Lecture 33: Microbial Diseases of the Upper Respiratory Tract

Because many microorganisms, especially viruses, may be airborne, many enter the body via the respiratory system; in fact, respiratory system infections are the most common type of infectious disease.

- Some of the pathogens that enter through the respiratory system, such as the viruses of measles, mumps and rubella, infect other organs.
- Others, such as influenza and pneumococcal pneumonia, target the respiratory system itself.
- It is convenient to divide the respiratory system into the upper respiratory system, consisting of the nose, throat, middle ear, and sinuses, and lower respiratory tract, consisting of larynx, trachea, bronchial tubes, alveoli, and pleura.

Note: Tortora et al. use the terms "respiratory system", "upper respiratory system" and "lower respiratory system"; from habit, I usually use the the terms "respiratory tract", "upper respiratory tract (URT)" and "lower respiratory tract (LRT)"; these are interchangeable.

- One important distinction between the upper and lower respiratory systems is that parts of the upper respiratory system possess a normal flora, while the entire lower respiratory system is sterile in the absence of infectious disease.
- The upper respiratory system serves as home to a number of potentially pathogenic bacteria, including Haemophilus influenzae, Nesseria meningitidis, and Streptococcus pneumoniae, which we have previously encountered as agents of bacterial meningitis; usually, these are held in check by host defenses and competition by other normal flora organisms.

The upper respiratory system is the site of many common infections, characterized by inflammation of upper respiratory system tissues.

- Pharyngitis of "sore throat", inflammation of the mucous membranes of the throat, may be caused by many viruses and some bacteria.
- Laryngitis, usually thought of in terms of loss of voice, involves inflammation of the larynx.
- Tonsillitis, which can result from many infections, is inflammation of the tonsils, lymphoid tissues in the rear of the nasal cavity.
- When the sinuses become infected, sinusitis results; this can be painful, as drainage of the sinuses may be blocked.
- Epiglottitis, infection of the epiglottis (which prevents ingested materials from entering the lower respiratory system) can be very serious, as it may block passage of air to the lower respiratory tract.

Streptococcal pharyngitis ("strep throat") is an upper respiratory system infection caused by β-hemolytic group A streptococci; the most common of these is Streptococcus pyogenes.

- S. pyogenes exhibits several virulence factors and is also responsible for infection of other tissues.
- In its symptoms, streptococcal pharyngitis resembles pharyngitis caused by other bacteria and by viruses; streptococci are involved in probably no more than half of "strep throat" cases.
- Traditionally, streptococcal pharyngitis was diagnosed by isolation of β-hemolytic colonies on blood agar.
  - This requires time for incubation of the plates, and has been replaced by immunochemical assays, especially indirect agglutination tests.
  - In any event, since S. pyogenes is found as part of the upper respiratory system flora of some individuals, its detection does not necessarily pinpoint it as the etiologic agent in a particular case of pharyngitis.
- Certain strains of S. pyogenes that produce an erythrogenic toxin (actually encoded by a prophage) are capable of causing scarlet fever.
  - Scarlet fever can lead to extensive damage to the skin and systemic symptoms.
Scarlet fever is not always a complication of streptococcal pharyngitis; it can also arise from streptococcal skin infection. Scarlet fever is communicable by droplets and contaminated fomites; for those who remember the stories of their childhood, this is why the Velveteen Rabbit had to be burned!

**Diphtheria** was once a major cause of death in children. It would be still, except for universal immunization with DPT vaccine, which includes a diphtheria toxoid. The agent of diphtheria is *Corynebacterium diphtheriae* (Tortora et al., Figure 24.5). *C. diphtheriae* colonizes the throat, generating a characteristic membrane consisting of fibrin, dead tissue cells and bacteria. Pathogenesis in diphtheria is due to the action of *diphtheria toxin* (like erythrogenic toxin, encoded by a prophage), which interferes with protein synthesis. Currently, diphtheria is a relatively rare disease, occurring mostly among adults who were either not immunized, or whose immunity has dropped. *Cutaneous diphtheria* also occurs, by introduction of *C. diphtheriae* into a wound or other skin break.

**Otitis media**, infection of the inner ear, is a common complication of upper respiratory system bacterial infections. Otitis media can be caused by spread of infection from another site, or directly by introduction of contaminated water ("swimmer's ear"). Otitis media is most common in young children, perhaps because the eustachian tube connecting the inner tube to the throat is small and easily blocked. *Streptococcus pneumoniae* and *Haemophilus influenzae* are the pathogens most commonly associated with otitis media.

A number of different viruses are responsible for the **common cold (acute coryza)**. About 50% are thought to be caused by *rhinoviruses*, although a variety of other viruses are known to cause the condition. There are probably more than 200 viral agents that cause common colds, including at least 113 strains of rhinoviruses. Although immunity does develop in response to common colds, the large number of potential pathogens prevents immunity to the condition itself. Most viral agents of the common cold use the same cellular receptors, which may provide a target for therapy; that is, maybe someday society (which is able to send people to the moon, etc., etc.) *will* find a cure for the common cold! It is thought that most colds are spread by contact with contaminated objects, rather than by airborne transmission.