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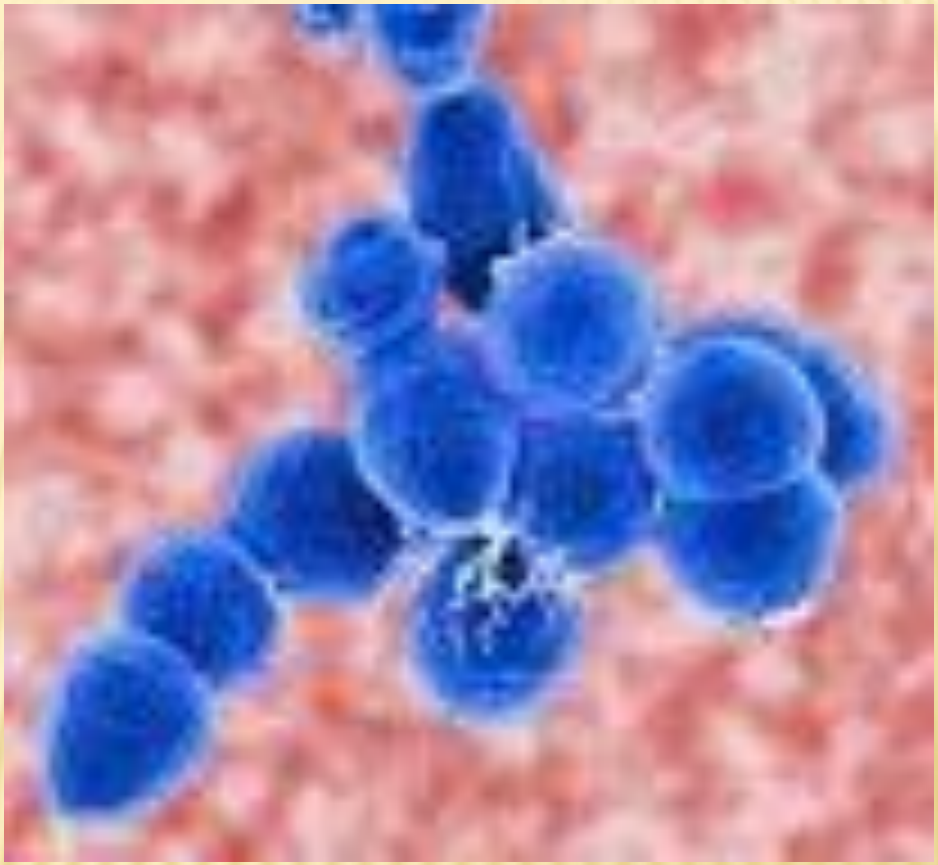
Streptococcus

Streptococci are gram positive spherical or ovoid bacteria that are characteristically arrange in pairs or chains .



They are widely distributed in nature , some are members of the normal human flora

(mouth ,colon , vagina) others are associated with important human diseases ,causing pyogenic infections as well as other non pyogenic infections like rheumatic fever .

Morphology:

Single cocci are spherical or ovoid arranged in chains, the lengths of chains, vary widely regarding medicine and environmental factors.

Reaction to Gram Stain

Streptococci are gram positive , however aged culture loss it's gram positivity and some are capsulated like type ,A,B,C& pneumococci

All Streptococci are non spore forming organisms.

