Streptococcus

Lec. 4

General Characteristic:

✓ G+ve cocci, arrange in chains or pairs.
✓ Some strains are capsulated (give rise to mucoid colonies), which are important in pathogenicity.
✓ Majority are facultative anaerobic, few are obligatory anaerobic.
✓ Catalase –ve
✓ Non motile.
✓ Non spore forming
✓ Fastidious microorganism (require rich media for its growth with additional growth supplement). Such as Blood Agar and Chocolate Agar (enrich media).

They are widely distributed in nature and are found in upper respiratory tract, gastrointestinal tract and genitourinary tract as normal microbial flora.

They are heterogeneous group of bacteria, and no one system suffices to classify them.

Classification: Streptococci can be classified according to the **type of hemolysis** on blood agar or according to the **antigenic components**

1. **HEMOLYSIS**: (tested on blood agar plate)
 β- hemolysis complete RBCs destruction Clear zone around the colony(called target sign) *S. pyogenes, S. agalactiae*
 α- hemolysis partial RBCs destruction Greenish discoloration of agar *S.pneumoniae*, Viridans streptococci
 γ- hemolysis No obvious changes around the colony (No hemolysis). *Enterococci* and *non-enterococcal streptococci* (*S.bovis*).

2. **SEROLOGY (antigenic components):**
 (Lancefield Grouping): there are differences in the polysaccharide antigens of the cell wall (**C carbohydrate**). Depending to these specific polysaccharide antigens, *Streptococci* named as groups (group specific) from A to U except I, and J (more than 20 serogroups). Important are:
 Group A *S. pyogenes*
 Group B *S. agalactiae*
 Group D *Enterococci* & *non-enterococcal streptococcus*.

Group A (*S. pyogenes***) have M-protein** which is a type specific Ag, classify (group A) into more than (80 serotypes).
M protein is a **major virulence factor** for the group A streptococcus. It inhibits the activation of **complement and protects the organism from phagocytosis**.

Although there are more than 30 species of streptococci, only 5 are significant human pathogens. Three of these pathogens have Lancefield antigens: **Lancefield group A, B and D.** The other two pathogenic species of the streptococcal genus do not have Lancefield antigens, and are therefore just called by their species names: One is **Streptococcus pneumoniae** and the other is actually a big group of streptococci collectively called the **Viridans group streptococci.**

