VIROLOGY

- Viruses are the smallest infectious agents (20-300 nm in diameter) containing only one kind of nucleic acid (RNA or DNA) as their genome.
- The nucleic acid is encased in a protein shell, which may be surrounded by a lipid–containing membrane.
- The entire infectious unit is termed as a virion.

- Viruses are inert in the extracellular environment. They replicate only in living cells, being parasites on the genetic level.

- The viral nucleic acid contains information necessary for programming the infected host cell to synthesize a number of virus-specific macromolecules required for the production of viral progeny.

- During the replicative cycle, numerous copies of viral nucleic acid and coat proteins are produced.

- The coat proteins assemble together to form the capsid, which encases and stabilizes the viral nucleic acid against the extracellular environment and facilitates the attachment and perhaps penetration by the virus upon contact with new susceptible cells.

- **Capsid**
  - The protein shell, or coat, that encloses the nucleic acid genome.
- **Nucleocapsid**
  - The capsid together with the enclosed nucleic acid.

- **Envelope**
  - A lipid-containing membrane that surrounds some viral particles. It is acquired during viral maturation by a budding process through a cellular membrane.
- **Virion**
  - The complete viral particle, which in some viruses may be identical with nucleocapsid. In more complex virions, this includes the nucleocapsid plus a surrounding envelope. The virion serves to transfer the viral nucleic acid from one cell to another.

- Viruses cause disease after they break through the natural protective barriers of the body, evade immune control, and either kill cells of an important tissue (e.g. brain, lungs) or change their properties.

- A particular disease may be caused by several viruses that have a common tissue tropism-preference (e.g. hepatitis – liver, common cold-upper respiratory tract, encephalitis – central nervous system). On the other hand, a particular viruses may cause several different diseases or no observable symptoms (e.g. HSV).

Basic steps in viral disease

- Viral disease in the body progresses through defined steps, just like viral replication in the cell.

- The early steps are as follows:
  - acquisition (entry into body),
  - initiation of infection at the primary site,
  - an incubation period, when the virus is amplified and may spread to a secondary site.

- The incubation period may proceed without symptoms (asymptomatic) or may produce nonspecific early symptoms, termed the prodrome.
- The symptoms of the disease are caused by tissue damage and systemic effects caused by virus and possibly the immune system.
- The symptoms may continue through the convalescence, while the body repairs the damage.

Infection of the target tissue

- The virus gains entry into the body through breaks in the skin or through the mucoepithelial membranes that line the orifices of the body (eyes, respiratory tract, mouth, genitalia, and gastrointestinal tract).
- The skin is an otherwise excellent barrier to infection, and the orifices are protected by many factors (e.g. tears, mucus and other).
- Inhalation is probably the most common route of viral infection.

- The blood stream and the lymphatic system are the predominant means of viral transfer in the body. The virus may gain access to them after tissue damage, by means of phagocytosis, or upon transport through the mucoepithelial cells of the oropharynx, gastrointestinal tract, vagina, or anus.

- The transport of virus in the blood is termed viremia. The virus may be either free in the plasma or may be cell-associated in lymphocytes or macrophages.

Viral pathogenesis

- The three potencial outcomes of viral infection of a cell are as follows:
  - abortive infection,
  - lytic infection,
  - persistent infection.

Abortive infection

- Viruses, which cause abortive infections, do not multiply and therefore disappear.

Lytic infection

- Lytic infection results when virus replication kills the target cell.

Persistent infection

- A persistent infection occurs in an infected cell that is not killed by the virus.

- Some viruses cause a persistent productive infection because the virus is released gently from the cell through exocytosis or through budding (enveloped viruses) from the plasma membrane.

Oncogenic viruses

- Some DNA viruses and retroviruses establish persistant infections that can also stimulate incontrolled cell growth, causing the transformation or immortalization of the cell.

Transmission of viruses

- Viruses are transmitted by direct contact (including sexual contact), injection with contaminated fluids or blood, the transplantation of organs, and the respiratory and faecal-oral routes.

- The route of transmission depends on the source of the virus and the ability of the virus to endure the hazards and barriers of the environment and the body route to the target tissue.
  - For example, viruses that replicate in the respiratory tract (e.g. Influenza A virus) are released in aerosol droplets, whereas enteric viruses (e.g. picornaviruses) are passed by the fecal-oral route.

Laboratory diagnosis of viral diseases

- Viruses are detected, identified, and quantitated by various methods.
- Specific diagnosis of viral infection is important. Often, the same viral syndromes can be produced by a variety of viral agents, and clinical differentiation of the specific infecting virus may be difficult, if not impossible.
- The etiology of a viral syndrome can be often established from viral culture, serologic tests, or both.

Diagnosis of viral infections

- **Viral culture**
  - The „gold standard“ for proving the etiology of a viral syndrome is the recovery of the agent in tissue culture, embryonated eggs or experimental animals.
  - The virus growth is detected by observation of changes in the cell culture – cytophatic effect (CPE).
  - Characteristic CPE include changes in cell morphology, cell lysis, vacuolation, syncytia formation and presence of inclusion bodies
- **Viral serology - determination of viral antibodies**

Classification of viruses

- DNA viruses
- RNA viruses