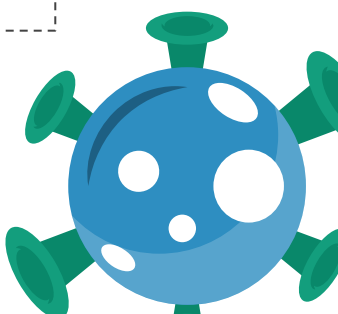
-Cloxacillin
-Clindamycin

Polymicrobial infection
usually a broad spectrum antibiotics is used

-Piperacillin-Tazobactam -Quinolone with Metronidazole

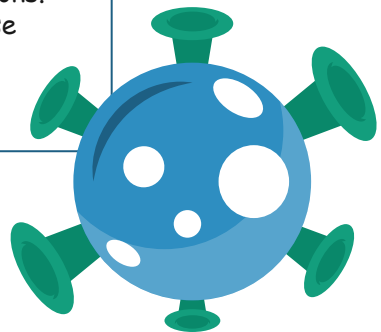
MRSA
methicillin resistant S.aureus

-Vancomycin
-Clindamycin
-Linezolid
-TMP-SMX



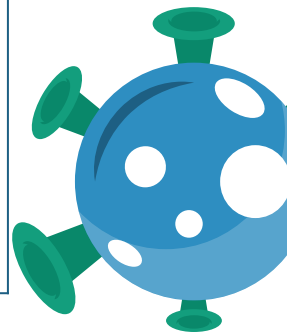
2) Chronic Osteomyelitis :

Definition	A chronic infection of the bone and bone marrow usually secondary to inadequately treated or relapse of acute osteomyelitis or foreign body.
Characteristics	Management difficult , prognosis poor. (Bad outcome) Infection may not completely cured. May recur many years or decades after initial episode. Most infections are secondary to a contiguous focus or peripheral vascular disease. Chronic infection due to hematological spread is rare.Management difficult , prognosis poor. (Bad outcome)
Etiology	- S.aureus is the most common pathogen - Other microorganisms: S.epidermidis, Enterococci, streptococci , Enterobacteriaceae , Pseudomonas and anaerobes. -Polymicrobial infection common with decubitus ulcers and diabetic foot infections. -Tuberculosis and fungal osteomyelitis clinically have indolent "chronic" course -Mycobacteria and fungi may be the cause in immunosuppressed patients. -Brucella



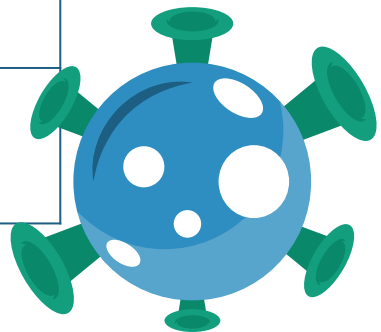
2) Chronic Osteomyelitis :

TB and Fungal osteomyelitis	-***Tuberculous* osteomyelitis** primarily results from haemtogenous spread from lung foci or as an extension from a caseating lymph bone (50% in spine) - It resembles *Brucella* osteomyelitis . - TB & *Brucella* are common in KSA. -Causes osteomyelitis in vertebrae called pott's disease - ***Fungal Osteomyelitis*** Due Hematogenous spread Eg. Candida species, Aspergillus species and other fungi may occur.
Diagnosis	Blood culture is not very helpful because bacteremia is rare. WBC usually normal, ESR elevated but not specific. Radiological changes are complicated by the presence of bony abnormalities. MRI helpful for diagnosis and evaluation of the extent of disease(MRI is rad). MRI is for diagnosis and evaluation of the extent of disease.
Treatment	Extensive surgical debridement with antibiotic therapy. Parenteral antibiotics for 3-6 weeks followed by long term oral suppressive therapy . - Some patients may require long life antibiotic , others for acute exacerbations. ***MSSA***: Is treated with the antibiotic Cloxacillin ***MRSA & S. epidermidis***: Vancomycin then oral Clindamycin or TMP-SMX. Other bacteria: treat as acute osteomyelitis. **MTB**: combination of <u>4 drugs</u> : INH+RIF +Pyrazinamide & Ethambutol for 2 months followed by RIF + INH for additional 4 months. ***Brucella*** is treated with Tetracycline and Rifampicin for 2 to 3 months.



