



Virus Morphology

Virology: Is the science that deals with discovery, isolation, identification, characterization, pathogenicity, and classification of viruses.

Virus: Is an infectious particle which is obligate intracellular parasite require a hosts to cause damage, they contain only **one type** of nucleic acid either **RNA or DNA**.

Viruses are not organisms, and contain no functional ribosomes, mitochondria or other cellular organelles. The virus was capable to replication only within the living cells such as bacteria, animals or plants by using the synthesizing machinery of the cell cause the synthesis of specialized structures that can transfer viral nucleic acid to other cells.

Viruses are generally made up of two parts, the outer protein (**called a capsid**) and the **genetic information inside DNA or RNA**. Generally the morphology of a virus can be one of two structures, that of a sphere or that of a tube.

Viruses can be found either inside a cell (intracellular) or outside of a cell (extracellular). If it is found extracellular, the virus is called a Virion.

General characteristic of virus:

1. **Very small agent cannot seen by light microscope but can see by electron microscope**, the largest of the human pathogenic viruses, the **poxviruses**, measure **only 300nm** and the **smallest, the poliovirus**, is **only 20nm in diameter**.
2. They contain one type of nucleic acid either **RNA or DNA**.
3. They multiply by replication of their nucleic acid comparing with other microorganism which replicated by binary fission.
4. May be surrounded by a lipid-containing membrane called **envelope**.
5. They don't carry enzyme.
6. They don't growth on synthetic media but grow in **living cell**.

7. They can pass through the filters that don't allow bacteria to do so.
8. There are no ribosomes and organelles inside the virus.
9. Antibiotic have not affected on viruses, whereas viruses sensitive to interferon.
10. Some viruses can caused latent infection.

Viral Morphology

The virion of the simplest viruses consists of a single molecule of **nucleic acid** surrounded by a **protein coat**, called **the capsid**. The capsid and associated nucleic acid then constitute the **nucleocapsid**. For some viruses the capsid is surrounded by a **lipoprotein envelope**.

The capsid is composed of a defined number of morphological units called **capsomers**, which are held together by **noncovalent bonds**. Within an infected cell, the capsomers self-assemble to form the capsid. The manner of assembly is strictly defined by the nature of the bonds formed between individual capsomers, which give **the symmetry** to the capsid.

Types of Viral Symmetry:

Viral architecture can be grouped into three types based on the arrangement of morphologic subunits.

1- Helical symmetry

In which the capsomeres are arranged **in spiral form around nucleic acid that appears rod shape** (tubular shape).the helical symmetry found only in **RNA viruses**.

2-Icosahedral or Cubic Symmetry:

Cubic multiple faces (polyhedron), in which the capsomeres are arranged in pattern **consisting of multiple triangular faces**, **Most DNA viruses and some RNA viruses** have Icosahedral Symmetry.

3- Complex Symmetry:

Some viruses have a multilayer complex structure, eg; Bacteriophage (virus infect bacteria) have complex shape consist from head (Icosahedral shape) contain nucleic

acid, and tail (in helical shape) has set of fibers which helping in attachment of virus to host cell bacterium.

Definition in Virology

Capsid: The protein shell or coat that encloses the nucleic acid genome.

Nucleocapsid: The Capsid together with the enclosed nucleic acid.

Capsomers: Morphological units seen in the electron microscope on the surface of icosahedral viral particles. Capsomers represent clusters of polypeptides.

Envelope: A lipid – containing membranes that surrounds some viral particles. It is acquired during viral maturation by a budding process through a cellular membrane.

Virions: are complete virus particle and is made up of from ten to fifteen percent nucleic acid and from fifty to ninety percent protein. The general purpose of the proteins is to protect the genetic information.

