MICROBIOLOGY

Introduction to Virology

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Viruses are extremely small agents, can't be seen under light microscope. Their particle sizes between 20-300 nm. They can pass through filters, which prevent the most of bacteria. Viral particles are not true , called virion that has one type of nucleic acid (either DNA or RNA). The virion particles are surrounded by protein material called capsid. The capsid composed of number of submits structure called capsomeres.

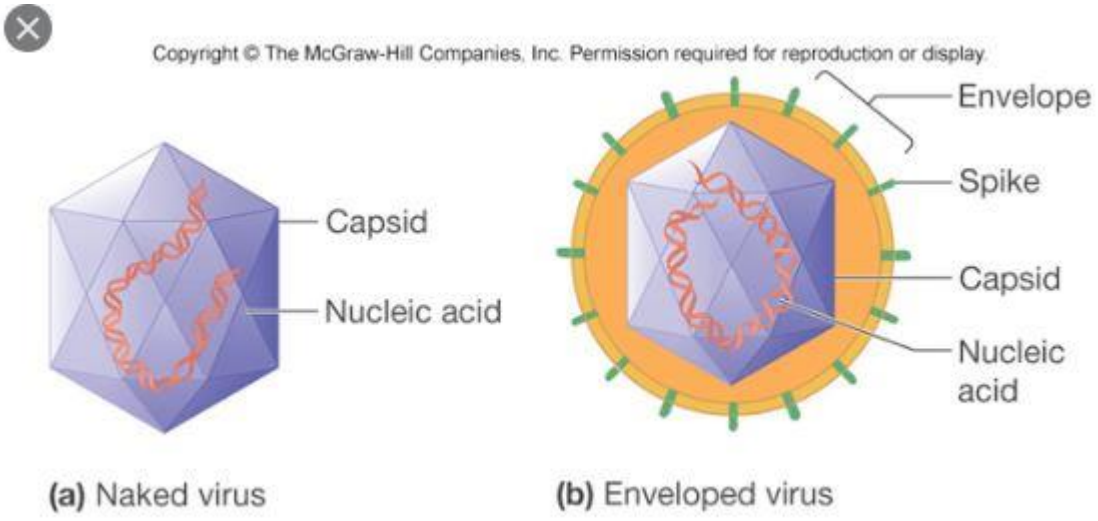
The virions are either composed of capsid, that is surrounded the nucleic acid which are called naked virions or surrounded with an outer glycolipid protein, are called enveloped.

The viruses have a nucleic acid which composed of geniuses that responsible of genetic characters, stability and regulation of propagation or replication of the viruses in the specific host cells.

The virus particles or virion deficient of organelles that responsible of energy, protein production they can not be active or replicated outside the specific host cells. They are completely dependent on the host cells for all their vital activities including replication.

1-Capsid } *Associated with spacifity of the virus*

2-Envelope } *for a particular type of the host cell.*



Development of virology associated with develop of different sciences i.e. Cytology, Pathology, Biochemistry and biophysics, Tissue culture Immunology, Monoclonal antibodies technique, Embryology.

Shape

1- Cubic

2-Helical

3-Complex (involves cuboidal & helical).

