PNEUMONIA

“… the most widespread and fatal of all acute diseases, pneumonia, is now the Captain of the Men of Death.”

Sir William Osler 1901

I. Background
6th most common cause of death in U.S.
Most common cause of infection related mortality

II. Pathophysiology
A. Host defenses
1. normally, airway sterile below larynx
2. acute pneumonia implies
   a) defect in host defenses
   b) challenge by especially virulent organisms
   c) overwhelming inoculum
3. defense mechanisms:
   a) anatomic barriers
   b) mechanical barriers
   c) humoral immunity
   d) cellular immunity (including phagocytosis)

B. Pathogenesis
1. adherence of microorganisms to epithelial surfaces of upper airway is critical initial step in colonization and subsequent infection
2. variety of factors interfere with normal host defenses and predispose to infections
   a) altered consciousness - compromises epiglottic closure, leads to aspiration of oropharyngeal flora into lower respiratory tract.
   b) cigarette smoke disrupts mucociliary function and macrophage activity
c) viruses inhibit important host defenses
   1. destroy respiratory epithelium
   2. may disrupt normal ciliary activity
   3. may inhibit neutrophil and macrophage function
d) alcohol impairs cough, epiglottic reflexes, increases risk of aspiration; associated with gram negative colonization also associated with decreased PMN mobilization and function
e) iatrogenic manipulations may bypass host defenses
   f) variety of drugs (e.g. aspirin) may inhibit host defenses
3. age related defects predispose to pneumonia
   a) diminished mucociliary clearance, abnormal elastic recoil
   b) alteration in humoral and cell-mediated immune function

C. Clinical
1. History - attempt to define
   a) clinical setting (age, homelessness)
   b) defects in host resistance predisposing to pneumonia (HIV, COPD, CF)
   c) possible exposure to specific pathogens (ICU)
2. Typical symptoms
   a) chest pain (often pleuritic)
   b) cough, often productive of sputum
   c) shortness of breath
   d) difficulty and pain on breathing
3. Physical examination
   a) general
      1. fever common
      2. cough (with sputum production)
      3. HSV labialis (pneumococcal pneumonia)
      4. bullous myringitis (mycoplasma)
      5. poor dentition
   b) chest
      1. splinting
      2. crackles
      3. evidence of consolidation
4. Diagnosis
   a) obtain diagnostic sputum
      1. identify pathogens by gram stain (sensitivity, specificity ≥ 85%)
         a) < 10 epithelial cells, > 25 PMNs per low power field
         b) may provide clues by absence of organisms
            1. Mycoplasma
2. TB
3. viruses
4. Legionella
2. culture may be useful
3. clinical patterns
   a) foul smelling - aspiration (mixed anaerobic)
   b) “rusty sputum” - pneumococcal pneumonia
   c) dark red, mucoid “currant jelly” - Klebsiella
e) special stains may diagnose
   a) AFB
   b) Giemsa, GMS; toluidine blue - pneumocystis
b) transtracheal aspirate
c) bronchoscopy
d) lung biopsy
e) examination of pleural fluid
   1. may provide diagnosis
      a) culture
      b) gram stain
2. incidence varies with etiologic agents
   a) pneumococcal (10%)
   b) gram-negative bacilli (50-70%)
   c) group A strep (< 95%)
f) blood culture
   1. when positive, proves etiology of infection
   2. 20-30% of patients with bacterial pneumonia
g) serologic tests
   1. mycoplasma
   2. Legionella
   3. chlamydia
h) radiology (chest x-ray)
   1. patterns
      a) consolidation
      b) bronchopneumonia
      c) interstitial
   2. not diagnostic in of themselves in terms of etiology

III. Specific pneumonia syndromes
A. community acquired pneumonia
   1. year-round, but peaks in winter
   2. patients mid-50’s to late 60’s
3. classic clinical symptoms (~ 80%)
   a) chronic underlying diseases common
   b) fever (68-78%)
   c) pleuritic chest pain (30%)
   d) productive cough (> 80% have cough; 60-80% productive)

4. common physical findings
   a) tachypnea (45-70%)
   b) tachycardia (45%)
   c) rales (~ 80%)
   d) signs of consolidation (~ 30%)

5. laboratory parameters
   a) elevated WBC
   b) neutropenia poor prognostic sign
   c) sputum
      1. rust-colored (classic, but uncommon)
      2. gram stain may be diagnostic

6. major pathogens
   a) *Streptococcus pneumoniae*
      1. risk factors: ↑ age, smoking malnutrition, COPD, CHF
      2. risk factors for severe pneumococcal disease
         a) asplenia
         b) abnormal immunoglobulin
            1. myeloma
            2. lymphoma
            3. HIV infection
   b) *Hemophilus influenzae*
   c) *Staphylococcus aureus*
      1. elderly
      2. post influenza
   d) *Mycoplasma pneumoniae*
   e) mixed anaerobes
      1. aspiration
      2. lung abscess
   f) Moraxella catarrhalis
   g) gram-negative bacteria (*Klebsiella pneumoniae*)
   h) Legionella
   i) chlamydia
      1. no specific distinguishing features
      2. common findings
         a) high fever (> 40°C)
         b) multi-lobar involvement
         c) rapid progression
         d) GI and neurologic abnormalities
         e) elevated liver enzymes, creatinine
   j) viruses (see Fig. 17.13, page 208)
1. most important in children, but occasionally in adults