GROUP A β-HEMOLYTIC STREPTOCOCCI
(*Streptococcus pyogenes)*

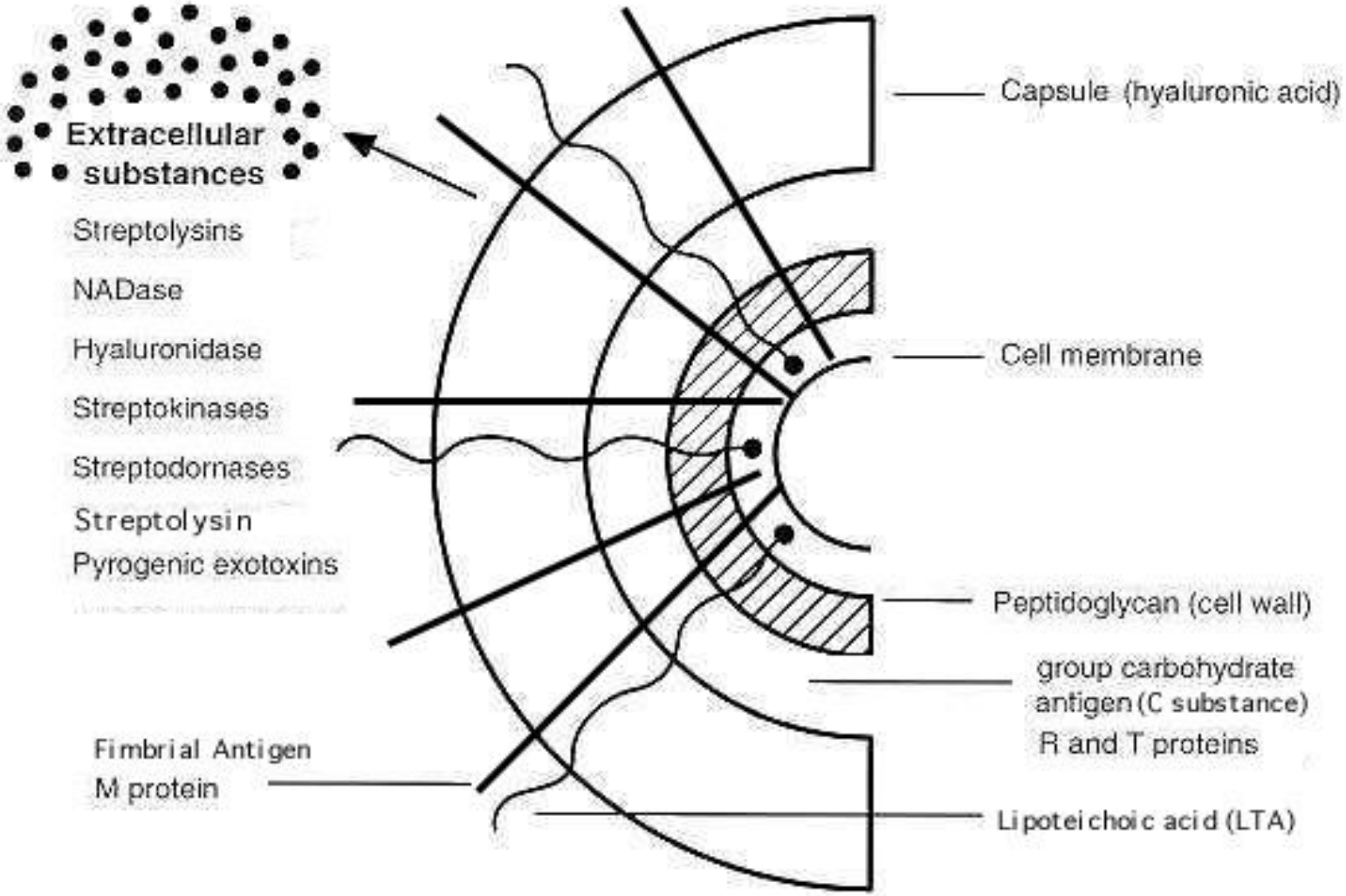
o Lancefield group A antigen and are beta-hemolytic on blood agar. They are also called Streptococcus pyogenes (which means pus producing).

o The components of the streptococcal cell wall that are antigenic include: C **carbohydrate & M protein** (~80 types).

o **Reservoir:** • Human throat • Skin

o **Transmission:** • Direct contact • Respiratory droplets

The cell envelope of a Group A streptococcus



Virulent factors & Pathogenesis:

1) **M protein** is a major virulence factor for the group A streptococcus.

2) **Streptolysin O:** The O stands for oxygen labile as it is inactivated by oxygen. This enzyme destroys red and white blood cells. This enzyme is also antigenic. Following pharyngeal or systemic beta hemolytic group A streptococcal infection, anti-streptolysin O **(ASO) antibodies** develop.

3) Streptolysin S: The S stands for oxygen stabile. This is also responsible for beta-hemolysis but is not antigenic.

4) **Pyrogenic exotoxin** (also called **erythrogenic toxin):** This is found in only a few strains of beta hemolytic group A streptococci, but when these strains invade they can cause scarlet fever (is an infectious disease which most commonly affects children. Symptoms include sore throat, fever and a characteristic red rash. Some strains produce pyrogenic exotoxins that are superantigens. The exotoxins directly super stimulate T cells to pour out inflammatory cytokines, this is called streptococcal toxic shock syndrome

5) Streptokinase (activates the proteolytic enzyme plasmin, which breaks up fibrin blood clots). □ spreading factor

6) Hyaluronidase □ spreading factor

7) Streptodornases (DNAases) □ spreading factor

8) (Anti-C5a) peptidase. □ anti-inflammatory

Diseases:

I. Local infections(invasion):

1) Sore throat (acute pharyngitis, pharyngotonsillitis).

