Tikrit University

College of Nursing

Basic Nursing Sciences

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Microbiology
(Virology)

by: assistant lecturer

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Virology

Is the study of viruses and virus-like agents:

Viruses

are obligatory intracellular parasite very small in size and have a simple, but effective structural organization. they usually consist of just two or three categories of components and use the components of the Host Cell to perform their "metabolism".

- **Viral infections are the most common cause of human disease, it responsible for at least 60% of the illness**

- **Antibiotic have no effect on viruses, but antiviral drugs have been developed to treat life-threatening infections.**

- **Vaccine can produce lifelong immunity and prevent viral infection**

- **Viruses effect on all life forms, including human, animals, plants, fungus and bacteria**

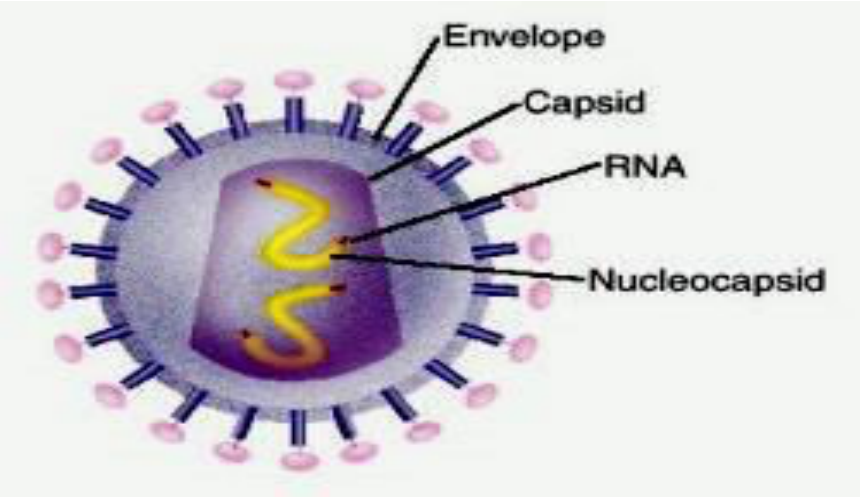
- **They damage or kill the cells that they infect**

- **A few viruses can produced cancer**

Virus components

1- Genome

The viral genome (either DNA or RNA but not both) codes for the few proteins necessary for replication. Some proteins are nonstructural, e.g.. Nucleic acid polymerases and some are structural, i.e. they become incorporated and form part of the virion.

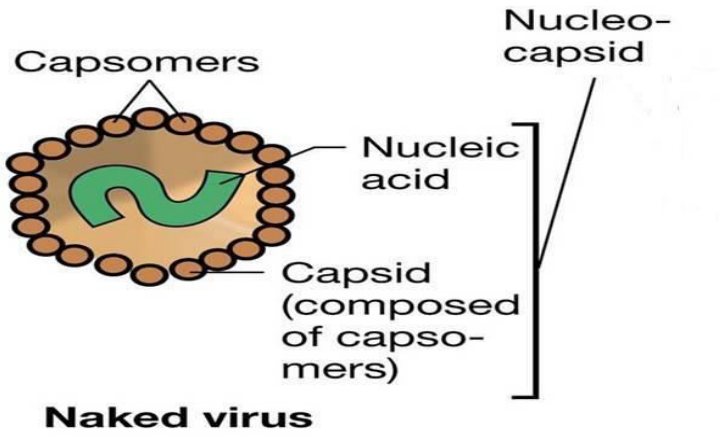


2- Capsid (outer protein coat)

- **Many protein subunits are assembled to form a tight "shell" (capsid made up of subunits called capsomers) inside which the nucleic acid genome lodges for protection.**

- **The arrangement of capsomers give the virus structure its genomic symmetry**

- **The capsid together with its enclosed nucleic acid is called the nucleocapsid.**



Viral envelop (not found on all viruses)

- **Some viruses acquire an outer lipoprotein coat by "budding" through the host cell membranes and are thus called Enveloped viruses.**

- **The envelop is important for interaction with cellular components during the process of infection and replication.**

- **Enveloped viruses are more sensitive to heat, drying, detergent and lipid solvents such as alcohol and ether than non enveloped virus**

- **Viruses are vary in size 20 – 300 nm in diameter**

- **The shape of viruses are determined by the arrangement of the repeating subunits that form the protein coat (capsid) of the virus.**

- **Most virus appear as spheres or rods in the electron microscope. In addition to these forms, bacterial viruses can have very complex shapes.**

- **Viruses have no metabolic enzymes and cannot generate their own energy.**

- **Viruses cannot synthesize their own proteins. For this they utilize host cell ribosomes during replication.**

- **Unlike cells, viruses do not grow in size and mass leading to a division process. Rather viruses grow by separate synthesis and assembly of their components resulting in production of mature viruses.**

A virus like particles (VLPs)

An assembly of virus structural proteins that mimics the configuration of a real virus, except that it contains no genetic material. If a person is vaccinated with VLPs then an immune response is generated as if the immune system has been presented with a real virus.