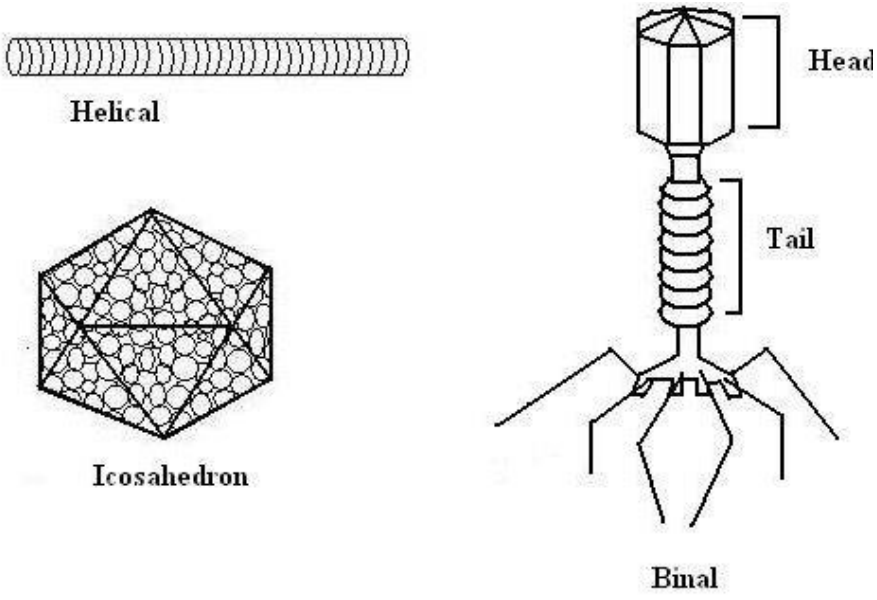


Fig 1. Different shapes of virus capsid

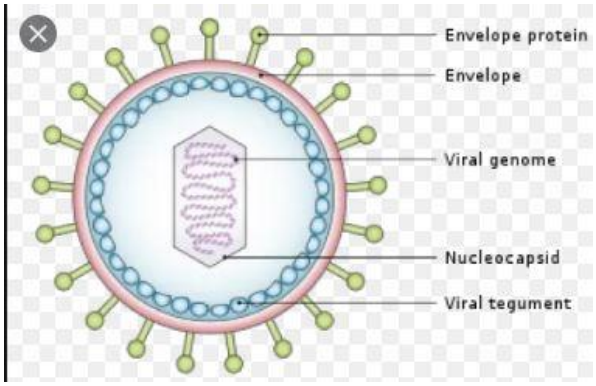


Figure: The structure of virus

These agents have wide spectrum hosts that can be divided upon the specifity of the host infection to: -

1-Animal and human viruses (minor specifity: infect specific tissue, organs, and systems.

2-Plant viruses.

3-Bactrial viruses (Bacteriophages).

4-Fungal viruses.

5-Algal viruses.

The life cycle of virus (Replication)

The replication of the viruses is happened in the host cells that can be represented in the following processes or phases:

1-Attachment and Absorption

The virus attaches itself to the host cell surface by means of the specific receptors on its capsid or envelope that are complementary to those on the host cells.

The host cells lacking the appropriate receptors can not be infected with virus.

2-Penetration

After the absorption the virus particle (virion) is carried into the cell by process called pinocytosis or phagocytosis.

3-Uncoating

The virus particle release nuclei acid in the cytoplasm of the host cell by uncoating of the virion, this uncoating of by means of the lysozymal enzymes, which produced by the host cell in the case of infection with envelope virion, that have DNA, this nucleic acid combined DNA of the host cell, which are be induced to multiplication the results of this replication is high amounts production of viral DNA. This process is induced by coded and translated of mRNA of the host cell. The same process when the host cell is infected with naked virion that have RNA, but the replication

The result of these metabolic processes is then turned to the replication of new viral particles.

4-Maturation

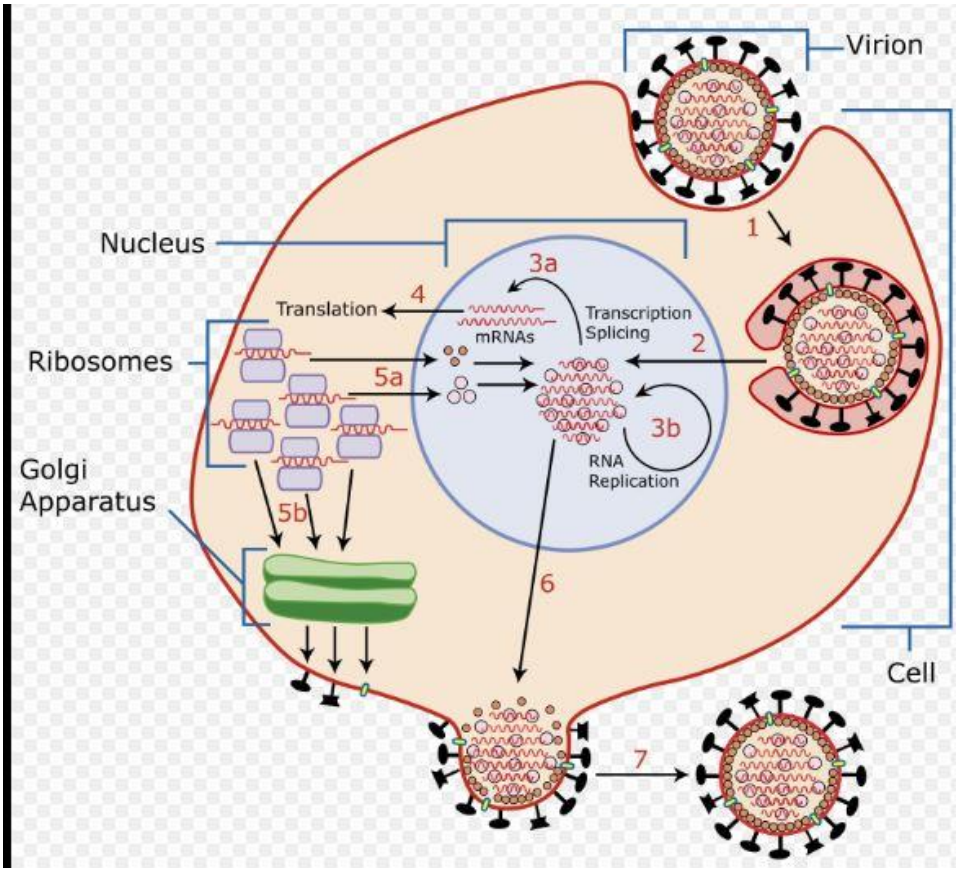
Protein capsidare condensed around molecule of viral nucleic acid to form new virion particles.

