Managing Pulmonary Infections—A Pathway to Patient Safety

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Learning Objectives

- ***Describe*** the etiology and pathophysiology of pulmonary infectious diseases
  - Children
  - Adults
- ***Review*** the manifestations of such diseases.
- ***Discuss*** the treatment of such diseases for safer patient care
- ***Examine* new discoveries related to Covid-19**
- ***Provide*** resources & how to find additional information

Brief History & Evolution of Infectious Disease

- Over 100 years ago, there were little to no knowledge of infectious disease.
- The prevailing belief was that disease was caused by “bad air” or “night air”; known as the **miasma theory** .
- *In 1676,* Antonie van Leeuwenhoek **discovered bacteria, but he did not know it caused disease**
- However, in 1928, Alexander Fleming discovered penicillin.

Key Terms in Pulmonary Infectious Disease

- Virus-RNA/DNA, Protein Coat and a Lipid Envelope
- Bacteria-Cells which can independently multiply
- Other microbes: Protozoa
- Pathogenic-Ability to cause disease
- Virulence-Ability to cause severe disease
- Transmission-Route of spreading
- Sterilization Vs. Disinfection

Diseases We'll Focus on Today

- Pediatric Respiratory Disease
  - Croup
  - Epiglottitis

- Adult Diseases:
  - TB
  - Pneumonia Viral & Bacterial
  - SARS
  - Covid 19

Croup--Etiology

- Viral Infection:
  - Parainfluenza
  - Influenza
  - RSV
  - Adenovirus
- Gradual onset
- Affects children 6 months to 3 years-old

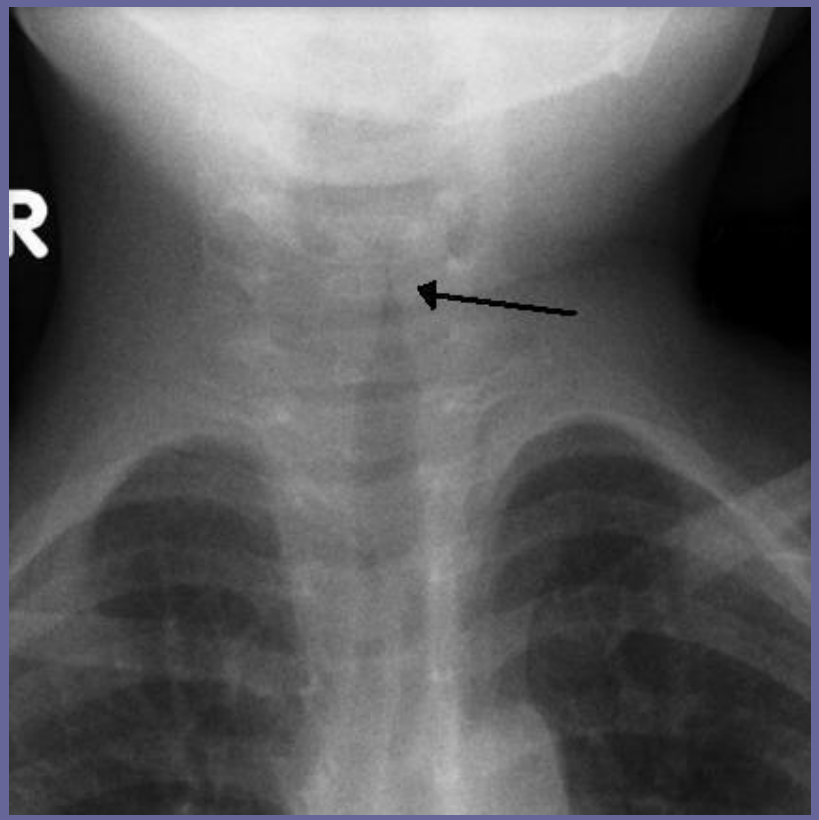
Croup--Pathophysiology

- Swelling and inflammation of subglottic structures.
  - Larynx
  - Trachea
  - Larger Bronchi
- Can affect mid-sized and smaller airways