3) Septic Arthritis:

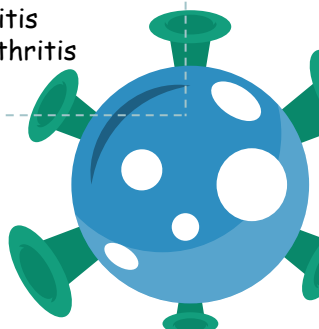
Definition	**Septic (Infectious) Arthritis** is an acute inflammation of the joint space secondary to infection. Generally affects a single joint and results in supportive inflammation. May caused by bacteria or viruses.
General Symptoms	Common symptoms :pain, swelling, limitation of movement.
Mechanism of infection	Haematogenous seeding of joint is most common.
Diagnosis	Diagnosis by Arthrocentesis to obtain synovial fluid for analysis; Gram stain, culture & sensitivity
Management	Drainage & antimicrobial therapy important management.



3) Common and other causes of septic arthritis

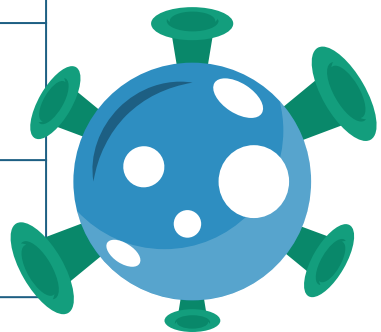
Age/ Special Condition	Common causative organisms
Neonates	*S. aureus*, group B *Streptococcus*, Gram negative rods (e.g., *E. coli*, *Klebsiella*, *Proteus*, *Pseudomonas*).
Infants / children	*S. aureus*, group A *Streptococcus*, *S. pneumoniae*, *H. influenzae* type b
Adults	*S. aureus*, *Neisseria gonorrheae*
Sickle cell disease	*Salmonella species*, *S.pneumoniae* *S.aureus* *S.aureus*
Trauma / surgical procedure	*S. aureus*
Chronic arthritis	*Mycobacterium tuberculosis* , Fungi
Prosthetic arthritis	Skin flora

---	Other Common causative organisms
Viruses	Include: Rubella, Hepatitis B, mumps, Parvovirus B19,Varicella,EBV,Adenovirus e,..etc. These are self-limiting
Reactive arthritis due:	*Campylobacter jejuni* *Yersinia enterocolitica* Some *Salmonella* species
Non –infectious causes of arthritis:	Rheumatoid arthritis Gout Traumatic arthritis Degenerative arthritis



3) Risk Factor of Septic Arthritis:

Gonococcal infection	most common cause in young, sexually active adults caused by *Neisseria gonorrheae* . Leads to disseminated infection secondary to urethritis/cervicitis. Initially present with polyarthralgia, tenosynovitis, fever, skin lesions. If untreated leads to suppurative monoarthritis.
Nongonococcal	occurs in older adults. Results from introduction of organisms into joint space as a results of bacteremia or fungaemia from infection at other body sites.
Procedures	direct trauma, procedures (arthroscopy) or from contiguous soft tissue infection. *S. aureus* is most common cause. Other organisms : streptococci and aerobic Gram negative bacilli.
Lyme disease	due to tick bite in endemic areas. Uncommon in KSA.
Sickle cell disease	*Salmonella* species.
Chronic Arthritis	Mycobacterium Tuberculosis or fungi



3) Septic Arthritis

-Diagnosis of Septic Arthritis

History / examination:
To exclude systemic illness
Note History of tick
Exposure in endemic areas

1

Arthrocentesis:
should be done as soon as possible;
(Synovial fluid is cloudy and purulent.)

(Leukocyte count generally > 25,000/mm^3,with predominant neutrophils.)

(Gram stain and culture are positive in >90% of cases.)

(Exclude crystal deposition arthritis or noninfectious inflammatory arthritis.)

2

Blood Culture:
If Gonococcal infection susbect,
Take specimen from cervix
Or urethra or rectum or pharynx
For culture or Dna testing for N. gonorrhea.

Investigate for other sexually transmitted diseases .

