Streptococcus pneumoniae
Staphylococci
KEYWORDS

- S. pneumoniae
- diplococci
- Pneumococcus
- autolysin
- bile solubility test
- optochin susceptibility
- capsule
- Quellung reaction

- Staphylococcus aureus
- opportunistic diseases
- food poisoning/enterotoxins
- toxic shock syndrome
- toxic shock toxin
- exfoliative toxin/scalded skin syndrome
- α, β, γ and δ cytotoxins
- leucocidin
- lipase
- hyaluronidase
- protein A
- coagulase (+) or coagulase (–)
- Staphylococcus epidermidis
*S. pneumoniae*
\textbf{S. pneumoniae}

- leading cause of pneumonia
  - particularly young and old
  - after damage to upper respiratory tract
    \*e.g. following viral infection
- bacteremia
- meningitis
- middle ear infections (otitis media)
S. pneumoniae

- α hemolytic
- pneumolysin
  - degrades red blood cells under aerobic conditions
- grows well on sheep blood agar
- no group antigen
Diagnosis - spinal fluid

- direct Gram staining
- detection of capsular antigen
Autolysis – identification after growth

- Autolysin
- Lipoteichoic acid
- Teichoic acid
- Choline
- Peptidoglycan
- Cell membrane

Diagram:
- Bile flow
- Cell membrane rupture
- Autolysin release
C polysaccharide

- Teichoic acid
  - Precipitates in serum
  - C-reactive protein
Identification

Not optochin sensitive

optochin sensitive
Capsule

• prominent
  – virulent strains
• anti-phagocytic
• carbohydrate antigens
  – vary among strains
Capsule

- immunity
  - serotype specific
- vaccine contains multiple serotypes
- only for susceptible population
Quellung reaction

- using antisera
- capsule "fixed"
- visible microscopically
Pathogenesis

• Teichoic acid
  – complement activation
  – large numbers of inflammatory cells at infection site
Therapy

• *S. pneumoniae*
  – most strains susceptible to penicillin
  – resistance is common
STAPHYLOCOCCI

- Gram positive
- Facultative anaerobes
- Grape like-clusters
- Catalase positive
- Major components of normal flora
  - skin
  - nose
Staphylococcus aureus
One of commonest opportunistic infections - hospital and community:

- pneumonia
- osteomyelitis
- septic arthritis
- bacteremia
- endocarditis
- abscesses/boils
- other skin infections
Food poisoning

- not an infection
- food contaminated by humans
  - growth of bacteria
  - production of enterotoxin
- onset and recovery both occur within few hours
Food poisoning

- Vomiting
- nausea
- diarrhea
- abdominal pain
Associated with outbreak of toxic shock syndrome.
Toxic shock syndrome

• fever
• rash
• desquamation
• vomiting
• diarrhea
Toxic shock syndrome

• Toxic shock toxin
  - Dissemination

• Organism
  - no dissemination
S. aureus

• babies
  – scalded skin syndrome
    * exfoliation
Lytic exotoxins:

- $\alpha$ toxin
- $\beta$ toxin (sphingomyelinase C)
- $\gamma$ toxin
- $\delta$ toxins
  - detergent-like
- leucocidins
Protein A inhibits phagocytosis
Spread

- tissue-degrading enzymes
  - lipase
  - hyaluronidase
Identification

• Sheep blood agar
• β hemolytic
• yellow pigmented (aureus)

• mannitol fermentation
• coagulase-positive

• reference laboratories
• phage-typing
Staphylococcus epidermidis

• major member, skin flora

• opportunistic infection
  - less common than S.aureus

• nosomial infections
  - shunts, catheters

• artificial heart valves/joints
Identification

- Sheep blood agar
  - non-hemolytic
  - Non-pigmented

- Does not ferment mannitol
- Coagulase negative
Staphyloccocus saprophyticus

- urinary tract infections
- coagulase-negative
  - not usually differentiated from *S. epidermidis*
Antibiotic therapy

• Resistance to penicillin
  – penicillinase
• β lactam antibiotics (including methicillin for MRSA)
  – often ineffective
  – modified penicillin binding proteins
• Vancomycin
  – current drug of choice
  – resistance has been observed
Summary Figure (Identification Scheme)

GRAM POSITIVE COCCI

Catalase

Staphylococcus (Clusters)
- S. aureus
  - Beta hemolytic
  - Mannitol yellow
- S. epidermidis
  - Non-hemolytic
  - Mannitol white

Streptococcus (pairs & chains)

Hemolysis/Test
- BETA: Bacitracin → S. pyogenes (group A)
- CAMP/ Hippurate → S. agalactiae (group B)
- ALPHA: Optochin /Bile Solubility → S. pneumoniae
- GAMMA OR ALPHA: Bile Esculin 6.5% NaCl → Group D
  - Enterococcus
- Bile Esculin 6.5% NaCl → Group D Non-Enterococcus

Note: S. viridans is ALPHA hemolytic and negative for all the tests below.

Note: Staphylococcus and Streptococcus can be further classified into clusters and pairs/chains based on their hemolytic and other tests results.