1. Streptococcus classification (1)

Streptococcus classification

- Classification hemolysis patterns
  Lancefield groups
  many species, *S. pyogenes*
  *S. pneumoniae*

- Not all species have a Lancefield group

2. Streptococcus classification (2)

Streptococcus classification

Hemolysis on Agar plates containing Sheep Blood

Lancefield Groups (A, B...T)

Major cell-wall carbohydrate antigens

β

Group A B C, G

Minute-colony

α and non-hemolytic, γ

Group D

*S. pneumoniae* Viridans

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3. Streptococcus classification (3)

Streptococcus classification

Hemolysis on Agar plates containing Sheep Blood

Lancefield Groups (A, B...T)

Major cell-wall carbohydrate antigens

β

Group A
B
C, G

S. agalactiae

α and non-hemolytic, γ

Minute colony

Group D

S. pneumoniae
Viridans

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4. Group B Strep GBS S. agalactiae

Group B Strep
GBS

S. agalactiae

Normally Inhabit lower GI
Female genital tract (20%)

neonatal sepsis, meningitis and pneumonia

20% fatal; 30-50% w/ permanent brain damage

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5. Streptococcus classification (4)

**Streptococcus classification**

Hemolysis on Agar plates containing Sheep Blood

Lancefield Groups (A, B...T)

Major cell-wall carbohydrate antigens

β

Group A  B  C, G

α and non-hemolytic, γ

Minute colony

Group D

S. pneumoniae  Viridans

S. bovis

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6. Streptococcus bovis Group D Strep

**Streptococcus bovis**

Group D Strep

- Common bowel flora

- But when found in bloodstream correlates w/colon cancer >50%

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7. Streptococcus classification (5)

*Streptococcus* classification

Hemolysis on Agar plates containing Sheep Blood

Lancefield Groups (A, B...T)

- Major cell-wall carbohydrate antigens
- β
- Group A
- Group B
- Group C, G

α and non-hemolytic, γ

- Minute colony

Group D
- S. pneumoniae
- Viridans
- Enterococcus

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8. Enterococci

*Enterococci*

- Normally found in GI tract
- Normally resistance to cephalosporins and inhibited, but not killed by penicillin.
- Isolated at heart valves → endocarditis
- Vancomycin resistant (VRE)

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9. Streptococcus classification (6)

Streptococcus classification

Hemolysis on Agar plates containing Sheep Blood

Lancefield Groups (A, B...T)

<table>
<thead>
<tr>
<th>β</th>
<th>α and non-hemolytic, γ</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group A</td>
<td>Group D</td>
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<td>B</td>
<td>S. pneumoniae</td>
</tr>
<tr>
<td>C, G</td>
<td>Viridans</td>
</tr>
</tbody>
</table>

Minute-colony

Subacute endocarditis
Nattually found on teeth

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10. Streptococcus classification (7)

Streptococcus classification

Hemolysis on Agar plates containing Sheep Blood

Lancefield Groups (A, B...T)

<table>
<thead>
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</tr>
</tbody>
</table>

| S. pyogenes |

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Case

7 year old boy presents with high fever and sore throat, complains of stomach ache and nausea

O/E

Temp 104°F
White exudate on tonsils
Tender lymphadenopathy

Widespread rash over trunk and limbs

Diagnosis and Treatment

Ix:

Throat swab - rapid strep test and culture
(or just culture)

Presumptive diagnosis of Group A strep pharyngitis

Penicillin orally 10 days

Final diagnosis depends on culture of β-hemolytic cocci plus clinical signs

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13. Necrotizing Fasciitis Flesh eating bacteria (Group A Strep)...

**Necrotizing Fasciitis**
Flesh eating bacteria (Group A Strep)

- Often follows minor skin injury
  - Usually arm or leg, but can start any place
- Rapid sudden, severe pain in infected area
- Fever, nausea, vomiting
- Spreads rapidly along fascial planes
- High morbidity and mortality
- Treatment: Aggressively with antibiotics and sometimes surgery to remove dead tissue
- Not contagious, but associated with certain strains of Strep.

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14. Group A streptococcal diseases associated with exotoxins

**Group A streptococcal diseases**
associated with exotoxins

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15. Non-infectious complications following Group A Strep infection

Non-infectious complications following Group A Strep infection

Glomerulonephritis - following either pharyngitis or impetigo
- 10-15% attack rate
- Antigen-antibody-complement complex deposited in kidney
- Edema, smoky or rust colored urine, hypertension

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16. Non-infectious complications following Group A Strep infection

Non-infectious complications following Group A Strep infection

Acute Rheumatic Fever - ARF
- Follows pharyngitis and/or scarlet fever, if not treated,
- Does not follow impetigo
- Presents 1-5 weeks post pharyngitis
- In developing countries accounts for major cause of heart disease 25-40%
- Associated with certain strains of GAS with specific M proteins

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17. Damage in ARF

Damage in ARF

- Hypothesis: cross reactivity between specific immunity to GAS and host proteins:

