

Case Studies: Introduction to Respiratory Diseases

Respiratory tract infections are a major reason why children and the elderly seek medical care. These infections are more common in cold-weather months in locales with temperate climates. Respiratory tract infections are primarily spread by inhalation of aerosolized respiratory secretions from infected hosts. Some respiratory tract pathogens such as rhinoviruses can also be spread by direct contact with mucous membranes, but this mode of transmission is much less common than inhalation. For the purpose of our discussion, we will divide these types of infection into two groups, upper tract and lower tract infection.

The most common form of upper respiratory tract infection is pharyngitis. Pharyngitis is seen most frequently in children from 2 years of age through adolescence. The most common etiologic agents of pharyngitis are viruses, particularly adenoviruses, and group A streptococci. Pharyngitis due to group A streptococci predisposes individuals to the development of the poststreptococcal sequela rheumatic fever. Because this sequela can be prevented by penicillin treatment, aggressive diagnosis and treatment of group A streptococcal pharyngitis is needed.

Otitis media is a common infectious problem in infants and young children. The most frequently encountered agents of this infection are bacterial, with *Streptococcus pneumoniae*, non-typeable *Haemophilus influenzae*, and *Moraxella catarrhalis* being most common. These organisms, along with certain viruses and anaerobic bacteria from the oral cavity, are the most important pathogens in sinusitis. *S. pneumoniae*, *H. influenzae*, *Moraxella catarrhalis*, and adenoviruses, as well as *Chlamydia trachomatis* in neonates, are the common etiologic agents of conjunctivitis. External otitis, a common problem in swimmers, is more common in warm weather months. *Staphylococcus aureus* and *Pseudomonas aeruginosa* are the most common agents of this relatively benign condition. Malignant external otitis is a serious medical condition seen primarily in diabetics, the elderly, and the immunocompromised. The infection can spread from the ear to the temporal bone, resulting in osteomyelitis and meningitis. The most common etiology of malignant otitis externa is *P. aeruginosa*.

Two other life-threatening infections of the upper respiratory tract are rhinocerebral mucormycosis and bacterial epiglottitis. Rhinocerebral mucormycosis is most common in diabetics. In this infection of the sinuses, the fungi *Mucor* and *Rhizopus* spp. invade blood vessels, resulting in necrosis of bone and thrombosis of the cavernous sinus and internal carotid artery. Treatment of this infection requires aggressive surgical debridement of the infected tissue. Epiglottitis is almost always caused by *H. influenzae* type b. In this disease, the airway may become compromised due to swelling of the epiglottis, with death due to respiratory arrest. With the widespread use of *H. influenzae* type b vaccine, this rare disease should essentially disappear.

Two childhood infections common in the early part of the 20th century, diphtheria and whooping cough, are now rare diseases in the developed world. This is thanks to the development and use of vaccines that are effective in children against the etiologic agents of these diseases, *Corynebacterium diphtheriae* and *Bordetella pertussis*.

Viruses play an important role in upper respiratory tract infections. The common syndrome of cough and "runny" nose is due to rhinoviruses. More severe upper respiratory infections such as the "croup" are due to respiratory syncytial virus and influenza and parainfluenza viruses. These viruses can also cause lower tract infection and are an important cause of morbidity and mortality in the very young and very old.

When discussing lower respiratory tract infections, it is important to look at four different groups of patients: patients with community-acquired infections; patients with nosocomial infections; patients with underlying lung disease; and immunocompromised individuals, especially those with AIDS.

Common agents of community-acquired lower respiratory tract infections include pneumoniae, especially in the elderly; *Klebsiella pneumoniae*, especially in alcoholics; *Mycoplasma pneumoniae*, especially in school-age students through young adulthood; *Mycobacterium tuberculosis*; respiratory syncytial virus in infants and young children; and influenza virus. *Histoplasma capsulatum* and *Coccidioides immitis* in patients residing in specific geographic locales may cause mild, self-limited diseases. *S. pneumoniae*, *H. influenzae*, *S. aureus*, and *Moraxella catarrhalis* may specifically cause bronchitis and/or pneumonia secondary to viral pneumonia in adults. Aspiration, resulting from either a seizure disorder or a semiconscious state resulting from excessive consumption of alcohol or other drugs, may lead to lung abscesses caused by organisms typically residing in the oral cavity.

