RNA viruses

Picornaviruses

- Picornaviruses represent a very large virus family with respect to the number of members but one of the smallest in terms of virion size.

- They include two groups:
  - enteroviruses
  - rhinoviruses

Enteroviruses of human origin include the following:

- Polioviruses
- Coxsackieviruses
- Echoviruses
- Enteroviruses

- Human rhinoviruses include more than 100 antigenic types.
- These viruses cause upper respiratory tract infections, including common cold.

Reoviruses

- Reoviruses are medium-sized viruses.
- The family Reoviridae is divided into six genera. Three of the genera are able to infect humans and animals:
  - Reovirus
  - Rotavirus
  - Orbivirus

Arboviruses (arthropod-borne viruses)

- The arboviruses are a group of infectious agents that are transmitted by bloodsucking arthropods from one vertabrate host to another.
- There are more than 450 arboviruses, of these about 100 are known pathogens for humans.

- Togaviruses
  - genus Alphavirus
- Flaviviruses
  - genus Flavivirus
- Bunyaviruses
  - genus Bunyavirus
  - genus Phlebovirus
  - genus Nairovirus
  - genus Hantavirus
- Arenaviruses
  - genus Arenavirus

Coronaviruses

- Coronaviruses are large, enveloped RNA viruses.
- The human coronaviruses cause common cold and have been implicated in gastroenteritis in infants.
- Coronavirus causes SARS.

Rhabdoviruses

- Rabies virus is usually transmitted to humans from the bite of a rabid animal.
- Although the number of human cases is small, rabies is a major public health problem because it is widespread among animal reservoirs.

Orthomyxoviruses

- The orthomyxoviruses comprise Influenza A, B and C viruses, vhich infect human.

Orthomyxoviruses - description

- The virions are spherical, 80-120 nm in diameter, but may be filamentous.
- From the envelope project spikes, which attach the virion to cell receptors, as a result they are able to agglutinate erythrocytes from certain species and are thus termed haemagglutinins (H).
- Influenza viruses bound to cells by the haemagglutinin interacting with membrane receptors containing A-acetylneuraminic acid (NANA).

Orthomyxoviruses - description

- Between the haemagglutinin spikes there are mushroom-shaped protrusions of neuraminidase (N).
- The enzyme catalyses the cleavage of NANA. This action allows the virus to permeate mucin and escape from these so-called "non-specific" inhibitors.
- Neuraminidase activity is also thought to be important in the final stages of release of new virus particules from infected cells.

- One of the most prominent features of the influenza viruses is their ability to change antigenically either gradually over years (antigenic drift) or suddenly (antigenic shift). Only influenza A virus has the potential to shift whereas all three types may drift antigenically, although only very minor changes have been demonstrated in influenza C.

- The major pandemics are associated with antigenic shifts – when the viral H or N, or both, are changed.

Influenza

- *Influenza A*
  - In classical influenza the incubation period is short (2 days), but it may vary from 1-4 days. The illnes is characterized by a sudden onset of systemic symptoms such as chills, fever, headache, myalgia and anorexia. Respiratory symptoms are also common but take second place to the systemic affects, aspecially early in the illness. Many patients have both upper and lower respiratory tract infections, often with a troublesome, dry cough.
- *Influenza B*
  - Symptoms closely resemble those associated with influenza A infections.
- *Influenza C*
  - Infection with this virus is comparatively rare compared with influenza A and B

Treatment

- There is still no satisfactory anti-influenza drug.
- Oral amantadine hydrochloride was introduced in the early 1980s, followed later by a derivate, rimantadine.
- Oseltamivir (Tamiflu) and zanamivir (Relenza) can be other drug for therapy.
- Unfortunately, these compounds only have activity against influenza A but not B or C.

Paramyxoviruses

- The paramyxoviruses include the most important agents of respiratory infections in infants and young children (RSV and the parainfluenza viruses) as well as the causative agents of two of the most common contagious diseases of children (mumps and measles).
- The Paramyxoviridae family can be divided into three genera:
  - Paramyxovirus
  - Morbillivirus
  - Pneumovirus

Retroviruses

- The Retrovirus family contains many viruses from widely different host species.
- They have been studied in the laboratory for many years, mainly because some of them are associated with tumor production in their natural hosts. Indeed, a wide variety of tumours are caused by the Oncovirus genus, including leukaemia and lymphomas, sarcomas, breast and brain tumours, auto-immune disease and blood disorders.

Retroviruses - description

- All retroviruses have an outer envelope consisting of lipid and viral proteins.
- The envelope encloses the core, made of other viral proteins, within which lie two molecules of viral RNA and the enzyme reverse transcriptase, an RNA-dependent DNA polymerase.
- The virions have a diameter of about 100 nm.

The retroviruses are divided into:

- Oncovirus
  - The oncoviruses include the viruses that cause tumours and a number of endogenous non-tumour producing viruses.
  - The human viruses are HTLV-I and HTLV-II.

- Spumavirus
  - The spumaviruses have been detected in various species, including cats and primates, but are not associated with disease.

- **Lentivirus**
  - The lentiviruses are so named due to their association with slowly progressive disease in animals.
  - The genus includes many viruses (virus causing arthritis and encephalitis in goats, bovine and simian viruses and other).
  - HIV-I and HIV-II are included.
  - In contrast to HTVL-I, a great deal is known about the association of HIV infection with disease.

Classification of HIV infection and AIDS

Group I	Seroconversion illness
Group II	Asymptomatic
Group III	Persistant generalized lymphadenopathy (PGL)
Group IV	A – constitutional disease B – neurological disease C – secondary infectious disease D – secondary cancers E – other conditions

Replication

- Retroviruses differ from other RNA viruses in that they replicate and produce viral RNA from a DNA copy of the virion RNA.
- Attachment of HIV to host cells is by the integration of the external envelope glycoprotein gp120 with part of CD4 molecule of T helper lymphocytes and other cells.
- Attachment is followed by entry of the virus by fusion of the two membranes, a function dependend on gp41.

Replication

- Once the RNA is released the reverse transcriptase acts to form the double-stranded DNA copy, which is circularized, enters the nucleus and is spliced into host cell DNA.
- Once inserted into the host DNA, infection with HIV is permanent.
- The virus may stay latent or enter a productive cycle.

Virus stability

- HIV is inactivated by:
  - Heat - it is destroyed in the autoclave and hot air oven.
  - Glutaralaldehyde 2%.
  - Hypochlorite.
  - Several other disinfectants, including alcohols.
  - The chemicals will kill virus within a few minutes, but is important to remember that disinfectants may not be effective in the presence of organic material.
  - At room temperature virus may survive for up to 15 days.

Laboratory diagnosis

- Isolation of virus in culture.
- The detection of viral components, e.g. p24 antigen, by direct assay in the plasma or detection of proviral DNA or RNA.
- The presence of antibody to HIV antigens in the serum.

Treatment

- There is no specific therapy.
- Peptide analogues of attachment can be used in therapy (e.g. azidothymidine)
- If T cell leukaemia or bacterial infections develop, then are managed by various drug therapies.