  Molecular Mimicry
  - M protein and cardiac myosin, vimentin and elastin

  Damage heart valves (hear murmurs)

  Greater Susceptibility to Endocarditis

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18. Encounter/Transmission of Group A Streptococcus

Encounter/Transmission of Group A Streptococcus

- Natural reservoir- humans
- On skin and mucosal surfaces
- Overall carriage rate is 5-25%

- Pharyngitis-colder climates; inhaling aerosolization from infected people
- Impetigo-warmer climates/seasons; touch

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19. Entry/Spread of GAS Localized versus Systemic disease

**Entry/Spread of GAS**

Localized versus Systemic disease

Pharyngitis and impetigo - localized infection, attachment to epithelial cells on mucosal surfaces or minor trauma

Necrotizing fasciitis caused by entry through wound or trauma site and rapid spread along the fascial planes

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20. Virulence Factors

**Virulence Factors**

- Entry/attachment to cells
- Resistance to host defenses
- Spread
- Toxins → Scarlet fever, Toxic Shock

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21. Multiplication/Prevention of Phagocytosis

Multiplication/Prevention of Phagocytosis

- M protein—resistance to phagocytosis
  - binds to Factor H
  - Factor H binds C3b
  - blocks C3bBb formation

- binds to fibrinogen, forming dense coat which masks bacteria from complement binding

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22. Spread of GAS: Necrotizing Faciitis Secreted digestive enzym...

Spread of GAS: Necrotizing Faciitis Secreted digestive enzymes

Streptolysin O- pore forming toxin
  - binds to cholesterol in membrane,
  - inserts and lyses cells including neutrophils
  - O’xygen labile
Streptolysin S-pore forming toxin,
  - causes β-hemolysis on blood agar plates
Streptokinase-plasminogen activator
  - (breaks up blood clots)
DNaseB
Hyaluronidase-degrades hyaluronic acid

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23. Therapeutic Strategies

Therapeutic Strategies

No vaccine. M protein has 120 variants—other membrane proteins being tested.

10 day course of antibiotics for pharyngitis to prevent rheumatic fever—STILL Penicillin sensitive

Surgical intervention often critical for necrotizing fasciitis & treat with Clindamycin and Penicillin

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24. Streptococcus classification (8)

Streptococcus classification

Hemolysis on Agar plates containing Sheep Blood

Lancefield Groups (A, B...T)

Major cell-wall carbohydrate antigens

β

Group A

Group B

C, G

Minute-colony

α and non-hemolytic, γ

Group D

S. pneumoniae

Viridans

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25. **Streptococcus: Two Cases**

32 year old male smoker
Presents to family practitioner with fever, cough, right sided chest pain and shortness of breath on exertion
O/E Temp 100°F
   Signs in his right lung base

86 year old woman, brought to emergency room by son
Confused, not responsive to questions, difficulty breathing.
O/E Fever 103°F
   Neck stiffness, no rash
   Signs right lung base

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26. **Diagnosis**

**Diagnosis**

- Gram stain of sputum containing neutrophils and gram-positive diplococci
- Culture on blood agar plates
  - α hemolytic---green
  - Optochin sensitive

Pneumonia caused by *S. pneumoniae*

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Treatment

Historically Penicillin-BUT now at least 30% of clinical isolates are resistant

- Treat presumptive *S. pneumoniae* caused pneumonia with ceftriaxone until determine MIC of strain

- Treat meningitis with ceftriaxone and vancomycin

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Outcomes

- 32 year old male
  - Is released from hospital with antibiotics
  - At Fenway next evening for game

- 86 year old female
  - Admitted to hospital
  - Given antibiotics, BUT
  - Succumbs to pneumonia & sepsis 12 hours after entering hospital and before cultures are grown to determine drug susceptibilities

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Spread/Multiplication/Damage in Lung

1. Serous fluid—many bacteria—few inflammatory cells.
2. Early consolidation—neutrophil and red blood cell infiltrate—rusty brown sputum.
3. Late consolidation—alveoli packed with neutrophils.
4. Resolution—macrophages replace neutrophils

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Encapsulated Bacteria

- Polysacchride capsule—impairs phagocytosis
- Sepsis and meningitis
- Are cleared by spleen
  - *Streptococcus pneumoniae*,
  - *Neisseria meningitidis*
  - *Streptococcus agalactiae*
  - *Hemophilus influenzae*

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Risk Factors for pneumonia

- Pre-existing lung infection
- Cigarette smoking
- Alcohol consumption
- Excess fluid in lungs
- Splenectomy**
- Immunocompromised

Vaccine

Conjugative vaccine: 1999
7 capsular polysaccharides each conjugated to a protein
  Children under 5
  People with splenectomy
  Elderly
Streptococcus lab classification

- Gram positive cocci, short chains or diplococci
- Catalase negative
- Hemolysin pattern (not diagnostic of Strep. w/out catalase and gram stain)
- *S. pyogenes*
  - bacitracin sensitive
  - β-hemolytic
- *S. pneumoniae*
  - optochin sensitive
  - α-hemolytic

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