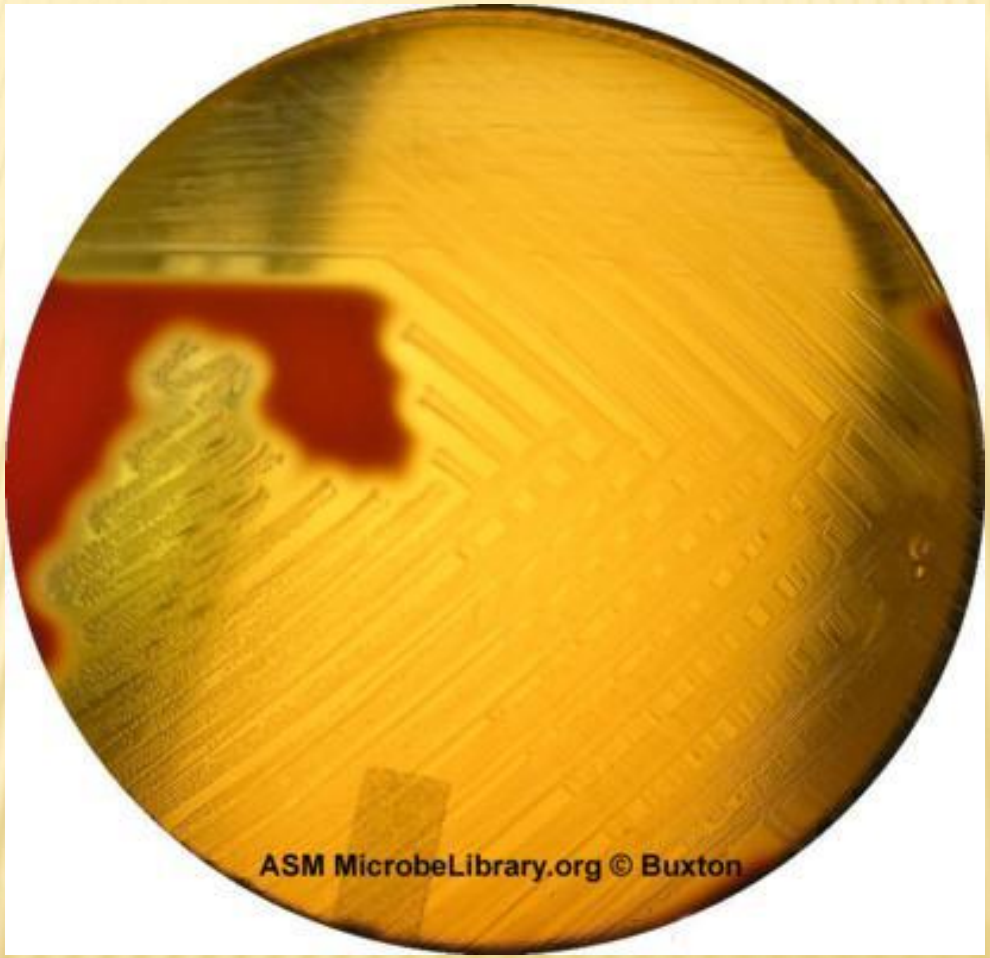
Classification :

Several systems of Classification have been employed:

1- Colony morphology and hemolytic activity on blood agar :

A- Beta hemolytic Streptococci :

Streptococci produced clear zone (colorless) zone of hemolysis around the Colony on blood agar like *Streptococci pyogenes* .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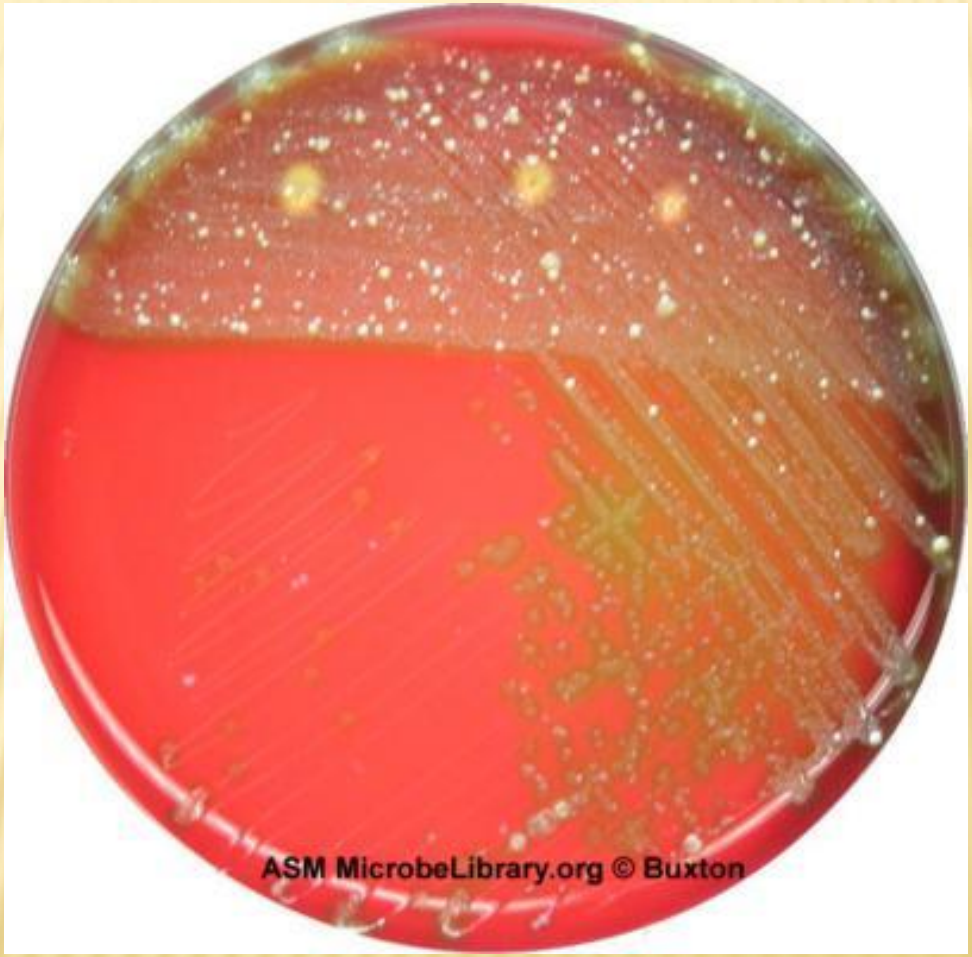
B-Alpha hemolytic Streptococci :

