Alpha Hemolytics Streptococci

Objectives:
Upon completion of this lecture, the student will:

- Analyze the diseases & pathogenicity for viridans & pneumococci.
- Demonstrate the epidemiology/transmission for viridans & pneumococci.
- Outline the laboratory diagnosis for viridans & pneumococci.
- State the drug of choice and prophylaxis where regularly used.
Viridans Group Streptococci
(No Lancefield antigen classification. Members include Streptococcus salivarius, S. sanguis, S. mitis, S. intermedius, S. mutans, and others.)

- They contain many species, they are untypable i.e. no group specific Ag, they are α-hemolytic Streptococcus
- It is present as a Commensal on mucosa of mouth, nasopharynx, and saliva.

Diseases:
1) Tooth carries: caused by S.mutans, by producing glyocalyx → plaque formation.

2) Subacute bacterial endocarditis (SBE):
   Tooth extraction → enters human body → subacute (slow) bacterial endocarditis (SBE) in patients with abnormal heart valves and no antibiotic prophylaxis. In contrast, acute infective endocarditis is caused by a staphylococcal infection, often secondary to IV drug abuse, and is characterized by an abrupt onset of shaking chills, high spiking fevers, and rapid valve destruction. See fig.4

3) Abscesses: There is a subgroup of the viridans streptococci called the Streptococcus intermedius which are microaerophilic and are part of the normal G.I. tract flora. Are often found in abscesses in the brain or abdominal organs. They are found alone in pure cultures or in mixed cultures with anaerobes. A clinical pearl is that if Streptococcus intermedius group bacteria grows in the blood you should suspect that there is an abscess hiding in an organ.

Lab Dx:

1) Specimen: blood, gingival swab … etc
2) Grams slide: G+ve cocci, arrange in chains.
3) Culture: on Chocolate or blood Agar: α-hemolysis small (pinpointed), gray, glistening colonies
4) Biochemical tests:
   - Optochin sensitivity disc: Chocolate agar streaked with Viridans Streptococci then apply Optochin disc → no zone of inhibition around the disc. This test used to differentiate S.pneumoniae from Viridans Streptococci.

Fig 4: Viridans Streptococcus is eating heart valves slowly, while Staphylococcus aureus is eating fast.
- Bile Solubility test: Viridans Streptococci are resistant for bile salt which remains intact in broth culture contains this salt, while \textit{S.pneumoniae} is sensitive for bile salt which induces the autolysis of this bacterium.

Turbid broth culture of \textit{S.pneumoniae} + 10% Bile salt = Clear Broth after 10 min (+ve result for \textit{S.pneumoniae})

Turbid broth culture of Viridans Streptococci + 10% Bile salt = No changes remains turbid) after 10 min (+ve result Viridans Streptococci)

- API Strept: a set of biochemical test in one plastic sheet.

5) Antibiotic sensitivity test.

\textbf{\textit{S.pneumoniae (Pneumococci, Diplococcus pneumoniae):}}

\textbf{Distinguishing Features:}
- $\alpha$-hemolytic.
- Optochin sensitive.
- Lancet-shaped diplococcic (cat eye).
- Lysed by bile.

\textbf{Reservoir:} human upper respiratory tract.

\textbf{Transmission:}
- Respiratory droplets:
  - Not considered highly communicable.
  - Often colonizes the nasopharynx without causing disease.

\textbf{Predisposing Factors:}
- Antecedent influenza or measles infection.
- Chronic obstructive pulmonary disease (COPD).
- Congestive heart failure (CHF).
- Alcoholism.
- Asplenia predisposes to septicemia.

\textbf{Virulent factors & Pathogenesis:}
- Polysaccharide capsule is the major virulence factor.
- IgA protease $\rightarrow$ anti IgA
- Teichoic acid.
- Pneumolysin O: hemolysin/cytolysin
  - Damages respiratory epithelium
  - Inhibits leukocyte respiratory burst and inhibits classical complement fixation
Notes:

- The Pneumococci is a very important organism because it is a major cause of bacterial pneumonia and meningitis in adults, and otitis media in children. Pneumococcus is to Parents while group B streptococcus is to Babies.
- Pneumococci are typed to 84 serotypes according to the nature of capsular polysaccharide antigen. In adults, types 1-8 are responsible for about 70% of pneumococcal pneumonia and for 5% of fatalities due to pneumococcal bacteremia. In children, type 6, 14, 19 and 23 are frequent causes.
- Pneumococci are part of the normal nasopharyngeal and oropharyngeal flora of many healthy persons. The carrier rate varied widely between different groups and among individuals of the same group from time to time (40-70%). Harmless to carrier unless provoked by predisposing factors such as influenza or common cold, measles, COPD, alcoholism….etc