EVOLUTIONARY ORIGIN OF VIRUSES

The origin of viruses is not known. Two likely hypotheses are as follows:

- 1) Viruses may be derived from components of host cells that became autonomous. They resemble genes that have acquired the capacity to exist independent of the cell. Some viral sequences are related to portions of the cellular genes encoding protein functional domains. The likelihood is great that most viruses evolved in this fashion.
- 2) Viruses evolved from free – living cells. There is no evidence that viruses evolved from bacteria; although the possibility exist that other obligatory intracellular

organisms e.g. Chlamydiae, did so. However, poxviruses are so large and complex that they might represent evolutionary products of some cellular ancestor.

CLASSIFICATION OF VIRUSES

◆ Basis of Classification

The following properties listed in order of importance, have been used as a basis for the classification of viruses. Viruses are mainly classified by phenotypic characteristics, such as morphology, nucleic acid type, mode of replication, host organism and the type of disease they cause. Viruses are classified on different bases:

- 1. Nucleic acid type RNA or DNA:** single – stranded or double – stranded; strategy of replication.
- 2. Size & morphology,** including type of symmetry, number of Capsomers, and presence or absence of membranes.
- 3. Susceptibility to physical and chemical agents,** especially ether.
- 4.** Presence of specific enzymes, particularly RNA and DNA polymerases concerned with genome replication, and neuraminidase necessary for release of certain viral particles (influenza) from the cells in which they were formed.
- 5.** Immunologic properties.
- 6.** Natural methods of transmission.
- 7.** Host, tissue, and cell tropisms.
- 8.** Pathology; inclusion body formation.
- 9.** Symptomatology.

◆ Classification by Symptomatology

A) Generalized Diseases.

B) Diseases Primarily Affecting Specific Organs.

- 1.** Diseases of the nervous system – polio myelitis
- 2.** Diseases of the respiratory tract – Influenza, para influenza.
- 3.** Localized diseases of the skin or mucous membranes – Herpes simplex type 1.

4. Diseases of the eye: Adenovirus (conjunctivitis), herpes (krato conjunctivitis).
5. Diseases of the liver – Hepatitis type A (infectious hepatitis)
6. Diseases of the salivary glands – Mumps and cytomegalovirus
7. Diseases of the gastrointestinal tract – Rotavirus.
8. Sexually transmitted diseases – Herpes simplex virus.

The Origen of Names of Viruses

Names of viruses may be derived from:

a-shape of the virus

Corona = crown like

Rhabdo = rod like

Arena = sand like

Toga = cloak

Rota = wheel

Pico = small

Calici = cup-like

Parvo = small

Orbi = ring

b-site of multiplication

Adeno = gland

Rhino = upper respiratory tract

Myxo = mucous

C-Names derived from lesions

Pox = pock lesions

Flavi = yellow fever

Morbilli = plague

D-According to an enzyme

Retro = reverse transcriptase

E-Derived from different names

Papova = Papilloma, Polyoma, Vaccinating

F-Geographic area or town

Bunya = Bunyayera in Uganda

All viruses contain the following two components:

1- Nucleic acid genome

2-Capsid: That covers the genome. Capsid with Nucleic acid is called the **nucleocapsid**.

The function of the capsid

- 1- To protect viral nucleic acid from harmful effects.
 - 2- The capsid gives shape of virus.
 - 3-Mediated attachment of viruses to specific receptor on surface of host cells.
 - 4- Act as antigen that induce neutralizing antibodies and activate cytotoxic T-cell to kill virus- infected cells.
- 2- **Envelope:** A lipid- containing membrane that surrounds some virus particles. It is acquired during viral mutation by budding process through a cellular membrane. Virus-encoded glycoproteins are exposed on the surface of the envelope. These projections are called peplomers.

Atypical virus – like agents:

Viroid: consist only single molecules of circular ssRNA without protein coat or envelope. They replicate and cause several diseases in **plant** but not in human.

Prion: is infectious particle that is composed only protein . the protein has ability to cause disease include ; Mad cow in cattle , Kuru disease in human.