

Micro of CVS

There are 3 types of Cardio infections:-

- ① Pericarditis: inflammation of pericardium (membranous sac)
- ② Myocarditis: inflammation of muscle wall of the heart
- ③ Endocarditis: inflammation of endothelial lining of the heart
المغشاة والبطانة البطينية والبجرات والمغشاة

• Infective Endocarditis

Endothelial damage by an organism by infection leads to colonization of other microorganisms inside heart.

Result of colonization:- colonization leads to vegetations (زخايم) caused by (خثرات) clots of fibrin and platelets and this leads to spread of these clots in the blood stream known as **embolism**

Embolism: ^{fibrin} blood clots moving in the blood stream cause infarction in other blood vessels and organs

Clinically: people with endocarditis complain of ① Fever
② new murmurs (اضطرابات قلبية) ③ Embolic phenomenon
ظواهر قلبية مختلفة

Infective endocarditis is classified into

- ① Acute Endocarditis: caused by highly virulent bacteria **ex:**
staph. aureus, S. pyogenes, Pneumococci, Gram -ve bacteria
- ② Subacute endocarditis: caused by low virulent bacteria **ex:**
S. viridans, Enterococcus, Haemophilus influenza

Acute Endocarditis:

~~cause~~ Rapid inflammation with large vegetations caused by highly virulent bacteria, vegetations occur in normal valves (~~Endothelium~~)

examples of Bacteria causing acute —:

S. aureus, S. pyogenes, S. pneumoniae, Gram negative bacilli

Subacute Endocarditis:

Gradual inflammation with smaller vegetation caused by lower virulent Bacteria, and occurs in injured valves

Note: some of normal flora cause subacute endocarditis ex: S. viridans

Ex on Bacteria causes subacute:

S. viridans, Enterococcus, H. Influenzae,

Infective Endocarditis is commonly caused by

Staphylococcus bacteria, enterococci, gram negative bacilli

less commonly: Kingella kingae, H. aphrophilus —

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Note: some strains of streptococcus cause acute while others cause subacute i.e. *S. viridans* ex: *S. pyogenes*

Myocarditis

mainly caused by viruses, reach the heart by hematogenous spread mainly, causes heart failure, general signs of inflammation

Causes: caused by bacteria or viruses

most common bacteria: *Mycoplasma pneumoniae*, *Corynebacterium diphtheriae*, *Borrelia burgdorferi*

most common viruses: Adenovirus, HIV, human Herpes virus-6, parvovirus B19, coxsackie B

Coxsackie virus:

its + single strand RNA (+SSRNA), Icosahedral in shape, Belongs to Picorna family

Transmission: Feco-oral transmission, Respiratory Droplets (cough)

Diagnosis: can be diagnosed through serological test especially ELISA: Enzyme linked immunosorbent assay

Diseases caused by Coxsackie: diseases are classified into 2 groups Group A & Group B

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① Group A diseases: contain many diseases

a) Hand, Foot & Mouth disease: happens in children, patients complain of Fever and watery patches on Hand and mouth.

حرارة ملاوثة لبقع حرا في القدم والرجل داخل الفم ، تصل درجة الحرارة إلى 40°

b) Herpangina: Patients complain of white blisters inside the mouth.

② Group B diseases:

causes: Myocarditis, Pericarditis, Meningitis, Pleurodynia

Adenoviruses:

Is DNA, icosahedral capsid shape, contain fibers helps it in attachment & adherent; it's latent virus.

يعمل دور وقت الملاحظة يتكرر صعب

Transmission: through various ways such as: Droplet, Direct contact, swimming pool, Fec-oral - etc

Diseases: mostly cause Respiratory Tract Infections, it cause also, Eye infections, Gastroenteritis, Myocarditis

Diagnosis: by isolation then Tissue culture, also Serological test (ELISA) also ~~PCR~~ PCR. (most important commonly used are ELISA & PCR)

في معظم الأمراض المتعلقة بالفيروسات ، يتعالج المرض (symptomatic) حسب الأعراض مثلًا عند حرارة يرفع أدوية الحرا ، نقص الأكسجين يخطى عن جهاز الأكسجين وغيرها

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Parvovirus B19:-

ss DNA virus, Naked (has no envelope), Icosahedral shape,

Transmission:- has many mode of transmission:- Respiratory Droplets
Blood transfusion, Trans Placental

Diseases it causes:- slapped cheek (Erythema infectiosum) or 5th disease

It is one of the most common viruses causing skin rash (exanthems)

- it causes also Deposition of immune complexes (Antibody bound with antigen) inside body ex: inside joints causing *arthralgia*
- it cause also Anemia in healthy and immunocompromised patients
- it causes hydrops fetalis when transmitted Placental

Diagnosis:- mostly by serological test (ELISA) & PCR

Treatment:- For anemia Patients:- Blood Transfusion
For immunocompromised:- giving them antibody

