8- Rhinoviruses, Coronaviruses, Influenza and parainfluenza viruses

RNA Viruses

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Objectives

- Discuss the structure, properties, epidemiology, clinical presentation, laboratory diagnosis and treatment of the following viruses:

1. Rhinoviruses
2. Corona viruses
3. Influenza Virus
4. Parainfluenza viruses
5. Respiratory syncytial virus (RSV)

Anatomy of Respiratory Tract

Function: Transfer of air

- The upper respiratory tract:
  - Nasal cavity, sinuses, pharynx, and larynx
  - Infections are fairly common.
  - Usually nothing more than an irritation → Self-limited
- The lower respiratory tract:

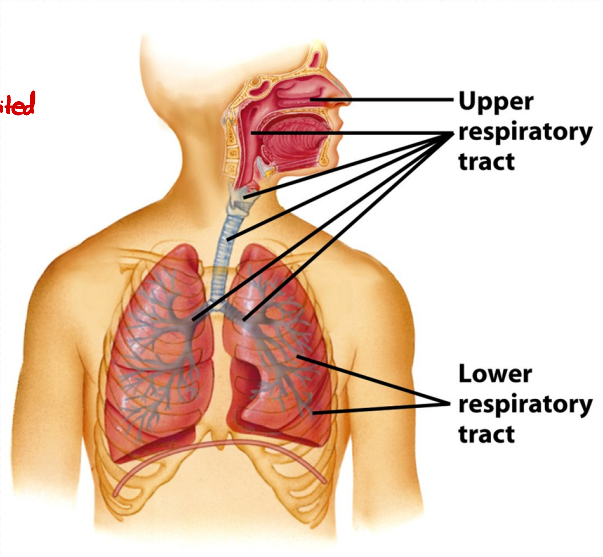
Pneumonia: Infection of lung tissue

  - Lungs and bronchi
  - Infections are more dangerous.
  - Can be very difficult to treat

2nd most accessible: GIT

- The most accessible system in the body:

Breathing brings in clouds of potentially infectious pathogens. → Contaminated air

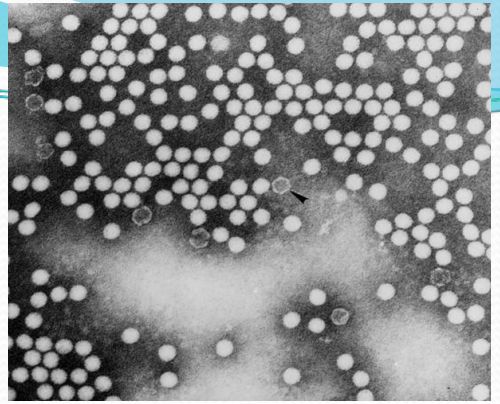


Upper respiratory infections make up 1/3 of the infections we see in medical practice.

Common Viral Causes

1. Rhinoviruses
2. Corona viruses
3. Influenza Virus
4. Parainfluenza viruses
5. Respiratory syncytial virus (RSV)

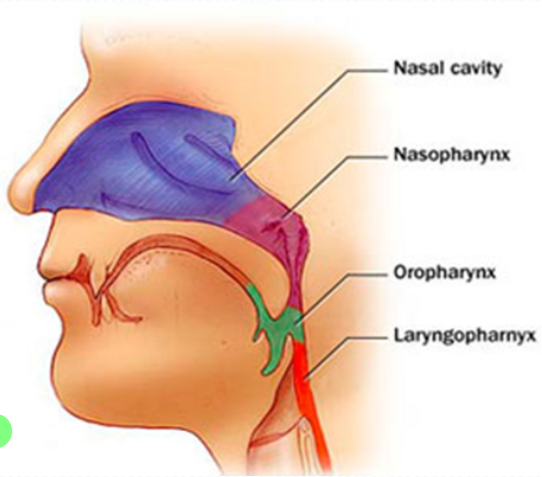
1. Rhinoviruses



- Family: Picornaviridae
- Genus : Rhinovirus
- Unenveloped
- Small icosahedral particle, 20 - 30 nm in diameter → Quite small
- The viral genome is ss-RNA
- More than 100 types → Infection is common and repeated → Immunity is serotype-specific
- They replicate in the nasopharynx → Upper respiratory tract infection
- Shed in large amounts in nasal secretion
- The optimal temperature for their replication is 33-35 c
- Do not efficiently replicate at body temperature → in the lower respiratory tract