Croup--Clinical Manifestations

- Slow onset, like a “cold”
- Brassy/barking cough
- Horseness & Audible stridor
- Neck X-Ray: Steeple Sign
- If Severe:
  - Tachycardia/tachypnea
  - Retractions
  - Decrease in SPO2
  - ABG: Hypoxemia & Respiratory Acidosis

Steeple Sign-Often Found in Croup



Croup--Treatment

- Cool Mist w/oxygen via tent or face mask
- Reassurance--Parental presence
- Racemic Epinephrine via SVN or IPPB
  - 6 Y.O. or less: 0.25 mls of 2.25% w/NSS
  - More than 6 Y.O. 0.5mls w/NSS
- Systemic Steroids: Dextramethasone
  - 0.3 to 0.6 mg/KG
- Intubation: Mainly if respiratory failure present: e.g., muscle fatigue, change in sensorium, cyanosis, ABG results.

Epiglottitis--Etiology

- Bacterial infection
- Most common microorganisms:
  - Staphylococcus Aureus
  - Group A & B Streptococci
  - Strep Pneumoniae
- Other causes:
  - thermal injury
  - caustic ingestion
  - radiation exposure

Epiglottitis--Pathophysiology

- Supra-glottic swelling
- Epigottis turns bright, cherry red & swollen
- Inflamation leads to a/w narrowing and dysphagia
- If severe, a/w can become completely obstructed

Epiglottitis--Clinical Manifestations

- Patient appears acutely ill
- Rapid Onset
- Affects mainly children 1 - 5 years old
- Drooling, sore throat, dysphagia
- Stridor & hoarseness w/diminished breath sounds in lung regions
- High fever
- Lateral neck x-ray: Balloon-shaped epiglottis/”thumb sign”

Lateral Neck X-Ray—Thumb Sign

Epiglottitis-Treatment

- Minimal patient stimulation-keep patient calm!
- Cool mist aerosol w/supp'l O2
- Antibiotics and fluids (steroids generally not effective)
- If severe obstruction, intubation shouldn't be attempted in ER
- Intubate patient in OR as trach may be necessary and patient may need to be paralyzed

Adult Infectious Pulmonary Diseases

- TB
- Pneumonia
  - Viral
  - Bacterial
- Covid 19

Tuberculosis--Etiology

- Microorganism- Mycobacterium “family”
- Airborne transmission of droplet nuclei
- Droplet nuclei settle into the lungs and can start the infection
- Risk of infection is determined by many factors:
  - Length of exposure
  - Immune status

Tuberculosis-Pathophysiology

- Acid-fast bacilli are inhaled and begin to multiply
- Bacilli may migrate to kidneys, brain and bones
- 6-8 weeks after infection-immune system often localizes and contains infection.
- TB Infection Vs TB Disease
  - *TB Infection*: Bacilli become inactive but remain
  - *TB Disease*: Active bacilli are not stopped by immune system and continue to multiply.

TB-Clinical Manifestations

- Positive Mantoux Test (PPD)- 5mm,10mm,15mm
- CXR-Lesion in apical or posterior upper lobe. Affinity for higher oxygen environment
- Positive sputum culture.
- Laboratory data: Increased bands, elevated alkaline phosphate
- Signs/Symptoms--Productive Cough, chest pain, hemoptisis, weakness, weight loss, fever/chills, night sweats.

TB Lesion in Right Apex

TB-Treatment

- Antibiotics: Cure most cases
  - 6-month: Isoniazid, Rifampin and initially, pyrazinamide
  - 9-month: Isoniazid and Rifampin
  - Other ABX combinations for multiple drug resistant (MDR) strains.
- Supportive
  - Proper rest and nutrition
  - Avoid high risk activities

Pneumonia--Etiology

- Community Acquired vs nosocomial
- Pathogens
  - Bacterial
  - Viral
  - Other--fungal, rickettesia

Pneumonia--Pathophysiology

- Route - Often Inhalation of microbes or aspiration of stomach contents or other substances
- Microbes
  - Bacteria
  - Viral
  - Other-Fungus-coccidiodes = “valley fever”