2. may set the stage for bacterial superinfection

3. most common pathogens are:
   a) RSV
   b) parainfluenza type 3
   c) adenovirus
   d) influenza
   e) CMV in immunocompromised host
   f) varicella-zoster

B. Atypical pneumonia
   1. begins as mild respiratory tract illness, followed by “atypical” pneumonia with dyspnea and cough without sputum
   2. Atypical in term of severity, and clinical presentation, but best identified by absence of organisms on gram stain
   3. several usual pathogens
      a) mycoplasma
         1. children (> 5 yr); adolescents, young adults
         2. closed populations
         3. clinical
            a) sore throat frequent initial finding
            b) bullous myringitis (5%)
            c) pleuritic chest pain, splinting, respiratory distress uncommon
            d) x-ray worse than physical findings
      b) Chlamydia trachomata
      c) Chlamydia pneumoniae (TWAR)
      d) viruses
         1. adenovirus
         2. RSV
         3. influenza
         4. parainfluenza

C. Aspiration
   1. any disease state with altered level of consciousness and abnormal gag and swallowing
   2. distinguish from chemical pneumonia
   3. normal bacterial flora
   4. periodontal
   5. may lead to lung abscess
      a. Note: error in text. Antianaerobic treatment required, but usually not metronidazole.

D. Nosocomial
   1. 10-20% of all nosocomial infections
   2. leading cause of infection-related mortality in hospitalized patients (20-50%)
   3. risk factors
      1. advanced age
2. severity of underlying disease

3. intubation
4. use of respiratory equipment
5. nasogastric tubes
6. altered mental status
7. surgery
8. prior antibiotics
9. H2 blockers

4. microbiology
   a) gram-negative aerobes
   b) *Staphylococcus aureus* (13-20%)

E. Tuberculosis and related infections (Fig. 17.20, page 213)
   1. Droplet spread
   2. Defense depends on cell-mediated immunity, but often not until distal spread
   3. Most disease is reactivation (secondary TB)
   4. Clinically, disease runs very indolent course

IV. Therapy
   A. Specific therapy: the main goal of therapy
      1. gram stain for diagnosis
      2. beware pneumococcal resistance
         1. cephalosporins (3d generation)
         2. vancomycin
      NOTE: Penicillin still effective in most

   B. empiric regimens
      1. current recommendations
         a) British Thoracic Society
         b) American Thoracic Society
         c) Infectious Disease Society of America

      2. must be considered last resort and then at least be sensible.

V. Prevention
   A. Pneumovax
   B. Influenza vaccine
Study Questions

1. A 47 year old alcoholic is complaining of a cough productive of putrid sputum. An X-ray of his chest reveals an air-fluid level surrounded by an infiltrate. The most likely source for the organisms causing his disease is:
   a. inhaled respiratory droplets
   b. his oropharynx
   c. his nasopharynx
   d. his gingival crevices
   e. activation of latent infection
   Answer: d
   Rationale. The clinical picture describes an anaerobic lung abscess, which is caused by mixed anaerobic bacteria which reside in the gingival crevices. Alcoholism, as a condition, allows aspiration of an overwhelming inoculum, thus promoting development of pneumonia, the antecedent condition for lung abscess.

2. A 62 year old previously healthy woman presents with a three day history of cough, chest pain, fever and chills. Physical exam reveals evidence of consolidation which is confirmed by the chest X-ray. A PPD (TB skin test) is placed. Sputum is obtained for Gram and AFB stains and cultures. Blood is cultured and an empiric antibiotic regimen if selected. The test most likely to effectively guide the empiric therapy is the:
   a. Chest X-ray
   b. Sputum Gram stain
   c. Sputum culture
   d. Sputum AFB stain
   e. Blood culture
   Answer: b
   Rationale. The patient has acute pneumonia. The history excludes tuberculosis, thus the AFB stain will not help. Sputum cultures are frequently negative for the causative agent, as are blood cultures. The chest X-ray can help diagnose the disease as pneumonia, but cannot identify the etiologic agent.

3. You are consulted by the owner of a nursing home who is concerned about an outbreak of “flu” among residents of the home during the current influenza epidemic. None of the residents were previously offered influenza vaccine. The best approach at this time would be to offer the residents:
   a. Rimantadine
   b. Influenza A vaccine
   c. Influenza B vaccine
   d. 23-valent pneumococcal vaccine
   e. Penicilline prophylaxis
   Answer: a
   Rationale. Rimantadine inhibits replication of influenza A which is the cause of the most serious epidemics of influenza. The vaccines are given as a combined vaccine, but won’t be effective soon enough to protect the residents at risk. Pneumococcal vaccine is
appropriate and may ultimately provide protection against one of the most common post-influenza pneumonias, but won’t prevent influenza. Penicillin prophylaxis has no role in prevention of any pneumonia.