Rhinitis (common cold)

- Rhinoviruses are responsible for 30-50% of common colds, coronaviruses 10-30%.
  Cause 10-30% of Common Cold → Still called rhinitis
- Common cold: inflammation of the nose and throat (nasopharynx)
- Symptoms
  - Watery nasal discharge.
  - Sneezing.
  - Mild sore throat.
  - Fever is not common
- It is a highly contagious disease
- Transmitted by inhalation of respiratory drople and coughing and through contaminated hands
- No lab tests are usually required and no treatment is required only supportive treatment

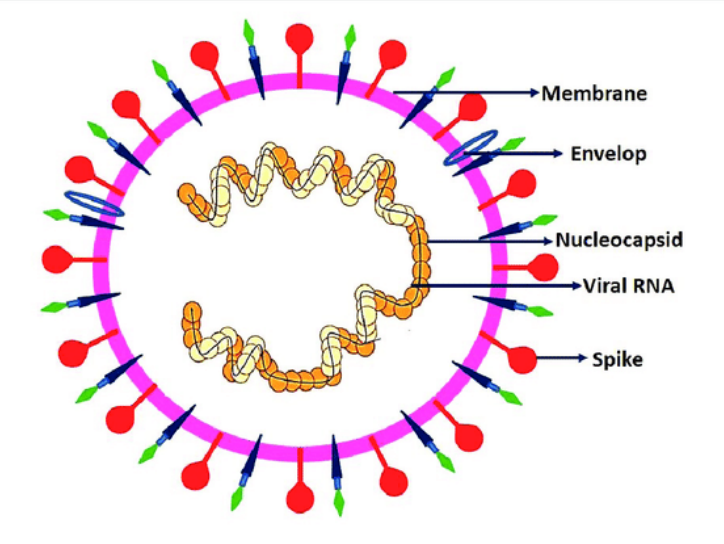


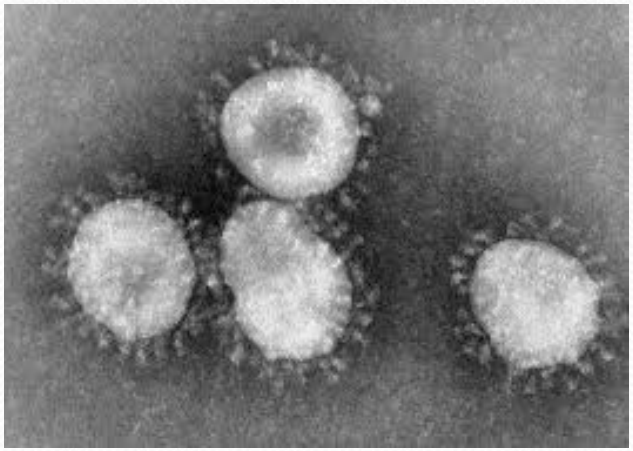
Pseudoephedrine.
Drugs to:
↓ Pain, ↓ congestion

→ Why don't some people catch COVID-19 by direct contact?
- They developed immunity from a previous rhinitis caused by a coronavirus

2. Coronaviruses

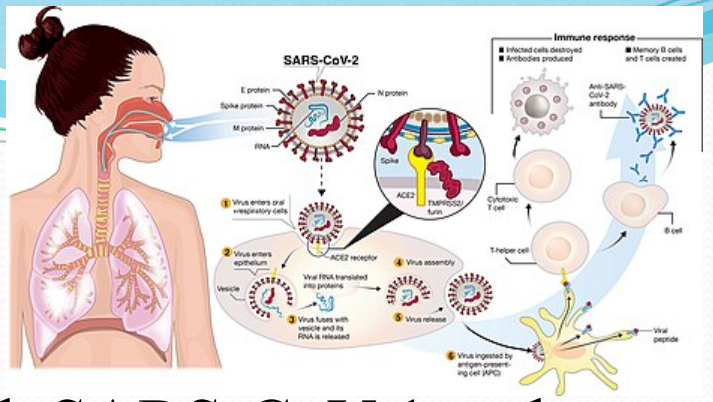
- Family: Coronaviridae
- Irregular in shape
- Enveloped with club-shaped glycoprotein spikes → Spike (S)
- Spike protein is important for attachment and immunity
- Helical nucleocapsid
- The viral genome is ss-RNA





