Microbiology

2025-2024

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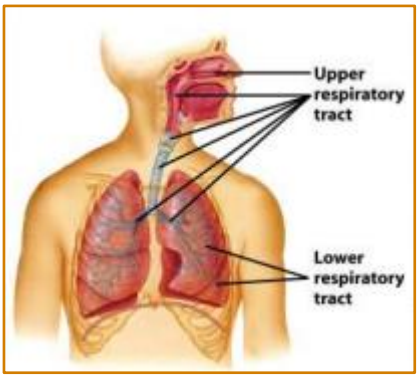
Rhinoviruses, Coronaviruses, Influenza and parainfluenza viruses

- **Objectives**
  - Discuss the structure, properties, epidemiology, clinical presentation, laboratory diagnosis, and treatment of the following viruses:
    1. Rhinoviruses
    2. Coronaviruses
    3. Influenza Virus
    4. Parainfluenza Viruses
    5. Respiratory Syncytial Virus (RSV)

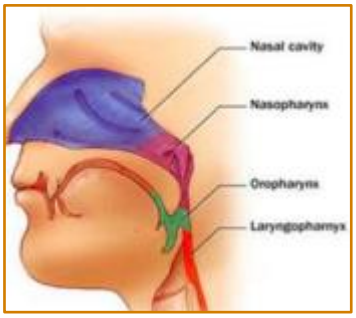
- **Anatomy of the Respiratory Tract**



  - Upper Respiratory Tract:
    - ✓ Includes: Nasal cavity, sinuses, pharynx, and larynx
    - ✓ Infections are fairly common.
    - ✓ Usually nothing more than an irritation
  - Lower Respiratory Tract:
    - ✓ Includes: Lungs and bronchi
    - ✓ Infections are more dangerous.
    - ✓ Can be very difficult to treat
  - The most accessible system in the body: Breathing brings in clouds of potentially infectious pathogens.

- **Common Viral Causes of Respiratory Infections**
  1. Rhinoviruses
  2. Coronaviruses
  3. Influenza Virus
  4. Parainfluenza Viruses
  5. Respiratory Syncytial Virus (RSV)

1. Rhinoviruses



- Family: Picornaviridae
- Genus: Rhinovirus
- Structure: Unenveloped, small (20-30 nm), icosahedral particle
- Genome: Single-stranded RNA (ss-RNA)
- Types: Over 100 types
- Replication Site: Nasopharynx
- Shed in: Nasal secretions [In large amounts]
- Optimal Temperature for Replication: 33-35°C (not efficient at body temperature)
- Clinical Presentation
  - ✓ Rhinitis (common cold)
  - ✓ Rhinoviruses are responsible for 30-50% of common colds, coronaviruses 10-30%.
  - ✓ Symptoms include:
    - Watery nasal discharge
    - Sneezing
    - Mild sore throat
    - Fever is not common

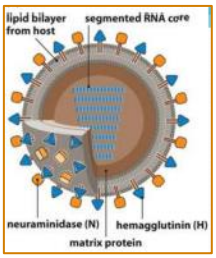
- Transmission:
  - It is a highly contagious disease
  - Inhalation of airborne droplets (sneezing, coughing) and contaminated hands.
- Diagnosis: No lab tests are usually required
- Treatment: No treatment is required only supportive treatment

2. Coronaviruses

- Family: Coronaviridae
- Structure: Irregular shape, enveloped with club-shaped glycoprotein spikes (important for attachment) and Helical nucleocapsid
- Genome: ss-RNA
- Diseases Caused
  - ✓ Includes common cold, SARS-CoV-1, MERS-CoV, and COVID-19 diseases (caused by SARS-CoV-2).
- Symptoms of COVID-19:
  - ✓ Fever/chills, dry cough, shortness of breath
  - ✓ Loss of taste/smell, fatigue, headache, vomiting, diarrhea
  - ✓ Complications: acute respiratory distress syndrome (ARDS)
- Transmission:
  - ✓ Airborne droplets and direct contact.
- Diagnosis:
  - ✓ RT-PCR, chest X-ray, and CT scan.
- Treatment:
  - ✓ No specific treatment; supportive care.
- Vaccines are available

3. Influenza Virus

- Family: Orthomyxoviridae
- Structure: Segmented ssRNA virus, 80-120 nm diameter, spherical/ovoid
- Glycoproteins: The outer surface of the particle consists of a lipid envelope from which project prominent glycoprotein spikes of two types:
  - ✓ Haemagglutinin (HA): Can agglutinate RBCs used for viral attachment and fusion, and it elicits neutralizing protective antibody responses
  - ✓ Neuraminidase (NA): Enzyme that uses neuraminic (sialic) acid as a substrate. Important in releasing mature virus from cells



- Types:
  - ✓ Three types: A, B, and C
    - Type A: Causes epidemics and pandemics, undergoes antigenic shift and drift and has an avian intermediate host (IH)
    - Type B: Causes epidemics, undergoes only antigenic drift and has no IH
    - Type C: is relatively stable. This group does not cause epidemics and causes mild disease
  - ✓ Subtypes:
    - According to antigenicity of HA and NA, influenza virusis divided into subtypes such as HnNm (H1N2, et al)