- They tend to show partial zone of haemolysis around the Colony on blood agar like *Streptococcus viridians.*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C-Gamma hemolytic Streptococci they show no zone of reaction around the colony like *Enterococcus fecalis , it is also known as Streptococcus fecalis.*


α
β
γ
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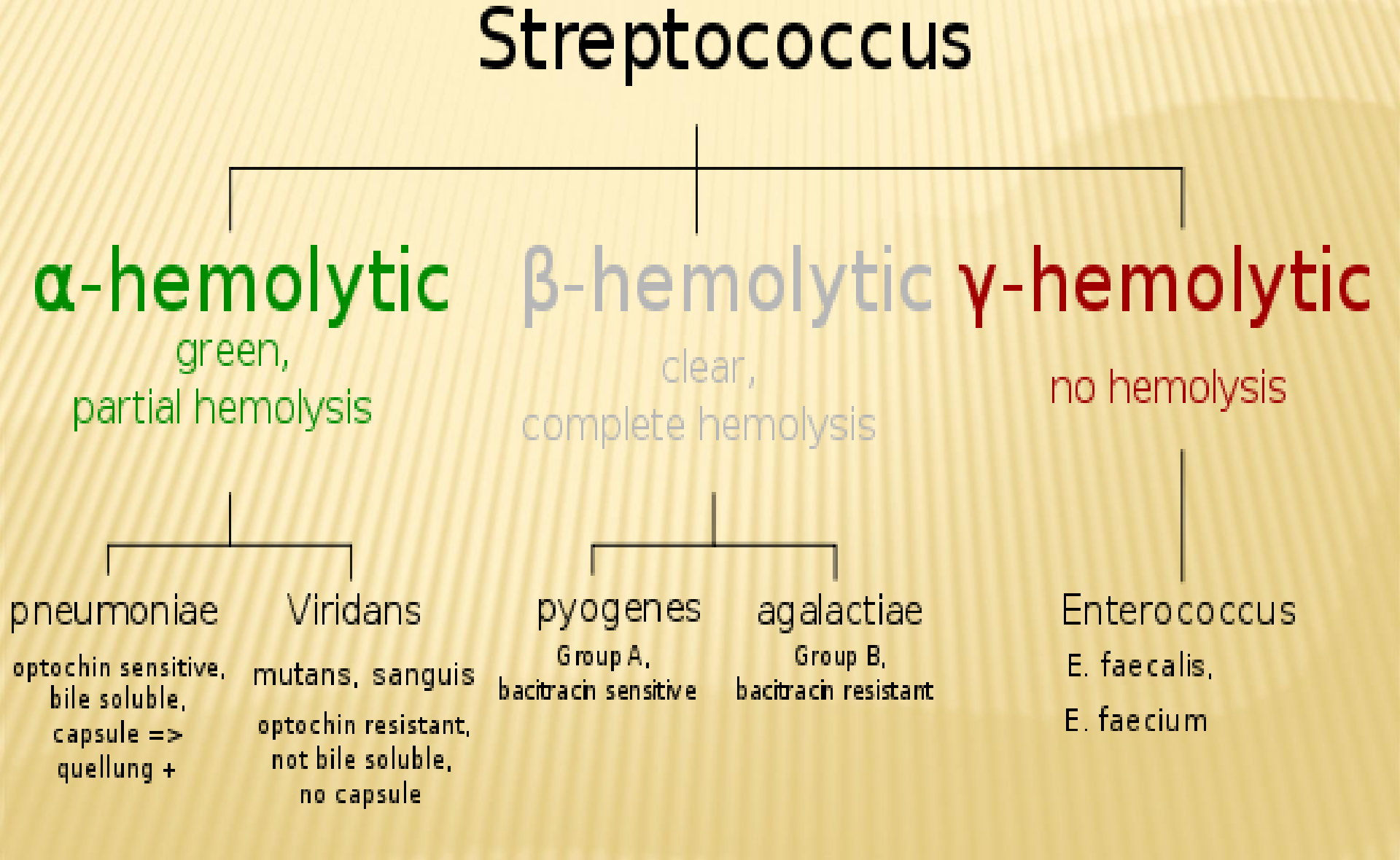
Types Of Streptococcus According To Hemolytic Activity