Diseases:

a) Typical pneumonia:
- Most common cause (especially adult & elderly)
- Shaking chills, high fever, lobar consolidation, blood-tinged, "rusty" sputum

b) Adult meningitis:
- Most common cause
- Peptidoglycan and teichoic acids are highly inflammatory in the CNS.
- CSF reveals high WBCs (neutrophils) and low glucose, high protein

c) Otitis media and sinusitis in children: most common cause

As both Pneumococci and Viridans streptococci are α-hemolysis (green color) on culture agar, we expect misdiagnosis between them. So we depend on the following differential points:

<table>
<thead>
<tr>
<th>Character</th>
<th>Pneumococci</th>
<th>Viridans streptococci</th>
</tr>
</thead>
<tbody>
<tr>
<td>Morphology</td>
<td>Ovoid or lanceolate diplococci</td>
<td>Rounded cocci in short or long chains.</td>
</tr>
<tr>
<td>Capsule</td>
<td>Present</td>
<td>Absent</td>
</tr>
<tr>
<td>Optochin sensitivity</td>
<td>+ve</td>
<td>-ve</td>
</tr>
<tr>
<td>Bile solubility</td>
<td>+ve</td>
<td>-ve</td>
</tr>
<tr>
<td>Capsular swelling test (Quelling reaction)</td>
<td>+ve</td>
<td>-ve</td>
</tr>
<tr>
<td>Virulence in mice</td>
<td>+ve</td>
<td>-ve</td>
</tr>
</tbody>
</table>
**Lab Dx of S.pneumoniae:**

- **Gram stain:** direct exam for sputum to differentiate from pneumonia caused by viral infection. Direct exam reveals G+ve diplococci and many neutrophiles.

- **Culture:** on Chocolate or blood Agar → α- hemolysis small (pinpointed), gray, glistening; colonies tend to dip in the center and resemble a doughnut (umbilicated) as they age; colonies may be mucoid.

- **Biochemical tests:**
  
  A. **Optochin sensitivity disc:** Chocolate agar streaked with *S.pneumoniae* then apply Optochin disc. Demonstrate a zone of inhibition around the disc. This test used to differentiate *S.pneumoniae* from Viridans Streptococci.

  B. **Bile Solubility test:** *S.pneumoniae* is sensitive for bile salt which induces the autolysis of this bacterium. While Viridans Streptococci are resistant for bile salt and remain intact in broth culture contains this salt.

  Turbid broth culture of *S.pneumoniae* + 10% Bile salt = Clear Broth after 10 min (+ve result for *S.pneumoniae*)

  Turbid broth culture of Viridans Streptococci + 10% Bile salt = No changes after 10 min (+ve result Viridans Streptococci)

- **Serology:**
  
  a) **Rapid diagnosis** test for *S.pneumoniae* is the **Quelling reaction** test: Is a rapid diagnostic test on culture. By mixing *S.pneumoniae* with specific anti-polysacchride (capsule component) on microscope slide. The capsule swell due to Ag-Ab reaction. Examined by capsular stain such as Indian ink.

  b) **Latex particle agglutination** test for capsular antigen in spinal fluid diagnostic for meningitis.

  \{ *S.pneumoniae* + specific Ab = capsule swelling (+ve result) → stain with negative stain like India ink \} → diplococci surrounded by clear area with dark background.

- **Virulence in mice:** when inject Pneumococci in the mice the mice will die, while when inject Viridans the mice will survive.

- **Antimicrobial susceptibility testing.**
**Vaccine**

- **Pediatric (PCV, pneumococcal capsular vaccine):**
  - Seven of the most common serotypes
  - Conjugated to diphtheria toxoid
  - Prevents invasive disease
- **Adult (PPV, pneumococcal polysaccharide vaccine):**
  - 23 of the most common capsular serotypes
  - Recommended for all adults >65 years of age and any at-risk individuals

**Summary**

- Alpha haemolytics streptococci causing greenish discoloration on chocolate agar.
- Viridans causes SBE in suspected individuals. AB prophylaxis needed.
- **Pneumococcus is capsulated and typed accordingly to 84 serotyped.**
- **Pneumococci are the leading cause of adult pneumonia.**
- **Pneumococci present in carrier state in 40-70% of healthy humans.**
- **Pneumococci & viridans can be differentiated by Optochin sensitivity, arrangement, bile solubility, Capsular swelling test (Quelling reaction) and serologically.**
- **Pneumococci can be prevented by a Vaccine → causing Ab against capsular Ag.**

**References:**

- Baily & Scott diagnostic microbiology, 12th ed.
- Lippincotts Illustrated microbiology 3rd ed, 2013

**END**