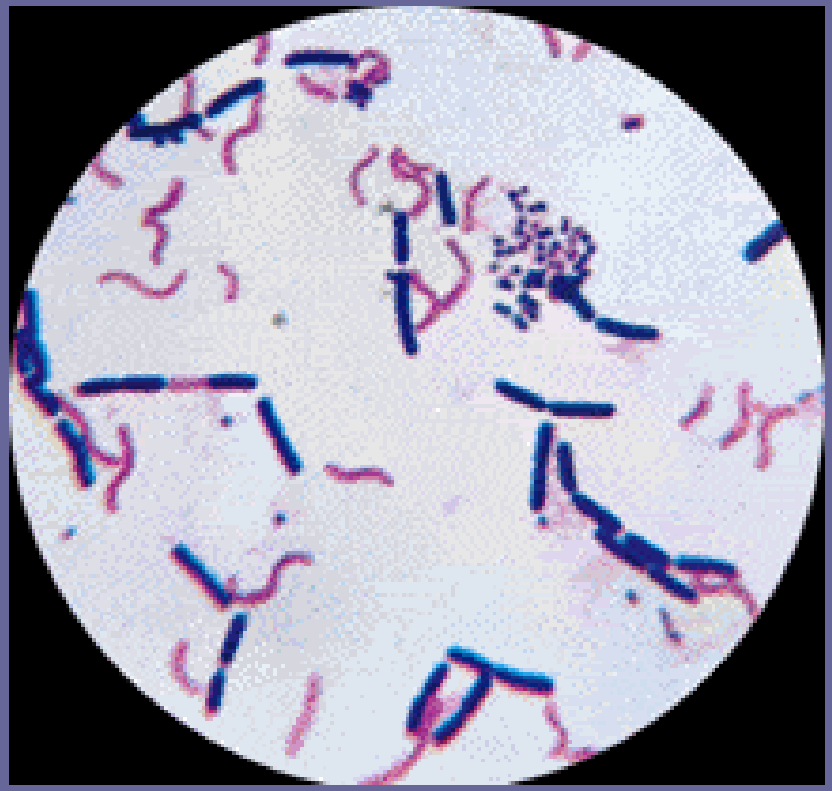
Pneumonia-Clinical Findings

- Acutely ill patient
- Hypoxemia & possible cyanosis
- CXR-Consolidation
- Unilateral Chest expansion
- Dull percussion note
- Decreased breath sounds &/or rhonchi
- Cough-Productive or non-productive
- Sputum- Green, yellow, brown, red

Types of Bacterial Pneumonia

- Gram positive - aerobic
- Gram negative - aerobic
- Anaerobic
- Mycobateria

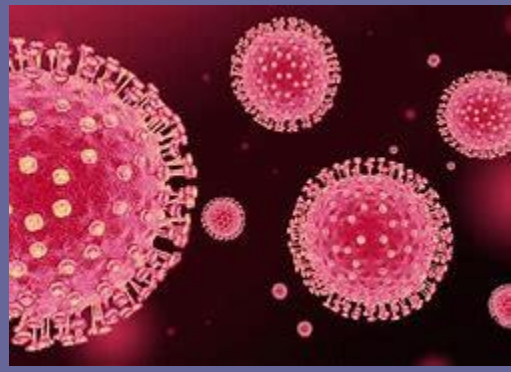
Gram stain will show
Bacilli (rods) or Cocci (round)
Positive (blue) or Negative (red)



Pneumonia--Treatment

- Supportive
  - Oxygen therapy
  - Rest
  - Proper hydration & nutrition
- Isolate the microbe - Sputum C&S
- Antibiotics/antimicrobials
- CPT
- Bronchodilators

Covid 19--Etiology



- Viral Infection
- Spread most via droplet infection
- May also be spread via airborne
- Indirect contact may also be possible
- Virus settles into the lungs and replicates
- Migrates to other body systems.