2- Classification Based On Antigenic Structure :

1- Cell wall polysaccharide (C hapten).

This antigen is found in the bacterial cell wall, according to the specificity of this antigen aerobic Streptococci are Classified into

20 serotypes:

A,B,C,D,E,F,G,H,K,L,M,N,O,P,Q,R,S,T,V.

Lancefield Classification .

This Classification is known as Lancefield Classification .

S. pyogenes resembles type “A”.

3- Pili Proteins

M. protein . It is type specific ,virulence related and resists phagocytosis .

T. protein it is not related to virulence ,heat labile.

R. Protein :

It is surface protein related to virulence .

Streptococcal classification depending on MTR protein is known as Griffth typing, more than 65 Griffth types of S- pyogenes have been reported.

3. Classification depending on growth and metabolic activity :

Regarding oxygen demand:

Streptococci are classified into :

1- Aerobic Streptococcus like S . pyogenes.

2-Microaerophilic type like S. pneumoniae

3-Anaerobic Streptococcus like

S. putridus.

Culture:

Most Streptococci grow on solid media as discoid colonies small pinpoint size ,capsulated strains often give rise to mucoid colonies .

All Streptococci are lacking catalase .

They require enriched media for their growth like blood agar , hemolysis on this medium is taxonomic reaction.

Growth temperature:

Most pathogenic hemolytic Streptococci grow best at 37C . Group D, Entrococci grow well between 15C. and 45 C.

Enterococci grow in high NaCl concentration medium .

Streptococcus pyogenes

It is usually capsulated non spore forming and non motile, the capsule is composed of hyaluronic acid.

Cultural characters:

S. pyogenes is aerobic and facultative anaerobic with optimal growth at 37C.

Enriched media with whole blood ,serum favors rapid growth .

It is catalase negative and exhibit beta (clear) hemolytic zone on blood agar.

Resistance :

It is easily destroyed by heat at 56C for 80 minutes, it can survive in dust for several weeks .

It is resistant to crystal violet , it is susceptible to bactracin (highly sensitive)and this property is used in rapid identification of this organism ,it is sensitive to penicillin also.

Pathogenicity:

Streptococcus pyogenes, is one of the most frequent Pathogens of human in spite of 5-15% of normal individuals harbor this bacterium in respiratory tract without signs . *S.Pyogenes*, is invasive and produce septicemia readily there is tendency to spread locally along lymphatic's & through blood stream.

Pathogenicity of *S. Pyogenes* is due to many Pathogenicity factors like antigenic make up like M protein , capsular Ag extracellular and cellular metabolites like toxins & enzymes.

Toxins &Enzymes :

Hemolysins:

S. pyogenes elaborates two hemolysins

(Streptolysins):

A-streptolysin S :

It is not antigenic responsible for the hemolytic zone around Streptococcal colony growing on the surface of the blood agar.

B- Strptolysin O

It is antigenic & immunogenic leading to an antistreptolysin-O, this reaction forms the basis of general test ASOT .

An antistreptolysin-O serum titer (ASOT) above 160-200 IU/ml is considered high and suggests recent infection with *S. pyogenes*.

2- Erythrogenic Toxin :

It is pyrogenic heat stable exotoxin , associated with damage to small blood vessels and the rash of scarlet fever ,

The production of Erythrogenic toxin is dependent on lysogenic cycle of Streptococci by a certain bacteriophage .

3- Streptokinase:

It is produced mostly by strains of group A , C & G. It is heat stable and antigenic ,it promotes lyses of human fibrin clots .

fibrinolysin appears to play a part in Streptococcal infections by breaking down fibrin barrier around lesion and spreading infections .

It transforms the plasminogen of human plasma into plasmin. Streptokinase has been given 1/v for the treatment pulmonary emboli and of coronary artery and venous thrombosis.