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Rheumatic Fever: complications caused by *S. pyogenes*

- Pathogenesis: Antibody attacking self antigen existed in the heart tissue (*cross reactivity*) after streptococcus infection
- Symptoms: Pain in Joints, neurologic dysfunction, Cardiac problem
- ~~Diagnosis~~ migratory arthritis (الوجع المتقطع في المفاصل), subcutaneous Nodules
Erythema Marginatum (الحلقات الحمراء)
Sydenham chorea (*abnormal movement*) (basal ganglia) (انتفاخ العقد القاعدية)
(antibody)
- Diagnosis: ASO test (*mostly used*), C-reactive Protein (بروتين الارتفاع الحاد)
Erythrocyte sedimentation rate ESR (---)
- Treatment: start giving antibiotics for streptococcus family as soon as possible, ex: penicillin

Note: Rheumatic Fever occurs after Bacterial infection especially *S. pyogenes*, *S. pyogenes* initially cause tonsillitis, pharyngitis, etc

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Streptococci :-

Gram +ve bacteria, don't contain catalase &

Classification :- classified into Aerobic & anaerobic

① Anaerobic streptococci :- only one type (Peptostreptococci)

② Aerobic streptococci :- classified according to blood agar hemolysis it produces into :-

Ⓐ α hemolysis (Partial) Ⓑ β hemolysis (complete)

Ⓒ γ hemolysis (No)

examples on α hemolysis :- *S. pneumonia*, *S. viridans*

examples on β hemolysis :- *S. pyogenes* (sometimes it's called GAS) group A streptococci

Streptococcus Pyogenes

Gram +ve, β hemolytic, forms Pur, sensitive to **Bacitracin**

- The most famous organism causing diseases for human ex: Tonsillitis, Pharyngitis
- it contains M protein (antiphagocytic hair like projection) for protection.

Note :- M protein looks like self antigen (which cause Rheumatic fever)

- It contains :- ① str. kinase ② str. deoxyase ③ hyaluronidase
Fibrinolysin DNAase

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• *S. pyogenes* produce many toxins ex:

streptolysin O, pyrogenic exotoxin, streptolysin S

Note: streptolysin toxins are the main cause of β hemolysis of *S. agalactiae*

Note: streptolysin O can be recognized by lymphocytes $\Rightarrow$ it produces antibodies against it. (which is useful in ASO serologic test)

• *S. pyogenes* produce different types of disease

① Pyogenic disease: sore throat & impetigo

② Invasive: acute bacterial endocarditis

③ Toxicogenic: Toxic shock syndrome, Scarlet fever

④ post-streptococcal: acute Rheumatic fever, acute Glomerulonephritis

ARF

occurs after Tonsillitis because of cross reactivity of M protein and self antigen heart tissue

It causes: Arthritis, skin nodules
Erythema marginatum
Fever, heart murmurs, ...

diagnosed by: ASO, CRP, ASR

AGN

in *S. agalactiae*

occurs after impetigo, antigen-antibody complexes accumulate and block the blood vessels leads to ischemia

it causes: edema, hematuria, Albumin in urine

diagnosed by: Anti-DNAse test

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S. viridans:

Germ +ve, α hemolytic, exist as Normal Flora in Teeth and cause (dental abscess).

- It cause subacute endocarditis if the valves are injured.

- Diagnose^d by blood culture and Blood culture or ELISA

Treatmentⁱ by penicillin (drug of choice), after that Erythromycin

Noteⁱ In the case of endocarditis, we use combination of vancomycin with Aminoglycosides (gentamycin or ~~streptomycin~~) ~~or~~ instead of penicillin

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Borrelia burgdorferi :-

belongs to spirachetes bacteri, lives in animals & insects especially Ticks, so it's called Tick borne, it reaches heart through hematogenous spread.

Transmission :- Through Ticks bite

Diseases: it cause many diseases, most importantly Lyme disease

Lyme disease: it passes through 5 stages :-

1st stage: the bacteria enters the skin through Ticks bite and reach the blood stream causing skin lesion looks like  (called Erythema chronicum migrans ^{قرصه بالاط} (ECM)) and Fever and chills (زعم), Pain, headache

2nd stage: The bacteria reaches the heart and cause Myocarditis (which affects the electrical impulses) and cause AV block (AV node & SA node ^{نقطة اتصال القلب}), also it reaches CNS and cause Neurological manifestation

3rd stage: patients complain of chronic arthralgia (pain in joints) & Migrating Arthritis (الوجع ينتقل من مكان لآخر)

Diagnosis: skin biopsy then check it under Dark Field microscope also we can use ELISA & PCR

Treatment: we give Doxycycline orally, or Ceftriaxone IV

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Mycoplasma:

smallest bacteria, doesn't contain cell wall so cannot be stained by Gram stain or treated by cell wall synthesis inhibitors (penicillin, cephalosporins, vancomycin). it contains sterol in its membrane, grows slowly on artificial media and give fried eggs appearance.