Nosocomial infections due to the organisms listed above certainly occur. Particular emphasis should be placed on preventing the spread of *Mycobacterium tuberculosis* in all patient populations and of respiratory syncytial virus in pediatric patients. Nosocomial pneumonia due to methicillin-resistant *S. aureus* and multi-drug-resistant gram-negative bacilli such as *P. aeruginosa* is a common problem in intubated patients. The potential for outbreaks of pneumonia due to *Legionella* spp. is a constant threat because of this bacterium's ability to survive within hospital water and air conditioning systems.

Patients with chronic obstructive pulmonary disease brought on by smoking frequently develop bronchitis. *S. pneumoniae*, *Moraxella catarrhalis*, *H. influenzae*, and *P. aeruginosa* are frequent causes of this type of infection. Chronic airway infections are primarily responsible for the premature death of patients with cystic fibrosis. *S. aureus* and mucoid *P. aeruginosa* are the most important agents of such chronic airway disease. Both of these patient populations have an increased risk for developing allergic bronchopulmonary aspergillosis. Patients with cavitary lung disease, frequently due to prior *Mycobacterium tuberculosis* infection, are at increased risk for another type of infection, an aspergilloma or fungus ball caused by *Aspergillus* spp. This fungus grows in the form of a "ball" in the preformed lung cavity.

The diagnosis of the etiology of lung infection in immunocompromised patients one of the most daunting in clinical microbiology and infectious disease. It has been greatly facilitated by the development of the flexible bronchoscope, which provides a relatively noninvasive means to sample the airways and alveoli. Immunocompromised patients are typically at risk for essentially all recognized respiratory tract pathogens. Certain pathogens are seen with increasing frequency in selected immunocompromised populations. In AIDS patients, *Pneumocystis carinii*, *S. pneumoniae*, and multi-drug-resistant *Mycobacterium tuberculosis* are all seen more frequently than in other patient populations. Profoundly neutropenic patients have a very high risk for invasive aspergillosis and mucormycosis. Transplant patients have greatly increased risk for pneumonia with cytomegalovirus, herpes simplex virus, *Legionella* spp., *Pneumocystis carinii*, and the invasive fungi. These patients are frequently given prophylactic drugs to prevent pulmonary infection with *Pneumocystis*. Prophylactic therapies are not as widely used for other agents for a variety of reasons, including expense, questionable efficacy of the prophylactic measures, or the rarity with which the organism is encountered.

Organism	General Characteristics	Patient Population	Disease Manifestation
Bacteria			
<i>Neisseria meningitidis</i>	Oxidase-positive, gram-negative diplococcus	Adults	Pneumonia
<i>Nocardia</i> spp.	Partially acid-fast, aerobic, branching, gram-positive bacilli	Adults, especially with immunosuppression	Pneumonia with abscess
Nontuberculous mycobacteria (many species)	Acid-fast bacilli	Adults with chronic lung disease; CF patients	Granulomatous lung disease
<i>Prevotella</i> sp.; <i>Porphyromonas</i> spp	Anaerobic gram-negative bacilli	Adults with aspiration	Lung abscess
<i>Pseudomonas aeruginosa</i>	Glucose-nonfermenting, gram-negative bacillus	Adults and children; diabetic adults; nosocomial; CF patients	External otitis (swimmer's ear), malignant external otitis, ventilator-associated pneumonia, chronic bronchitis with mucoid strains
<i>Staphylococcus aureus</i>	Catalase-positive, gram-positive cocci in clusters	Nosocomial	Pneumonia, pneumonia superinfections