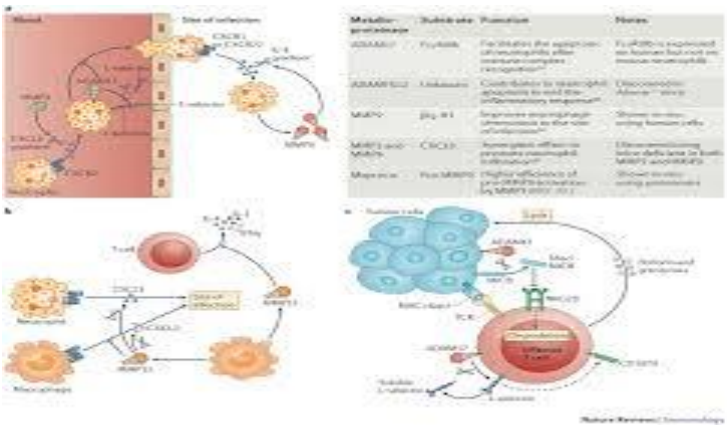
5-Release

Virion particles or mature viruses are released from the host cell by two ways:

a)-The naked viruses that are replicated in cytoplasm of the host cell are released from the cell by lyses of the host cell membrane.

b)-The envelope viruses are released by extrusion through the cell membrane of the host.





Effects of viral infection on the host cell

Viral invasion in the host cell leads to viral replication, causing either destruction (lyses), changed (altered) function, or proliferation of the host cell. The most important effects as follow.

1-Cytopathic effects (CPE)

The viral effect causes lyses of the host cells by lytic viruses, which appears as plaques (clear zones) as a result of the lyses of the host cells, that can be seen by naked eye or by light microscope (Bacteriophages)

2-Inclusion body formation

Inclusion bodies may be formed during the replication of some viruses in the cytoplasm or nucleus of the host cells. These bodies may be considered to be colonies of mature viroins or any cellular material be produced as a results of viral infection. The presence of these inclusions helps for identification (diagnosis) of some viral infection (i.e. infection by small pox, poliomyelitis.

3-Cell fusion

Some viral infections cause fusion of the infected host cells. This fusion happen when the infection with the some enveloped viruses such as Paramyxoviruses and Herpesviruses.

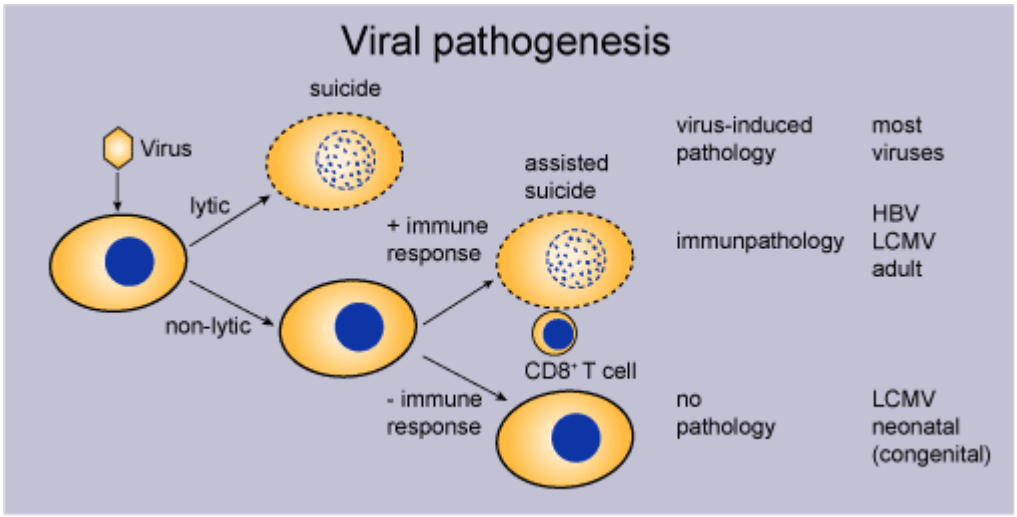
4-Changing of surface host cells receptors