Culture of joint fluid and skin lesions

3

-Prognosis of Septic Arthritis

Gonococcal Arthritis

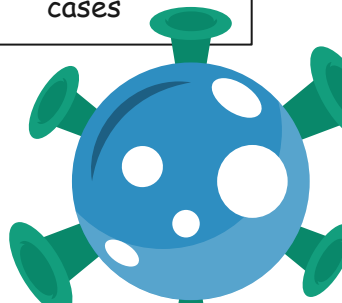
1

Excellent outcome and prognosis

Non gonococcal Arthritis

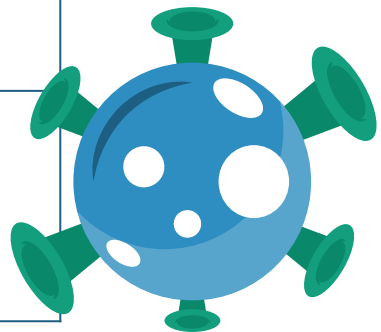
2

can result in scarring with limitation of movement, ambulation is affected in 50% of cases



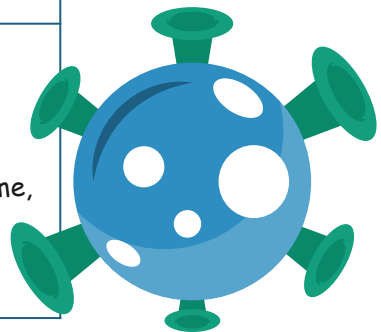
3) Treatment of Septic Arthritis:

Arthrocentesis	Drainage of infected synovial fluid (Repeated therapeutic arthrocentesis often needed)
Surgical intervention	Occasionally, arthroscopic or surgical drainage/debridement
Antimicrobial therapy	Antimicrobial therapy should be directed at the suspected organism and susceptibility results: **1- Gonococcal arthritis**: IV Ceftriaxone (or Ciprofloxacin or Ofloxacin) then switch to oral Quinolone or Cefixime for 7-10 days **2- Nongonococcal infectiuos arthritis:** 1. MSSA: Cloxacillin or Cefazolin 2. MRSA: Vancomycin 3. Streptococci: Penicillin or Ceftriaxone or Cefazolin 4. *Enterobacetriacae*: Ceftriaxone or Fluroquinolone 5. *Pseudomonas:* Piperacillin and Aminoglycoside 6. Animal bite : Ampicillin-Sulbactam 3- **Lyme disease arthritis**: Doxycycline for one month
Risk factor for long term adverse sequelae include	Age, prior rheumatoid arthritis, polyarticular joint involvement, hip or shoulder involvement, virulent pathogens and delayed initiation or response to therapy.



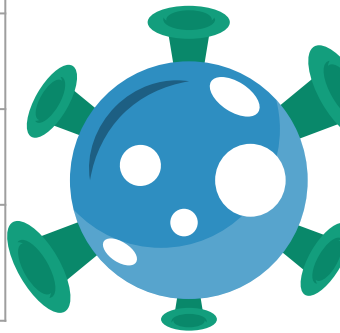
4) Infection of joint prosthesis:

Definition	Occur in 1 - 5 % of total joint replacement. Most infections occur within 5 years of joint replacement. Diagnostic aspiration of joint fluid necessary. Result in significant morbidity and health care costs. Successful outcomes results from multidisciplinary approach.
Etiology	Often caused by skin flora (Staph. Epidermidis)
Diagnosis	Aspiration & surgical exploration to obtain specimen for culture , sensitivity testing & histopathology. **Skin flora regarded as pathogens if isolated from multiple deep tissue cultures.** **Plain X-ray** may not be helpful. **Arthrography** may help define sinus tracts. Bone scan-not specific for infection. ESR and C-reactive protein(CRP) may be high.
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, Cefepime, Ciprofloxacin, or Aminoglycoside) Chronic therapy with oral drug if removal of prosthesis not possible.