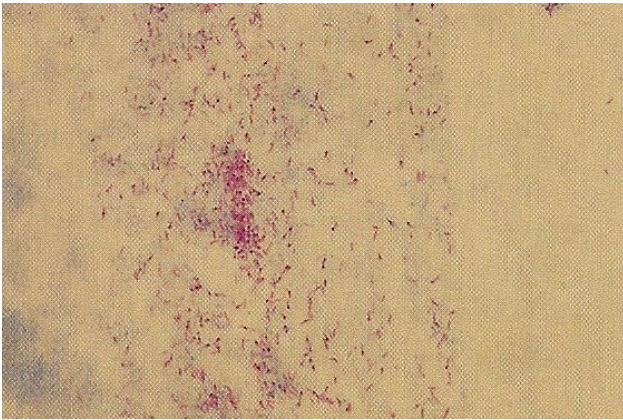
<i>Stenotrophomonas maltophilia</i>	Glucose-nonfermenting, gram-negative bacillus	Nosocomial	Ventilator-associated pneumonia
<i>Streptococcus pneumoniae</i>	Catalase-negative, gram-positive diplococcus	Children and adults	Otitis media, conjunctivitis, pneumonia
<i>Mycobacterium tuberculosis</i>	Acid-fast bacillus	Children and adults, especially HIV-infected	Tuberculosis
Fungi			
<i>Aspergillus</i> spp.	Acute-angle-branching, septate hyphae in tissue; mold	Children and adults with chronic lung disease; adults with cavitary lung lesions; immunocompromised individuals	Allergic bronchopulmonary aspergillosis; aspergilloma (fungus ball); invasive pneumonia
<i>Blastomyces dermatitidis</i>	Broad-based budding yeast; dimorphic	Adults	Pneumonia
<i>Coccidioides immitis</i>	Spherules in tissue; mold with arthroconidia at 30.C	Children and adults, especially in desert southwest of US and northern Mexico	Flu-like illness with pneumonia
<i>Cryptococcus neoformans</i>	Encapsulated, round yeast	Immunocompromised adults, especially with AIDS	Pneumonia, often asymptomatic preceding meningitis
<i>Histoplasma capsulatum</i>	Very small, intracellular yeast; dimorphic	Adults, primarily with AIDS, spread through bat/bird droppings	Pneumonia
<i>Pneumocystis carinii</i>	Clusters of 4-6-11µm cysts in tissue and secretions	Immunocompromised individuals, especially with AIDS	Pneumonia
<i>Rhizopus</i> sp., <i>Mucor</i> sp.	Ribbon-like, nonseptate hyphae in tissue; rapidly growing mold	Diabetics, immunocompromised individuals	Rhinocerebral mucormycosis, invasive pneumonia
Parasites			
<i>Ascaris lumbricoides</i>	Larvae	Children and adults	Usually asymptomatic, incidental finding
Hookworm	Larvae	Children and adults	Usually asymptomatic, incidental finding
<i>Strongyloides stercoralis</i>	Rhabditiform larvae	Immunocompromised individuals	Wheezing, cough, pneumonia
Viruses			
Adenovirus	Enveloped, dsDNA	Children and adults	Pharyngitis, bronchiolitis, pneumonia, conjunctivitis
Cytomegalovirus	Enveloped, dsDNA	Immunocompromised individuals	Pneumonia
Hantavirus	Enveloped, ssRNA	Children and adults	"Shock" lung, pneumonia

Herpes simplex virus	Enveloped, dsDNA	Immunocompromised individuals	Pneumonia
Influenza virus	Enveloped, ssRNA	Children and adults, particularly elderly	Influenza, pneumonia
Parainfluenza virus types I, II, III	Enveloped, ssRNA	Infants and young children	Croup, bronchiolitis, pneumonia
Respiratory syncytial virus	Enveloped, ssRNA	Infants and young children	Cough, wheezing, bronchiolitis, pneumonia
Rhinovirus	Nonenveloped, ssRNA	Children and adults	Common cold
Varicella-zoster virus	Enveloped, dsDNA	Immunocompromised individuals, pregnant women	Pneumonia

Case One

The patient was a 55-year-old male with a 2-month history of fevers, night sweats, increased cough with sputum production, and a 25-lb weight loss. The patient denied intravenous drug use or homosexual activity. He had had multiple sexual encounters, "sipped" a pint of gin a day, was jailed 2 years ago in New York City, and had a history of gunshot and stab wounds. His physical examination was significant for bilateral anterior cervical and axillary adenopathy and a temperature of 39.4°C. His chest radiograph showed paratracheal adenopathy and bilateral interstitial infiltrates. His laboratory findings were significant for a positive HIV serology and a low absolute CD4+ lymphocyte count.