4- Steptodornase (DNA-ase) :

It causes depolymerization of (DNA) , Four types of this enzyme have been recognized from A to D , Type B is more antigenic in men .

Type B & D possess ribonuclease (RNA) activities in addition to (DNA) as activity.

5-Hyaluronidase:

It is spreading factor , it breaks down hyaluronic acid of tissue and this favors spread of infection along intracellular space .

In Addition These Toxins And Enzymes

S. pyogenes produce other metabolites like proteinase pyrogenic exotoxin like toxic shock syndrome toxin, and esterase enzymes.

Pathogenesis & Clinical Findings :

In spite of *S .Pyogenes* bacterium is a part of nasopharyngeal flora in some normal carries about (5 – 15 %) of normal individuals without signs of disease .

The portal of entry of *S .Pyogenes* determines the principal clinical picture.

S. pyogenes is more invasive and produce septicemia readily , when the organisms are able to penetrate the constitutive defenses there's a tendency to spread locally along lymphatic's and through blood stream .

S. Pyogenes Infections:

They are of different forms:

1- Streptococcal sore throat :

It is the most common form of infection caused by *S. pyogenes*. Virulent group A streptococci -adhere to the pharyngeal epithelium by lipo-teichoic Acid covering pili surface and fibronectin-binding protein (protein F).

It may be localized infection in tonsils (Tonsillitis) or may involve pharynx (pharyngitis) and extend to the middle ear , the mastoid and meningies infection in children (Meningitis).

In older children and adults the illness is characterized by naspharyngitis, tonsillitis & intense redness and edema of the mucous membranes with purulent exudates enlarges tender cervical lymph nodes. A similar clinical picture can occur with infectious mononucleosis ,diphtheria, and adenoviruses infections.

Streptococcal infections of the upper respiratory tract does not involve the lung, but pneumonia due to S. pyogenes is rapidly progressive severe & is most commonly a sequela to viral infections like Influenza or measles .

2-skin Infections

A –Impetigo : It is local infection of superficial layers of skin especially in children .

B – Cellulites: It is infection of the deep layers of skin , it is widely spreading in wounded skins ,burned skin & eczema .

C-Erysipelas: It is cellulites accompanied by fever and systemic toxicity with massive edema .

D. Scarlet Fever (Scarlitina) :

It is an erythematous rash on the skin followed *S. pyogenes* erythematous toxin producer strains infection , it may accompanied with tonsillitis impetigo or other forms of *S. pyogenes* infection.

E-toxic Shock Syndrome

It is systematic toxigenic infection of multi organ involvement and finally death.

It is reduced because of antibiotic therapy .

F-wound Infections :

It may cause pyogenic Wound infections like burns, surgical ,traumatic wound infections and even abrasion infections.

Any type of these infections must show complications like Scarlet fever, cellulites and even septicemia if it is not treated properly .

3. General Infections :

Puerperal fever (sepsis at child birth) caused by *S. pyogenes.* Mother get nosocomial infection form carries like doctors , nurses & attendants during delivery septicemia originating in the infected wound (endometritis).

Other infections like abscess of organs (Brain , lungs , kidneys) may occur , it may causes septicemias and pyaemia .

S. pyogenes infections can also result in bone infections, meningitis and even endocarditis (infective type).

5. Post Streptococcal Diseases:

Rheumatic fever glomerulonephrits :

Infections with S. *pyogenes* can give rise to serious sequelae , acute Rheumatic fever and acute glomerulonephrits .

The sequlae begin 1-3 weeks after the acute illness , a latency period consistent with an immune mediated rather than pathogen meditated etiology .

A . Rheumatic Endocarditis :

The most serious sequlae of S. pyogenes infection , because it results in disease of heart muscle and valves . Streptococci contain cell membrane antigen that cross react with human tissue , antigenic Streptococcal sore throats have a greater chance to develop rheumatic fever .

B. Acute Glomerulonephritis

This results from deposition of antigen – antibody complement complex on the basement membrane of the kidney glomeruli.

The antigen may be Streptococcal in origin or it may be a host tissue species with antigenic determinates(Epitopes) similar *S.pyogenes* antigen(cross to those of reactive eptopes)sore throat or impetigo (pyoderma) caused by nephretogenic *Streptococcus pyogenes* may lead to this sequlae .

Diagnostic Laboratory Tests :

A-Specimens :

Specimens depend up on the nature and site of infection .

1-Throats swab in tonsillitis, pharyngitis.