2) Wound infection, cellulitis, Necrotizing fasciitis (**flesh-eating disease**, **flesh-eating bacteria** or **flesh-eating bacteria syndrome**, is a rare infection of the deeper layers of skin and subcutaneous tissues, easily spreading across the fascial plane within the subcutaneous tissue) and myonecrosis.

3) Impetigo.

It is a highly contagious bacterial skin infection most common among pre-school Children

II. Systemic infection: (invasion &/or toxin)

1) Sepsis.

2) Meningitis.

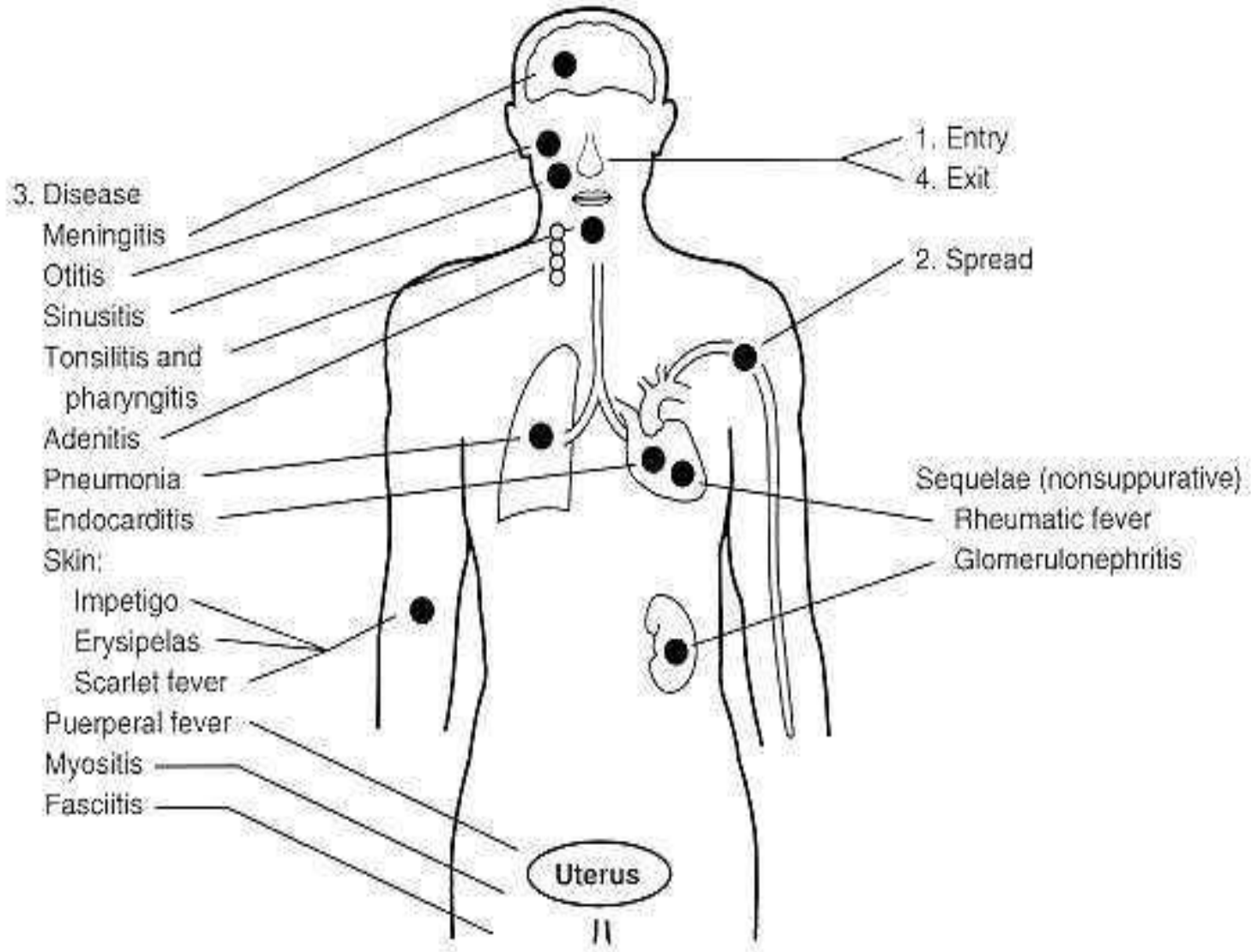
3) Puerperal sepsis.