examples: *Mycoplasma pneumoniae*, *Mycoplasma hominis*, *ureaplasma urealyticum*, *mycoplasma genitalium*

Mycoplasma pneumoniae

it causes Atypical pneumonia, Myocarditis,

Mycoplasma hominis causes post partum fever, urethritis

Both *U. urealyticum* & *M. genitalium* cause Non-gonococcal urethritis

Diagnosis: by Immuno fluorescence, PCR, DNA Probes, ELISA

also we can use **Cold agglutination** only for *mycoplasma*

Test II for *Mycoplasma* (the agglutination test) is used to detect the presence of *Mycoplasma* in the blood.

Treatment: Tetracycline (drug of choice) also we can use Erythromycin or Azithromycin

Cell wall inhibitors are not effective against *Mycoplasma*.

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Corynebacterium diphtheria

it secretes powerful toxin kills and produce graywhite pseudo membrane in the upper throat . colonize pharynx & larynx

Transmission : through Respiratory droplets , ~~it~~

It secretes its toxin locally but it may diffuse and reach the blood stream till it reach the heart causing myocarditis causing circulatory failure and death

Acute pericarditis : inflammation of the pericardium

when the pathogene reach the pericardium , inflammation occur causing watery effusion (سوائل مائية) which leads to Cardiac Tamponade which cause slowing & weakening cardiac blood pumping

Cardiac Tamponade : cardiac dysfunction because of pressure caused by watery accumulation in the pericardium .

Clinical symptoms : chest pain (ألم في الصدر)

Causes of pericarditis idiopathic (غير معروف)

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Tuberculous Pericarditis

caused by Mycobacterium Tuberculosis (acid fast bacilli)

This bacteria cause Tuberculosis (scrofula), but as a complication it may invade the parietal layer of peritoneum and cause pericarditis

or

Note! it reaches the pericardium through lymphatic spread

It cause signs & symptoms of pericarditis, ~~but~~ The only difference is its source.

Staphylococci:-

^{Gram + VR}

~~Coag~~ arranged in clusters, contain catalase
usually resistant to cell wall inhibitors

it contain high virulent factor ex:

and cause both Nosocomial & community acquired infection

Culture: using blood agar, also nutrient agar (causing golden colonies)

Note: *S. aureus* is β -hemolytic

- Staphylococci are classified into ~~Cocci~~ positive & Coagulase negative
Coagulase

S. aureus is the only staphylococci Coagulas positive, other
Coagulase negative: *S. epidermidis*, *S. sapropheticus*

- staph. aureus cause acute bacterial Endocarditis, It enters
the body through Drug intravenous injection in Drug abuse, because
it's part of normal flora

① Coagulase +ve: *S. aureus* (next page)

Virulence of *S. aureus* :-

its highly virulent, it contain

- ① Protein-A :- antiphagocytic molecule (inhibits opsonization)
- ② Toxins :- ^{secretes} ~~contains~~ several exotoxins as :- Toxic shock syndrome toxin, enterotoxin
Exfoliative toxin
- ③ Enzyme :- contain many enzyme :- Catalase, Coagulase, Hyaluronidase
B-lactomase

Note :- *S. aureus* infections are localized because they contain coagulase enzyme which help them to ~~help~~ fibrin coagulate blood around them and build a wall for protection from immune system.

Diseases caused by *S. aureus* :- cause many types

- ① Pyogenic infection :- skin infections, acute bacterial endocarditis
- ② Toxicogenic infection :- staph. scalded skin syndrome (SSSS)
Food poisoning, Toxic shock

Treatment :- we usually use antistaph (methicillin, ~~claxathi claxathi~~)
except in case of MRSA we use vancomycin

② Coagulase -ve staphylococci :- *S. epidermidis* & *S. saprophyticus*

S. epidermidis :- normal flora skin bacteria, some strains produce glycocalyx helps them to adhere to any plastic surfaces such as artificial joints

Disease :- it causes subacute endocarditis only when artificial valves exist

Treatment :- Vancomycin

Diagnosis of Staphylococci :-

we use PCR or ELISA serologic test, we can also use Biochemical reactions (against catalase & coagulase enzyme), sometime we grow on Blood Cultures & Nutrient agar.

Enterococci

It's a member of streptococci family, but contains specific characteristics of its own. It lives in 6.5% NaCl & 40% bile salt, occurs after procedures.

- They are γ haemolytic and classified into

① *E. faecalis* ② *E. faecium*

- It contains virulent factors :-

It contains enterococcal surface protein which allows them to adhere to cell surfaces and invade.

- Disease: it causes subacute endocarditis

Treatment :- we use vancomycin (drug of choice), we also can use linezolid, daptomycin, streptogramins