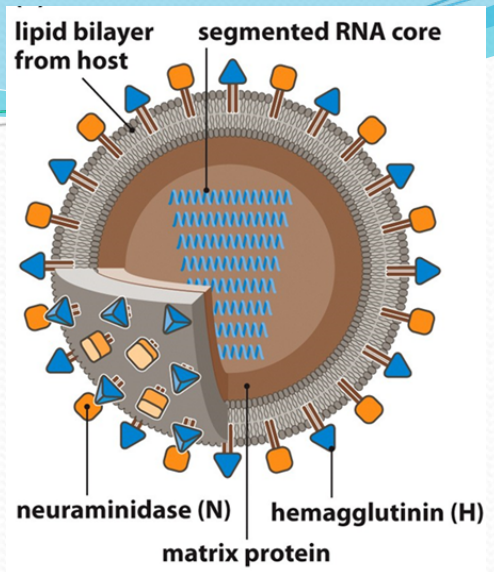
Corona Diseases

Upper + lower infection



- Coronaviruses can cause common clod (10-30%), SARS-CoV-1 and MERS-CoV, and recently COVID-19
- COVID-19 disease caused by SARS-C0V-2
- Transmission by air droplets and direct contact
- Symptoms: Fever or chills, cold-like symptoms dry cough, shortness of breath (lower respiratory tract infection), loss of taste or smell (can be permanent), fatigue, headache, vomiting, diarrhea
- Complications: acute respiratory distress syndrome (caused by overworking of the immune system → ↑Cytokines → Death; Supportive Treatment: Corticosteroids) can cause post-COVID fibrosis
  - Variations in CBC, ↑ liver enzymes
- Diagnosis: RT-PCR, chest x ray and CT-scan
- Treatment: debatable and none specific
- Vaccinations are available → Efficacy: 70-80%

6. Influenza Virus



- Influenza virus is an orthomyxovirus
- Segmented ssRNA virus
- Spherical/ovoid, 80-120 nm diameter
- The outer surface of the particle consists of a lipid envelope from which project prominent glycoprotein spikes of two types

1. Haemagglutinin (HA): Can agglutinate RBCs used for viral attachment and fusion, and it elicits neutralizing protective antibody (specifically IgA) responses
2. Neuraminadase (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 undergoes antigenic shift and drift. This group is the cause of epidemics and pandemics and has an avian intermediate host (IH)
- Type B undergoes antigenic drift only. This group causes epidemics 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 virus is divided into subtypes such as HnNm(H1N2, et al)

Antigenic shift and drift

Antigenic shift:

- 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
  - is a must
  - also a must → Only ones capable of antigenic shift
- New viruses produced in this way may survive due to a selective advantage within the population

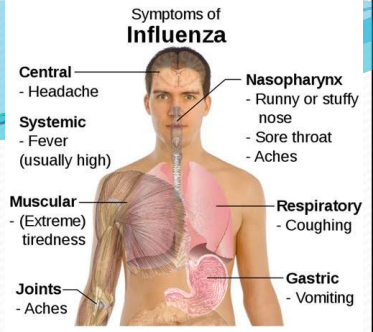
1918	H1N1:	"Spanish Influenza"	20-40 million deaths
1957	H2N2:	"Asian Flu"	1-2 million deaths
1968	H3N2:	"Hong Kong Flu"	700,000 deaths

Antigenic drift:

- Constant mutations in the RNA of influenza which lead to polypeptide mutations
- Changes are less dramatic than those induced by Shift

→ Doesn't form a new strain or endemic

Influenza (Flu)



Can occur as pandemics due to antigenic shifts or Epidemics through antigenic drifts or sporadic cases

Transmission is by respiratory droplets

Occur more frequently in the winter

Main difference from common cold

Systemic manifestation

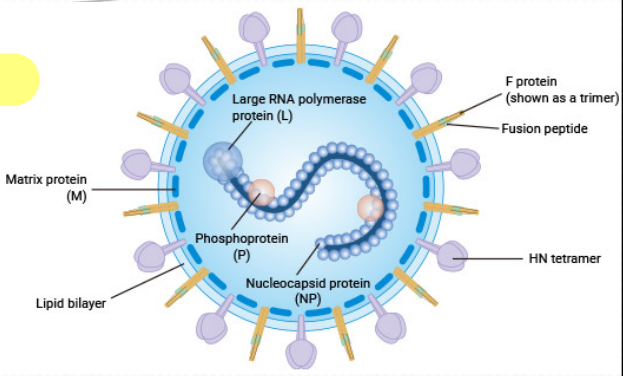
Symptoms: Fever, headache, myalgia, cough and rhinitis

Diagnosis: nasopharyngeal aspirates, throat, and nasal swabs are normally used for antigen detection, RT-PCR for viral RNA, Virus Isolation, and Serology

Neuraminidase inhibitors (Tamiflu) - are now the drugs of choice.