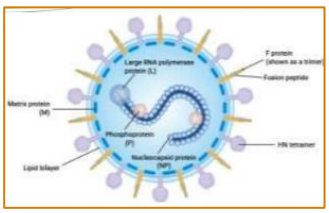
- Antigenic Shift and Drift:
  - ✓ Antigenic Shift: Genetic reassortment leading to new strains. Can cause pandemics.
    - Reassortment of genes is a common feature of Influenza A, but not B or C
    - When two different "A" viruses infect the same cell, their RNA segments can become mixed during replication
    - New viruses produced in this way may survive due to a selective advantage within the population

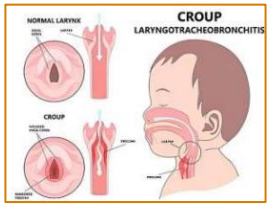
• 1918	H1N1:	"Spanish Influenza"	20-40 million death
• 1957	H2N2:	"Asian Flu"	1-2 million deaths
• 1968	H3N2:	"Hong Kong Flu"	700,000 deaths

  - ✓ Antigenic Drift: Smaller mutations causing seasonal epidemics.
    - Constant mutations in the RNA of influenza which lead to polypeptide mutations
    - Changes are less dramatic than those induced by Shift
- Influenza (Flu) can occur as pandemics
  - ✓ Due to antigenic shifts or Epidemics through antigenic drifts or sporadic cases
- Clinical Presentation:
  - ✓ Symptoms: Fever, headache, myalgia, cough, rhinitis
- Transmission: Respiratory droplets, more common in winter.
- Diagnosis: Nasopharyngeal aspirates, throat/nasal swabs are normally used for antigen detection, RT-PCR for viral RNA, virus isolation, and serology.
- Treatment: Neuraminidase inhibitors (e.g., Tamiflu).
- Vaccines: Available annually with 40-50% efficacy.

4. Parainfluenza Viruses

- Family: Paramyxoviridae
- The viral genome is ss-RNA
- Structure: Large (150-300 nm), pleomorphic, helical nucleocapsid, enveloped with two glycoprotein spikes, HN and F
- Glycoproteins:
  - ✓ HN: Hemagglutinin and neuraminidase activities used for attachment
  - ✓ F: Fusion protein, mediates cell entry by the fusion process
- Subtypes:
  - ✓ 5 subtypes: 1, 2, 3, 4a, and 4b.
- Transmission:
  - ✓ Respiratory droplets, more common in winter.
- Clinical Presentation:
  - ✓ Common in children (under 3 years).
  - ✓ Croup:
  - ✓ Acute inflammation of the larynx and trachea in infants and young children characterized by swelling of the epithelial cells lining the airway, so that the airway narrows, and breathing becomes difficult.
  - ✓ Symptoms: afebrile, early runny nose, harsh cough, inspiratory stridor, and hoarse voice. Symptoms subside within 1 or 2 days.
  - ✓ Treatment:
    - No specific antiviral chemotherapy is available.
    - Severe cases should be admitted and placed in oxygen tents.
    - Severe respiratory obstruction may require endotracheal intubation and tracheotomy
    - Vaccine: No vaccine is available.





- Diagnosis:
  - ✓ Clinical diagnosis is often sufficient.
  - ✓ Lab tests include antigen detection, virus isolation, and serology.

5. Respiratory Syncytial Virus (RSV)

- Family: Paramyxoviridae
- The viral genome is ss-RNA
- Structure: Large (150-300 nm), pleomorphic, helical nucleocapsid, enveloped with two glycoprotein spikes
- Glycoproteins:
  - ✓ G: Attachment protein (no hemagglutinin or neuraminidase activities)
  - ✓ F: Fusion protein, mediates cell entry, by the fusion process
- Clinical Presentation:
  - ✓ Major cause of lower respiratory tract disease in infants (50-90% of bronchiolitis, 5-40% of bronchopneumonia).
  - ✓ In older children and adults, the symptoms are much milder.
  - ✓ Bronchiolitis:
    - Inflammation of the bronchioles in infants and young children. Bronchioles become inflamed, edematous and obstructed by mucous causing obstruction and difficulty breathing.
    - Respiratory syncytial virus (RSV) and parainfluenza virus type 3 are the major cause of bronchiolitis in infants.
    - Symptoms:
      - Usually preceded by URT symptoms.
      - Expiratory obstruction.
      - Expiratory wheezing.
      - Respiratory distress (difficult & labored breathing).
      - Hypoxia and cyanosis
    - Most cases are mild, recover completely & do not require hospitalization. Increasing respiratory distress, cyanosis, fatigue or dehydration are indication for hospitalization.
- Diagnosis:
  - ✓ Clinical diagnosis. No specific treatment available and no vaccination is available

• Additional Notes on Viral Pneumonia

- Inflammation of the lung and alveoli
- RSV and parainfluenza virus type-3 are the major cause of infantile pneumonia
- Symptoms:
  - ✓ Fever, chills, cough, shortness of breath, fatigue, muscle aches, chest pain, Pharyngitis
- Prognosis: Most cases are mild and get better without treatment
- Some cases are more serious and require hospitalization
- Complications: Respiratory failure and heart failure

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