Summary from 443

organism	Classification	What does it cause	Note
Staph aureus	Gram (+) Coccus Aerobic Catalase And Coagulase (+) Remember Catalase (+) = Staph	➢ All ages for acute Osteomyelitis and septic arthritis ➢ Most common for chronic Osteomyelitis	
Streptococcus Pneumoniae	Gram (+) Streptococcus α hemolytic	➢ Acute and septic arthritis for Sickle cell disease patients	
Neisseria gonorrhoeae	Gram(-) Diplococci	➢ Adults Septic Arthritis ➢ Gonococcal Infection in young sexuall active adults	
Group A Streptococci	Gram (+) Coccus Aerobic Catalase (-) Remember A,B were the two groups of beta hemolytic	➢ Acute Osteomyelitis and Septic arthritis for **Infants /children** ➢ Acute Osteomyelitis and Septic arthritis for **Trauma/Injury/ Surgery**	
Group B StreptoCocci		➢ Acute Osteomyelitis and Septic arthritis for **neonates**	It is transmitted from mother to child during birth
E.coli	Gram (-) Bacilli Oxidase (-) Sugar Fermenter	➢ Acute Osteomyelitis and Septic arthritis for **neonates**	Both glucose and lactose fermenting
Salmonella		➢ Acute and septic arthritis for Sickle cell disease patients	Glucose but not Lactose fermenting
Haemophilus influenzae (H.influenzae))	Gram (-) CoccoBacilli Fastidious	➢ Acute Osteomyelitis and Septic arthritis for Infants /children	Grows in Chocolate agar and not blood or another
Pseudomonas	Gram (-) Bacilli Aerobic Non Fermenter Oxidase (+)	➢ Chronic osteomyelitis (Non-common) ➢ Infection after puncture wound of foot	
Mycobacterium Tuberculosis	Non-Staining Gram	➢ Aids Patients ➢ Chronic Arthritis ➢ Immunosuppressed patients	



MCQs:

1- 31 Year old patient develops osteomyelitis most likely would have infection in which bone?

A) Tibia

B) Vertebrae

C) Sternum

D) Femur

Q2: Most frequent pathogens in a sickle cell anemia pateint with osteomyelitis?

A) Salmonella

B) S aureus

C) S pneumoniae

D) A,B AND C

Q3: Might be a site of acute osteomyelitis include?

A) Skull

B) Scapula

C) Vertabrae

D) Tibia

MCQs:

answer: 1-B 2-D 3-D 4-B 5-C 6-D

Q4: Complication of acute osteomyelitis include?

A) Comic osteomylitis

B) Metastatic bone infection

C) Need to perform amputation

D) A and C

Q5: Diagnosis of chronic osteomylitis?

A) arthrocentesis

B) Blood culture

C) MRI

D) All

Q6: Diagnosis of acute osteomylitis?

A) arthrocentesis

B) Pseudomonas aeruginos

C) MRI

D) Blood culture

SAQ:

1- Case 1
A 5 years old child presented to ER has History of fever and feeling unwell for 2 days unable to walk and pain in leg examination relieved tenderness over lower area of right leg. ,
1-What is the name of the condition ?
2- blood culture showed Gram (-) CoccoBacilli only growing in chocolat, what is the name of Bacteria ?
3- what if blood culture showed Gram (+) cocci in Cluster
4- what would you see in X-Ray

SAQ:

Case 2
A 20 years old male recently returned from travel with history of unprotected sexual intercorse with one day history of pain swelling and inability of walk,. what is the condition ?
What is the potential organism?

SAQ:

Case 3
60 years old Septic arthritis patient joint fluid relieved Gram (+) cocci in clusters Catalase coagulase (+) MRSA, what medication would you use ?

SAQ:

Case 4
15 years old has sickle cell disease presented to ER has History of fever and feeling and well for 2 days unable to walk and pain in leg examination relieved tendones over lower area of femur, What is the name of the organism in each case:
1-gram(+) in pairs alpha hemolytic
2- Gram(-) bacilli glucose fermenter non lactose fermenter

Answers key:

	Case 1	Case 2	Case 3	Case4
Q1	Acute osteomyelitis	Septic arthritis	Vancomycin	Streptococcus pneumonia
Q2	Haemophilus influenzae	Neisseria gonorrhoeae		Salmonella
Q3	Staph Aureus			
Q4	Lytic Lesion			

Meet The Team :

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