The results both an acid-fast stain and colony isolation is seen below. The same organism was detected in bronchoalveolar lavage fluid from the right middle lobe.



1. What is bronchoalveolar lavage fluid? How is it obtained? What is its value as a diagnostic specimen?
2. Which organisms can be positive for an acid-fast stain?
3. Given the medical history, which organism is likely to be causing his infection? How does the finding that the patient is HIV positive affect this conclusion?
4. What is a PPD test? What is its value in this patient? What additional tests would you order with a PPD test?
5. What infection control measures must be taken during this patient's hospitalization? What other issues are important in the management of this patient?

Case Two

A 23 year old male, a known asthmatic, developed a 'cold' a week before a referral letter was written in March. He complained of malaise, generalized dull headache, a mild sore throat and non-productive cough. After four days he suffered a severe shaking chill lasting 15 minutes, his cough worsened and the patient produced rusty colored sputum. The patient was pyrexial when examined and was admitted to hospital. Your notes are below:

Presenting complaint

Cold - one week
Cough - one week
Headache - one week
Shaking chill three days ago.

History of presenting complaint

Known asthmatic, cold week ago, tired, headache, sore throat, general aches, chestiness. Just before tea-break three days ago suffered a chill. Cough worsened. Started coughing up sputum, wheezing got worse, pain on breathing in.

Past history

Known asthmatic, tonsillectomy aged 7, LGL.

Current Medication

Sodium chromoglycate 20 mg qds (for asthma)
No recent antibiotics

Social History

Non-smoker, Social drinker

Physical Examination

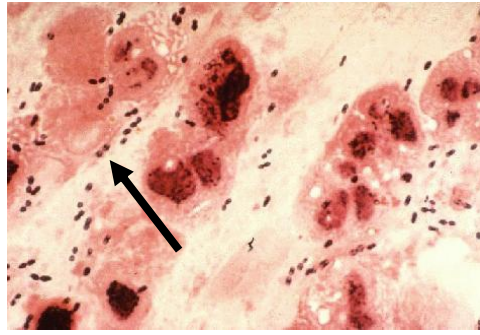
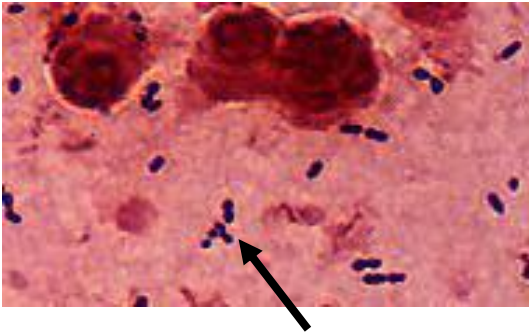
23 year old male, respiratory distress and an obvious herpetic lesion on his top lip. No signs of anaemia.
Temperature: 40 C
Blood pressure: 112/ 70
Rapid, shallow breathing, rate 36/min.
Reduced expansion on right side.
Dullness to percussion over right middle lobe.
Fine crepitations over right middle lobe.

Laboratory reports

Blood chemistry: normal
Hematology: normal, except total wbc 15,000/cu mm

Differential leukocyte count:	
Cell type	Count
neutrophils	11,000
eosinophils	1,000
basophils	30
lymphocytes	2,500
monocytes	470

You are provided with a Gram stain from the specimen of sputum, which was cultured overnight at 37 °C.



1. What is your diagnosis of the patient?
2. What is the most likely etiological agent of this disease?
3. What is your proposed treatment regimen and how do his predisposing factors affect this, if at all?