Viral infection changes the cell membrane or cytoplasmic membrane components (protein), by fusion of viral protein with cell membrane protein that causes the induction of the body host to form humoral immunity against specific viruses.

5-Interferon production

Interferon is a protein substance, produced and released after viral infection, that cases protection of the non infected cells from the viral reinfection of the same virus or other.

6- -transforming viruses and cancer



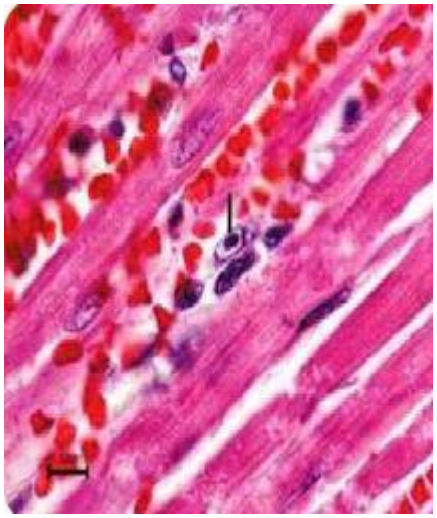


Fig. show Inclusion body formation

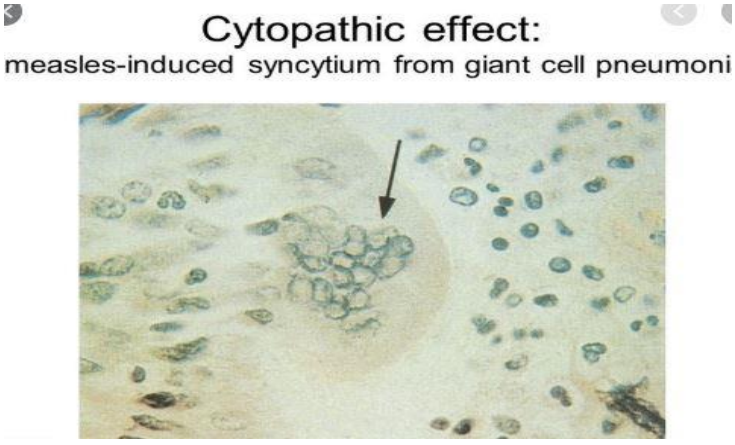


Fig. show CPE .

Stability

Resistance to heat, drying and ultraviolet irradiation is an important factor to determination of virus activity in nature. The infectivity of the most viruses generally disappears by heating at 50-60 ^{o}C for 30 minutes. In dry state viruses are more resistant to heat than in normal hydrated state.

Diagnosis

There are many steps or methods of examination:

1-Examination of the infected tissues of cells under light and electron microscope.

2-Serological tests to detect the presence of specific antibodies by: -

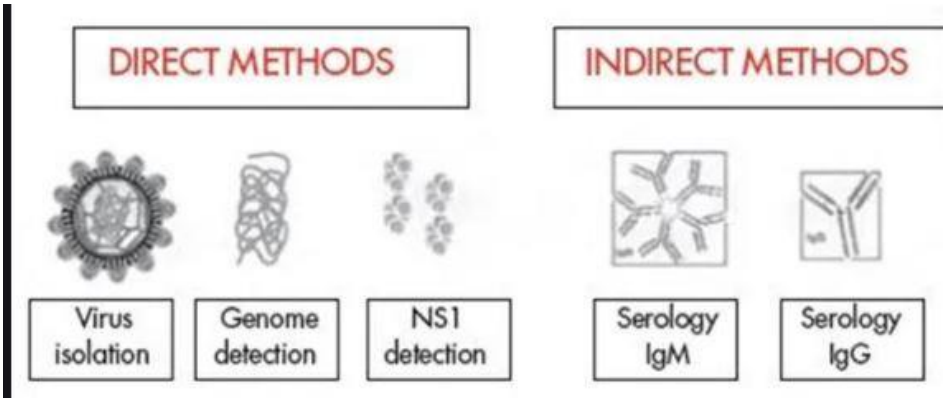
a)-Complement fixation or hem agglutination inhibition.

b)-Radioimmunoassay (RIA).