2-Pus from pyogenic lesion on skin or other sites .

3-Blood in sepsis and Endocarditis .

4-CSF in meningitis .

5-Ear swab in otitis.

6-Sputum from pneumonic patients.

Bacteriological Investigations :

a- Direct gram smear to see Gram positive streptococci.

b-Cultivation on blood agar to see Beta hemolytic pin point colony after an overnight incubation at 37 C.

A rapid presumptive identification of S. pyogenes can be made by performing Bactracin sensivity test (+ ve test).

D: Serological Tests :

1- CRP test it is none specific test , it shows increased titer of CRP in patients .

2- ASOT : patients with S. pyogenes infections show increased titer of ASO above 250 IU/ml .

Rheumatic sequelae in patients due to

S. pyogenes show sharp increase in ASOT,(more than 400 IU/ml) .

E-Skin Tests :

1- Dick Test :

It is done to find out susceptibility of a person to scarlet fever .

0.2 ml of erythrogenic toxin is injected I/D on the fore arm and the same amount of heat inactivated toxin on the other fore- arm. A bright red rash appears within 6 hours and become maximum in 24 hours , and fades away . Control forearm does not show any reaction .

A positive reaction means no immunity to scarlet fever.

2. Schultz Charlton reaction:

Erythrogenic antitoxin injected I/D in patient with scarlet rush .There is local bleaching of rush in positive result.

Treatment :

Antibiotic therapy .

S. pyogenes is sensitive to penicillin and there is no resistance genes for it till now , it is the drug of choice for treatment and preventive therapy for post S. pyogenes , sequela.

Erythromycin , is effective also in treatment.

Antitoxin therapy :

Antitoxin was used to relief the toxigenic infection like scarlet fever, Toxic shock syndrome beside antibiotic therapy .

EPIDEMIOLOGY:

Streptococcus pyogenes infections particularly skin infections (impetigo)are of epidemic type in school age children ,treating of such infections is of Epidemiological importance to control such infection.

Streptococcus Type B Infections:

Streptococcus pyogenes B type is Beta hemolytic resides normally 20% of female genital tract and intestine and they are imposed in many human infections.

1. Neonatal sepsis :

Neonate may get risky infection through delivery from birth canal like septicemia and meningitis may arise in neonatal and Premature embryonic death.

2-puperal fever :

Septicemic infection of mother due to endometritis followed delivery. This type of infection is reduced due to antibiotic therapy.

other rare human infections like infective Endocarditis, meningitis may occur.

Diagnosis :

Specimens:

1-Blood from patients of infective endocarditis and septicemia and neonatal sepsis .

2-Cerebrospinal fluid (CSF) from neonates.

3-High vaginal smear.

Cultivation on blood agar (B hemolysis) ,and resistance for bactracin regarding Bactracin sensitivity .

Group C *Streptococcus*

Streptococcus equi , primary causes animal disease (in equines and horses)

It is Beta hemolytic Streptococcus sometimes reside human nasopharynx.

It causes sinusitis bacteremia and Endocarditis .

Group D Streptococci :

They are bowel flora like *Enterococcus. fecalis*

S. facium S. durans and S. avium, the remaining non-entrococcal group D strain include S. bovis .

These bacteria are involved in :

1-urinary tract infection particularly female UTI.

2-Biliary tract infections

3- Disseminated bacteremia and infective Endocarditis ,particularly those with colon cancer.

Enterococci resist cephalosporins and inhibited but not killed by penicillin . Enterococci are vancomycin resistant, drug incombination is necessary there .

Cultural Characters Of Group D Streptococci

On blood agar cultivation , colonies are little bigger than S. pyogenes raised and emulsify easily . Most of strains are non-hemolytic .

On MacConkey medium , colonies are tiny and deep pink in color .They resist bile salt in this medium and intestinal tract.

Viridians Group Streptococci

They are alpha hemolytic Streptococci like *S.anginosus, S.milleri, S. salivarius &S. mitis*, they reside oral cavity and they are involved in dental manipulation and bacterial Endocarditis especially in prosthetic heart valves patients .

S. mutant is involved in dental caries due to it's high ability to glycogalyx and glucan modification

Anaerobic Streptococcus: (Peptostreptococcus)

It resides colon and female genital tract as well as oral cavity. They may give rise to pyogenic lesions like deep pelvic infections(deep abscess like colonic abscess and salpingitis endometritis ,puerperal fever. They can be isolated from gangrenous lesions also .