Covid 19--Pathophysiology

- During 2-10 day incubation period, virus settles into the lungs and upper airways and replicates geometrically.
- Most contagious 1-2 days before symptoms
- Severity ranges from asymptomatic to multiple system failure => septic shock => death.
- Immune system responds:
  - Helper T cells identify the virus and send WBCs
  - Antibodies are also produced
- Cytokine storm begins on day 5 and peaks at day 10-12, flooding inflammatory mediators.
  - ARDS
  - Renal Failure

Covid 19-Clinical Findings

- May be asymptomatic
- Symptoms include
  - Mild-Moderate:
    - Loss of smell
    - Fatigue
    - Muscle aches
- Approximately one-sixth of COVID-19 patients will have complications, including life-threatening ones.
- Severe:
  - Fever & Chills
  - Hypoxemic respiratory failure
  - Renal, Hepatic, Cardiac Failure
  - Coagulopathies
  - Neurologic Complications
  - Septic Shock
  - Death

Covid-19 Patient Chest X-Ray

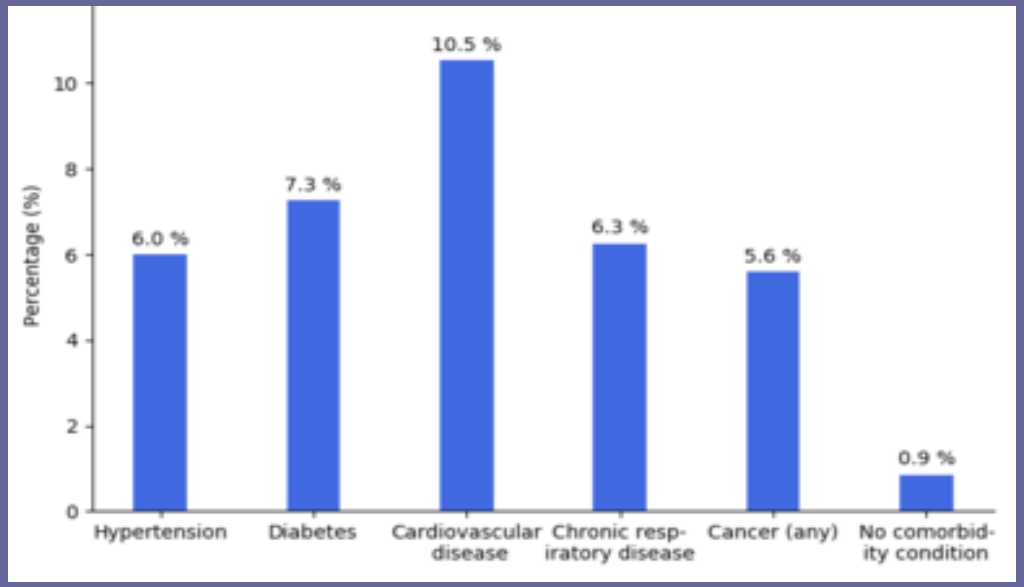
Covid 19-Treatment--

- Supportive Care: Hydration, antipyretics, bedrest
- Except for Remdesivir, Anti-virals are of limited value.
  - Remdesivir seems most effective with mild-moderate disease
- Steroids to be timed with Cytokine Storm (day 8/10?).
  - If started too early thought to potentially can contribute to ***steroid induced viral proliferation***
- Anticoagulation-For Coagulopathies
- Dialysis with Kidney Failure
- Respiratory:
  - Supp'l O2: NRM. HFNC with flows not to exceed 30-35.
  - Early Intubation?
  - ARDsNet
    - Plateau's Pressure $\leq$ 30: Driving press. < 15
    - Low VT 6 mls / Kg
  - Prone positioning
  - Inhaled Nitric Oxide

Covid 19-- Prognosis & Mortality

- Good prognosis (< 1% Mortality) for mild disease, not requiring hospitalization.
- 0.5 % mortality rate for those < 50 YO but is over 8% for those > 70 YO.
- 12% of cases require ICU admission.
- 20-30% Mortality if admitted to ICU.
- 40-70% mortality if intubated and placed on mechanical ventilation.

Mortality Rate By Comorbity Condition



Take Home Messages

- Use proper *Infection Control Techniques, especially now, with Covid 19!*
- Maintain an index of suspicion.
- Identify and utilize practical resources.
- Participate in all appropriate training.
- Exercise common sense and good judgment.
- Don’t let your ego get in the way.
- If you have questions…or need add’l info…***Ask***!

Selected References

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