Self education for *Streptococcus pyogenes*
Paul A. Gulig, Ph.D.

1. Basic microbiology - see Schaechter Chapters 12 and 62, Dr. Jin's handout on classification and URT infections, Dr. Lawrence's handout and PowerPoint (on the web), my comments and examples from *S. pyogenes* through general pathogenesis, and material in the Virtual Lab.

Streptococci are gram-positive cocci, often, but not always found in chains (*S. pyogenes* forms nice chains, *S. pneumoniae* is in pairs [diplococci] that are somewhat pointed). The major surface components of interest of *S. pyogenes* are the Group A carbohydrate, M protein, capsule, and lipoteichoic acid. There are many more!

a. Group carbohydrate. The streptococci were classified antigenically by Lancefield using antisera based on cell wall carbohydrates. Group A equals *S. pyogenes*, so these terms are interchangeable. Note that the group carbohydrate is NOT the same as the capsule.

b. hemolysis. The streptococci are also classified by their hemolysis on blood agar plates. *S. pyogenes* forms beta hemolysis (see the text and the Virtual Lab for images - you will be responsible for identifying the different forms of hemolysis on the exam). Several clinically relevant streptococci cause beta hemolysis, so "beta hemolytic streptococci" DOES NOT EQUAL *S. pyogenes.*

c. M protein. Fibrillar layer protein. Antigenic variety. Used to classify by serotype (over 100 serotypes). See below in pathogenesis.

2. **Diseases** - numerous! (bolded covered for first exam - see Dr. Lawrence's notes and PowerPoint online for symptoms and treatment)

a. Infections: **Pharyngitis, scarlet fever**, skin infections - superficial (impetigo) and deep (necrotizing fasciitis), **pneumonia**, Streptococcal toxic shock syndrome

b. Sequellae - **Rheumatic fever** and **glomerulonephritis**

3. Pathogenesis

a. Encounter - **Human only** for respiratory infections - **respiratory droplet**; skin contact for skin infection, dogs apparently can cause skin infections via biting

b. Entry - Upper respiratory tract or skin
i. adherence - M protein binds fibrinogen
ii. LTA, among other factors

c. Spread - **yes**, can invade tissues and pass through epithelial cells
i. hyalurinidase breaks down intercellular matrix
ii. DNase B - helps spreading (antibody response used as a diagnostic sign)

d. Multiplication - fastidious, culture on blood agar (typical in lab)

e. Evade defenses
i. hyaluronic acid capsule - antigenic mimicry, antiphagocytic
ii. M protein - binds host factor H to inhibit complement
iii. C5a peptidase - cleaves C5a to inhibit inflammation

f. Damage

i. Hemolysins - lyse defense cells

- Streptolysin O (antibody response used as a diagnostic sign)

- Streptolysin S

ii. Pyrogenic exotoxins (numerous) - **superantigens** causing toxic shock syndrome, **scarlet fever rash (phage encoded)**

iii. Glomerulonephritis

- **non-suppurative** - no infection of kidney
- follows **pharyngitis or skin infection** with "nephritogenic" strains
- **immune complex-mediated?**

iv. Rheumatic fever

- **non-suppurative** - no infection of heart
- only follows **pharyngitis**, not skin infections
- **autoimmune** reaction between **certain M proteins** and heart tissue (so not all serotypes equally likely to cause rheumatic fever, but serotyping is not done clinically)

g. Transmission - yes, highly contagious

As noted above, this material complements and reinforces that from several other sources for this class. It is not all-inclusive. You will be responsible for knowing the lab diagnosis from the Virtual Lab, and the diagnostic criteria for the various diseases and the treatments from Dr. Lawrence, and material from the Streptococcus pyogenes web page linked on the course web page.

h. Outcome – highly variable depending on strain, patient, circumstances, treatment

i. In untreated pharyngitis, usually self resolving. However, if the patient and bacterial strain have the right genotypes, rheumatic fever or glomerulonephritis can occur. Rheumatic fever can be fatal and/or lead to subsequent problems (e.g., endocarditis).

ii. Simple skin infections usually are self-limiting, but can lead to glomerulonephritis.

iii. Serious skin infections (necrotizing fasciitis) can be fatal or require surgery.

iv. Other more rare diseases (pneumonia, Streptococcal Toxic Shock Syndrome) can be fatal.