C-Immunodiffusion.

3-Isolation and Identification

4- genome identification (PCR).



Classification of viruses

There are many ways for classification of viruses that are depending upon different information's or criteria. Among the most of these are: -

1-Nucleic acid types DNA or RNA, whether it is single or double stranded.

2-Size and morphology of the virion and the capsid.

3-Susceptibility to the physical and chemical agents.

4-Immunological properties.

5-Natural method of transmission.

6-Host, tissue and cell specific infection.

7-Pathogenicity and clinical picture.

Divided or classified due to the local of specific organ or tissues or types of cells, that are infected with specific viruses i.e.:

1-Entero-viruses which infects the digestive system.

2-Respiratory viruses that infects the nose, the tracheal and the lung (Influenza, Pneumonia).

3-Dermo-viruses (Small Pox, Measle, Herps).

4-Neurotropic-viruses, infects the central nervous system, such as Rabies, Poliomyelitis, Encephalitis.

5-Others such as, Hepatitis (A, B), Mumps, Yellow fever, Chicken, Acquired Immune Deficiency Syndrome (AIDS) caused by HTLV (Human T-Lymphocytes Virus) and Syndrome Acute of Respiratory System (SARS) virus or Severe Acute Respiratory System.

Diseases caused by viruses (viral diseases)

Table: - Demonstrated some viral diseases.

Viruses types	Disease and Clinical Picture
Polioviruses	Poliomyelitis (paralysis, headache, vomiting and fever). Portal of entry in human is the mouth. Prevention by Vaccine.
Coxsakieviruses A & B	Group A: causes Herpanging (vascular pharyngitis). Infection localizes in the back of the mouth and lesions rarely occur on the gingival. Group B: causes (Bornholm disease), that is characteristic by fever, chest pain and respiratory distress, and pain in the muscle of the back or neck.
Echoviruses (enteric cytophathogenic	These enteric viruses have been found to be associated with various clinical syndromes, such as upper respiratory diseases, summer diarrhea, and some times with paralysis resembling poliomyelitis. The viruses have been isolated from the pharynx, and gingival; the symptoms closely resemble those seen with (Oxsakieviruses group B.
Rhinoviruses (common cold viruses)	These viruses have been infected the upper respiratory tract, causes the nasal-stiffness,

	sneezing, headache, and fever.
Viral Hepatitis	The viruses infects the liver tissue cells, there are groups of viruses, viral hepatitis A, VHB and VHC. HAV infection has short incubation period 14-45 days. Characterized by jaundice, anorexia, nausea, and abdominal discomfort. HBV viral hepatitis B known as serum hepatitis. The disease appears after long time 50-180 days. The syndrome may be seen with arthritis, fever, anorexia, nausea, severe cases are fatal due to necrosis of liver tissues. Some cases may become chronic. HCV viral hepatitis C disease is a severe disease leads to malignant tumors in liver.
Orthomyxoviruses (Influenza viruses)	Influenza virus tends to destroy the ciliated cells of the nasal, trachea, bronchi and bronchioles. The disease is characterized by fever, headache, muscle pains dry cough, nausea, and sometime chest pain
Mumps virus	Parotitis is the most common manifestation. The onset is usually moderately acute with maliase, headache, muscle aches, fever with swelling of one parotid or both glands.
Measles virus rubella	Agent causing measles disease that characterized by koplike spot. These spots are small elevated pinpoint surrounding by dark red areola. The infected child's may become dry and ulcerated.
Rubella (German measles)	Rubella is typically a disease of young childhood that is characterized by pinpoint rose-red anathema of soft palate.
Rabies virus	Hydrophoia. The highly virulent viruses, the incubation period is from 4-6 weeks. The disease has been caused by animal bites. The onset of disease in human is by feeling of apprehension, headache, fever and sensory changes, leads to encephalitis and death.