4) Streptococcus toxic shock syndrome, Scarlet fever (sunburn rash) both caused by pyrogenic exotoxins.

III. Post streptococcal infection sequel (delayed antibody mediated diseases): it is a **non-suppurative complications**

1) **Rheumatic fever** (after sore throat): type II hypersensitivity

2) **Acute glomerulonephritis** (after skin or pharynx infection), mainly by M-12 serotype: type III hypersensitivity


1. Entry
4. Exit
2. Spread
3. Disease
Meningitis
Otitis
Sinusitis
Tonsilitis and pharyngitis
Adenitis
Pneumonia
Endocarditis
Skin:
Impetigo
Erysipelas
Scarlet fever
Puerperal fever
Myositis
Fasciitis
Sequelae (nonsuppurative)
Rheumatic fever
Glomerulonephritis
Uterus

 Rheumatic fever:

It usually strikes children 5-15 years of age. When it occurs, follow untreated beta-hemolytic group A streptococcal **pharyngitis** (but NOT after a skin infection). **Rheumatic fever is antibody-mediated**. There are antigens in the heart that are similar to the antigens of the beta-hemolytic group Astreptococci. Therefore, the antibodies that forms to eradicate this particular streptococcus also cross-react with antigens in the heart. This immunologic attack on the heart tissue causes heart inflammation, called myocarditis. Patients may complain of chest pain and may develop heart failure.

ASO test:

 Measure Ab against Streptolysin O,

 ASO test used in suspected case of rheumatic fever.

 This test used to determine significance of current streptococcal infection by measuring the ASOT: ASOT (Ab Titer): **Normal < 200 > significance result**

 Acute post-streptococcal glomerulonephritis:

This is an antibody-mediated inflammatory disease of the glomeruli of the kidney. It occurs about one week after infection of either the **pharynx OR skin** by **nephritogenic** (having the ability to cause glomerulonephritis) strains of beta-hemolytic group A streptococci. Certain antigens from these nephritogenic streptococci induce an antibody response. The resulting antigen-antibody complexes travel to and are deposited in the glomerular basement membrane, where they activate the complement cascade. This leads to local glomerular destruction in the kidney.

Lab Dx for *S.pyogenes*:

 Specimens: depend on the nature of infection, e.g. sputum, throat swab, nasopharyngeal swab, blood, CSF…etc.

 Gram stain: G+ve cocci, arrange in chains.

 Culture: on **blood agar** under 5-10%CO2 pinpointed, Grayish white, translucent, with large zone of β- hemolysis.

 Sensitive to Bacitracin disc (0.04 U) causes zone of growth inhibition more than 15mm.

 PYR +ve: rapid test, pink is positive. (PYR test is a rapid colorimetric method for presumptive identification of certain groups of bacteria based on the activity of the enzyme pyrolidonyl arylamidase. L-pyroglutamic acid beta-naphthylamide is impregnated into the test disk and serves as the substrate for the detection of pyrolidonyl arylamidase. Hydrolysis of the substrate yields beta-naphthylamide which combines with the PYR Reagent (p-dimethylamino-cinnamaldehyde) to form a bright pink to cherry red color. A positive PYR tests allows for the presumptive identification of group A streptococci (Streptococcus pyogenes) and enterococci. In addition, investigators have determined that PYR activity is a key test for differentiation of some species of coagulase-negative Staphylococcus and for some genera of the family Enterobacteriaceae.)

 Serology: 1)The rapid strep test (ELISA-based), 2) Lancefield grouping, 3) M-protein serotyping and 4) ASO test: Ab Titer: Normal < 200 > significance result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Streptococcus pyogenes on Columbia Sheep Blood Agar