Pathogenic Gram +

- Staphylococcus
- Streptococcus
- Bacillus
- Clostridium
- Mycobacterium
Staphylococcus

- Facultative anaerobe
- Salt tolerant
- Catalase positive

- Two species:
- Found on skin, upper respiratory, GI, urogenital tract

Table 19.1 A Comparison of the Virulence Factors of Staphylococcal Species

<table>
<thead>
<tr>
<th>Factor</th>
<th>S. aureus</th>
<th>S. epidermidis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protein A</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>Coagulase</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>Catalase</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Hyaluronidase</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>Staphylokinase</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>Lipase</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>β-lactamase (penicillinase)</td>
<td>+</td>
<td>-</td>
</tr>
</tbody>
</table>
Pathogenicity

- Protein A: coat antibody stems
- Slime layer
- Bound coagulase
- $\beta$-lactamae

- Toxins:
  - TSS toxin
  - Enterotoxin: food poisoning
Diseases

- Scalded skin syndrome
- Toxic shock syndrome
- Bacteremia: cells in blood
- Endocarditis: lining of heart
Staph

- Half of all hospital acquired infections for Bacteremia
- Penicillin & MRSA
Streptococcus

• Catalase negative
• Pairs or chains
• Serological classification
<table>
<thead>
<tr>
<th>Lancefield Group</th>
<th>Scientific Name</th>
<th>Hemolytic Pattern</th>
<th>Significant Characteristics</th>
<th>Characteristic Diseases</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td><em>S. pyogenes</em></td>
<td>Large zone of beta-hemolysis</td>
<td>1- to 2-mm white colonies on blood agar; bacitracin sensitive</td>
<td>Pharyngitis, scarlet fever, pyoderma, erysipelas, streptococcal toxic shock syndrome, necrotizing fasciitis, rheumatic fever, glomerulonephritis</td>
</tr>
<tr>
<td>B</td>
<td><em>S. agalactiae</em></td>
<td>Small zone of beta-hemolysis</td>
<td>2- to 3-mm buttery colonies on blood agar; bacitracin resistant</td>
<td>Puerperal fever, neonatal bacteremia, meningitis, pneumonia</td>
</tr>
<tr>
<td>C</td>
<td><em>S. equisimilis</em></td>
<td>Large zone of beta-hemolysis</td>
<td>1- to 2-mm white colonies on blood agar</td>
<td>Pharyngitis, glomerulonephritis</td>
</tr>
<tr>
<td>C, F, or G</td>
<td><em>S. anginosus</em></td>
<td>Small zone of beta-hemolysis</td>
<td>1- to 2-mm white colonies on blood agar</td>
<td>Purulent abscess</td>
</tr>
<tr>
<td>-</td>
<td><em>S. mutans</em></td>
<td>Alpha-hemolysis</td>
<td>Viridans group (produce green pigment when grown on blood agar)</td>
<td>Dental caries; rarely bacteremia, meningitis, endocarditis</td>
</tr>
<tr>
<td>-</td>
<td><em>S. pneumoniae</em></td>
<td>Alpha-hemolysis (aerobic); beta-hemolysis (anaerobic)</td>
<td>Diplococci; capsule required for pathogenicity; bile sensitive</td>
<td>Pneumonia, sinusitis, otitis media, bacteremia, endocarditis, meningitis</td>
</tr>
<tr>
<td>D</td>
<td><em>Enterococcus faecalis</em>, <em>E. faecium</em></td>
<td>None (gamma-hemolysis)</td>
<td>Diplococci; no capsule; bile insensitive</td>
<td>Urinary tract infections, bacteremia, endocarditis, wound infections</td>
</tr>
</tbody>
</table>

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Pathogenicity

- Protein M: destabilizes complement system
- Hylaluronic acid capsule: evades white blood cells
- Streptolysins: lyse blood cells
- Toxins: erythrogenic and pyrogenic
**Strep Throat**

*Streptococcus pyogenes* - Gram Positive cocci

**Pathogenesis - Acute**

1-3 days – soreness, fever, redness, pus

Spreads to ears, sinuses...septic/systemic

Makes hemolysin, other flesh-eating enzymes

Some strains make exotoxins - toxic shock
Rheumatic Fever = untreated *S. pyogenes*

Bacterial proteins mimic body proteins
Specific defenses attack self = autoimmune
Attacked tissue in heart, joints, kidney
Bacillus anthracis

- Rod shaped
- Soil bacterium
- Spore forming
- Plasmid with toxin
- Primarily in herbivores
- Rare transmission to humans
Cutaneous Anthrax

*Bacillus anthracis* - Gram Positive rods

Contact between wounds and spores
Less severe, not considered communicable
Toxins produce blackened necrotic pustules
*Inhalational* - respiratory, systemic, fatal - NOT communicable.
Developed as a bioweapon.
Clostridium

- Anaerobic gram +
- Endospore forming
- Ubiquitous in soil, water, sewage and GI tract
- Potent neurotoxins
Pathogenesis - *Clostridium perfringens* - Acute Gas Gangrene: produce 11 toxins
borne spores grow in puncture wounds
Anaerobic bacteria makes gas/pockets of air
Destroys blood vessels, connective, muscle…
C. botulinum

- Spores survive improper canning
- Release toxin
C. tetani

- Terminal endospores
- Neurotoxin
- Over a million cases worldwide
- Effect of toxin is irreversible at any synapse affected
Spinal cord

(a) Excitatory neuron
Inhibitory neuron
Inhibitory neurotransmitter blocks nerve impulse
No nerve impulse
Motor neurons
Nerve impulse

(b) Nerve impulse
Small polypeptide of tetanus toxin blocks release of inhibitory neurotransmitter

Both muscles fully contract. The arm flexes because biceps brachii is larger and stronger.

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Mycobacterium

- Gram +
- Waxy lipid: mycolic acid
- Grow slow: hours to several days
- Protected from phagocytosis
- Acid fast staining
- TB and Lerosy
TB

- Respiratory disease
- Pandemic worldwide
- Prevalent in countries of the former Soviet Union
- #1 killer of AIDS patients in Africa
Primary infection
Leprosy (Hansen’s Disease)

- Similar: acid fast
- Grows best @ 30°C
- Cooler regions of the body
Prevention and Control
1.5-2.5 cases million/world; 50-100 cases US
Early treatment will correct deformities
Up to three months - multi-drug cocktail