Haemophilus and Bordetella

These two genera contain very small Gram-negative bacilli, *Haemophilus* causes a number of diseases and *Bordetella* is the agent of Whooping Cough.
Biology of *Haemophilus*

- Means “blood-loving”
  - culture requires blood in medium
- Found on mucus membranes
- *H. influenzae* composed of 6 serotypes (a to f)
  - most invasive infections are “b”
  - vaccine against b capsule (**Hib**)
  - Other spp, no capsule

Chocolate agar, with hemolyzed blood for culture of *Haemophilus* spp
Pathogenesis & Immunity

• Normal flora of upper respiratory tract
  – (except for *H. influenzae* type b, *Hib*)
  – Initially isolated in 1890 influenza pandemic, but 2ary invader, not cause
  – *Hib* infects children and immuno-compromised adults

• several infections are endogenous:
  – otitis media, sinusitis, bronchitis, pneumonia

• Encapsulated *Hib* is not normal flora, but the cause of:
  – meningitis, epiglottitis, cellulitis, arthritis, etc

• Virulence factors:
  – capsule=polysaccharide *PRP-b* = vaccine
  – LPS,
  – IgA-protease
Epidemiology of *Haemophilus*

- Composes 10% bacteria in oral cavity
  - *H. parainfluenza* & non-capsulated *H.influenza*
  - Main pathogen, *Hib* is rare in healthy children
- Immunity=antibody to Hib-PRP
  - naturally acquired*
  - vaccine acquired*
    - PRP=carbohydrate
    - vaccine conjugated to give T-cell response
  - available since 1989
- Spread via aerosols
  - Older adults, chronic pneumonia

*Hib meningitis in USA, initial vaccine was not effective,*
Clinical diseases, *Haemophilus*

- **Meningitis**=M.E.*
  - most common cause of pediatric meningitis*
  - clinically the same as *Neisseria* meningitis
  - follows 1-3 day mild upper respiratory disease
  - fatal w/o intervention

- **Epiglottitis**=M.E.*
  - inflammation of supraglottic tissues
  - pharyngitis, fevers, respiratory embarrassment
  - manipulations may induce laryngospasms & acute airway obstruction
  - may require tracheostomy
  - fatal w/o intervention

**Supraglottic tissue inflammation**
fatal case 5 yr old child
Other diseases of *Haemophilus*

- **Cellulitis:**
  - reddish-blue cheeks & periorbital area

- **Arthritis:**
  - in young children
  - large joints, 2ary to *Hib* invasion
  - may be seen in immunocompromised adults

- ** Conjunctivitis:**
  - “pink-eye”
  - highly contagious
  - *H. influenzae aegyptius*

- **Unencapsulated strains:**
  - otitis media, sinusitis, subacute endocarditis bronchitis & pneumonia

*Haemophilus otitis media, along with Strept. pneumoniae, common cause*
**Haemophilus ducreyi**

- **Chancroid:**
  - “soft chancre”
    - (hard chancre=syphilis)
  - tender papule becomes painful genital lesion, often with lymphadenopathy
  - non-indurated, marked margins
  - clinically more common in males
  - common in Africa & Asia, but some cases in USA
  - major enhancer of HIV, also in Africa & Asia

- **Treatments, all infections**
  - penicillin resistance, thus CSF-penetrating cephalosporins
Bordetella pertussis

- Agent of whooping cough, very small Gram-negative coccobacillus
- Pertussis means “severe cough”
- *B. parapertussis* causes milder form
- DPT vaccine has reduced USA incidence, but still important globally with increasing cases in USA
Pathogenesis of Whooping cough

- **Disease requires:**
  - exposure, colonization
  - attachment, growth = local tissue damage and systemic effects

- **Virulence factors:**
  - attachment to ciliated epithelial cells via filamentous hemagglutinin and pertussis toxin
  - **Pertussis toxin:**
    - classical A/B toxin
    - B = several cell types*
    - A = upregulation of adenylate cyclase
    - histamine sensitization
    - causes lymphocytosis
  - **Tracheal cytotoxin:**
    - peptidoglycan monomer
    - ciliostasis at low conc.
    - Extrusion of ciliated cells from bronchi & prevents regeneration
  - **Dermonecrotic toxin:**
    - vasoconstriction leading to localized tissue destruction
  - **LPS:**
    - you know this one

- blocks immune cell functions, chemotaxis, phagocytosis, oxidative activity of alveolar macrophages, etc

- ups insulin production
Epidemiology of whooping cough

- Recognized for centuries
- Global endemicity
- Most infections due to inadequately immunized children
- Strict human pathogen
- Vaccine problems
  - DPT vaccine
  - toxicity reports
  - immunity unstable
- On the increase in USA, Sweden, Japan, etc.
Clinical syndromes of pertussis

- Aerosolization, attachment, etc. 7-10 days:

- **Catarrhal Stage:**
  - resembles cold, fever, sneezing, rhinorrhea
  - highly contagious

- **Paroxysmal Stage:**
  - extrusion of ciliated cells
  - increased mucus secretion
  - classic cough with whooping inspiration, vomiting and exhaustion
  - 40-50 paroxysms/day
  - lymphocytosis (40k/mm³)
  - Severe apnea = death
  - supportive therapy

Bordetella attaching specifically to ciliated cells of bronchi

Cough-induced conjunctival hemorrhage
Whooping Cough continued

• **Convalescent Stage:**
  - Occurs over 2 to 4 wks with supportive therapy during lessening of paroxysms
  - Antibiotics do not help because convalescence is correlated with regeneration of ciliated cells, etc.

• Erythromycin may be used as prophylactic for other family members

Whooping cough is often fatal without supportive therapy with respirator