Vaccines are available annually with efficacy of 40-50%

3. Parainfluenza viruses



- Family: Paramyxoviridae
- Large, 150-300 nm in diameter
- Pleomorphic with helical nucleocapsid
- Enveloped with two glycoprotein spikes, HN and F
- The HN has both hemagglutinine and neuraminidase activities used for attachement
- The F (fusion), mediates cell entry by the fusion process
- The viral genome is ss-RNA
- 5 subtypes: 1, 2, 3, 4a and 4b
- Transmission: respiratory droplets, winter months.
- It occurs in children (below 3 years).

Croup

→ Usually self-limited and benign but not in children

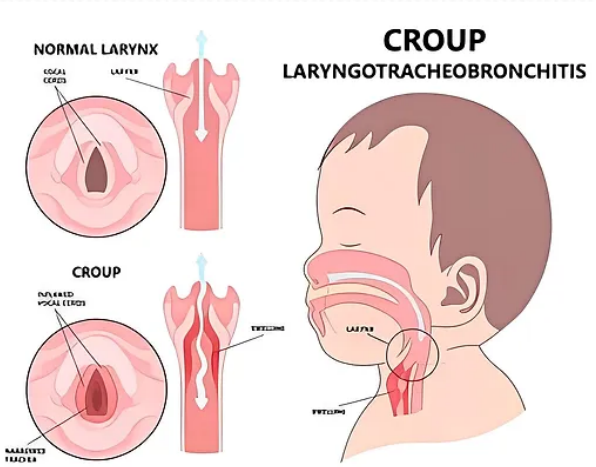
Acute inflammation of the larynx and trachea in infants and young children characterized by swelling of the epithelial cells lining the airway, so that the airway narrows, and breathing becomes difficult

Symptoms: afebrile, early runny nose, harsh cough (barking cough) inspiratory stridor, and hoarse voice. Symptoms subside within 1 or 2 days.

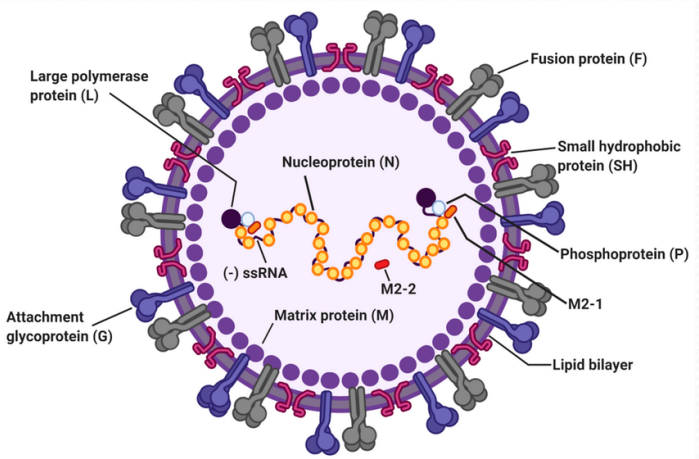
Diagnosis: clinical diagnosis is the rule. Lab: Detection of Antigen, Virus Isolation, and Serolog

Treatment:

- No specific antiviral chemotherapy is available.
- Severe cases should be admitted and placed in oxyge tents.
- Severe respiratory obstruction may require endotracheal intubation and tracheotomy
- No vaccine is available.



4. Respiratory syncytial virus (RSV)



- Family: Paramyxoviridae
- Large, 150-300 nm
- Pleomorphic, helical nucleocapsid
- Enveloped with two glycoprotein spikes:
  - The G protein, lacks hemagglutinins and neuraminidase activities. Attachment protein
  - The F, Mediates cell entry, by the fusion process
- The viral genome is ss-RNA
- Most common cause of severe lower respiratory tract disease in infants, responsible for 50-90% of Bronchiolitis and 5-40% of Bronchopneumonia. In older children and adults, the symptoms are much milder.