Attachment: is aspecific binding between viral capsid protein and specific receptors on the host cellular receptors.

Penetration: viruses enter the host cell through receptor- mediated endocytosis or membrane fusion

Uncoating: the viral capsid is degraded by viral enzyme or host enzymes thus releasing the viral genomic nucleic acid

Replecation: involves synthesis of viral messenger RNA (mRNA) for viruses except positive sense RNA viruses

Assemble: viral protein synthesis and assemble of viral protein and viral genome

Release: viruses are released from the host cell by lyses. Enveloped viruses (e,g, HIV) typically are released from the host cell by budding.

Prevention and treatment

Because viruses use vital metabolic pathways within host cells to replicate, they are difficult to eliminate without using drugs that cause toxic effects to host cells in general.

The most effective medical approaches to viral diseases are vaccinations to provide immunity to infection, and antiviral drugs that selectively interfere with viral replication.

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Influenza virus

Three distinct types of influenza virus, dubbed A, B, and C, have been identified.

Most cases of the flu, are caused by the influenza A virus, which can affect a variety of animal species, but the B virus, which normally is only found in humans, is responsible for many localized outbreaks.

The influenza C virus is morphologically and genetically different than the other two viruses and is generally nonsymptomatic, so is of little medical concern
The virion particles (RNA) are usually spherical or ovoid. Sometimes filamentous forms of the virus occur as well, and are more common among some influenza strains than others.

The influenza virion is an enveloped virus that derives its lipid bilayer from the plasma membrane of a host cell. Two different varieties of glycoprotein spike are embedded in the envelope.

1- **Hemagglutinin (18 major types): attachment of the virus to a host cell.**
2- **Neuraminidase (9major types) : involved in facilitating the release of newly produced virus particles from the host cell**

- **The function of the hemagglutinin is to bind to the cell surface receptor (neuraminic acid, sialic acid) to initiate infection of the cell.**

- **Neuraminidase degrades the protective layer of mucus in the respiratory tract. This enhances the ability of the virus to gain access to the respiratory epithelial cells**

Diagnosis

- **The test most commonly used is an enzyme-linked immunosorbent assay (ELISA) for viral antigen in respiratory secretions such as nasal or throat washings, nasal or throat swabs, or sputum.**
- **Detection of viral neuraminidase**
- **Polymerase chain reaction (PCR) is also used**

- The incubation period is 1–4 days, mostly 1–2 days.

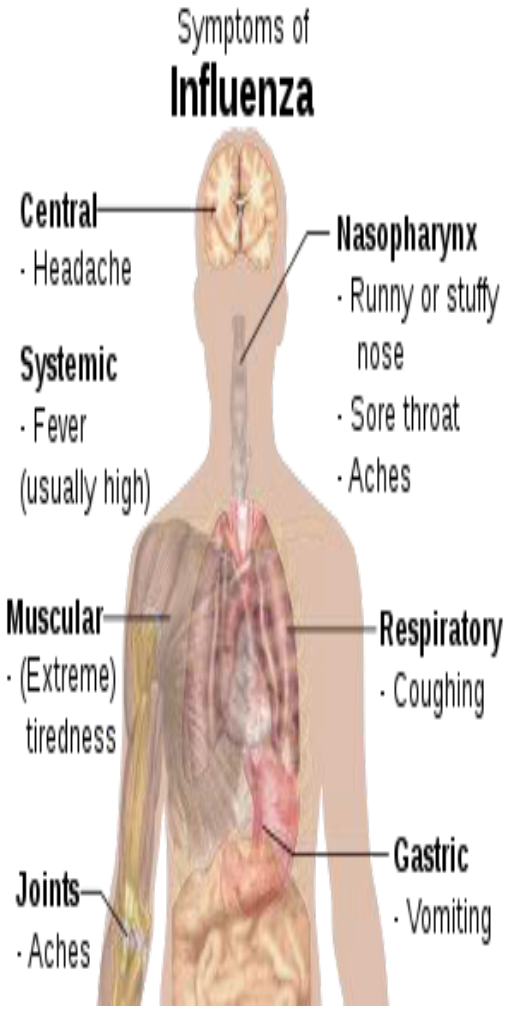
- Many infections are asymptomatic

- The onset of symptoms is sudden, and initial symptoms are predominately non-specific, including fever, chills, headaches, muscle pain or aching, a feeling of discomfort, loss of appetite, lack of energy/fatigue, and confusion.

- These symptoms are usually accompanied by respiratory symptoms such as a dry cough, sore or dry throat, hoarse voice, and a stuffy or runny nose.

- Coughing is the most common symptom, and also include nausea, vomiting, diarrhea, and gastroenteritis, especially in children.

- The standard influenza symptoms typically last for 2–8 days.



Pathogenesis & Immunity

- Influenza virus infection causes inflammation of the mucosa of upper respiratory tract sites such as the nose and pharynx, and lower respiratory tract sites such as the larynx, trachea, and bronchi.

- Pneumonia, which involves the alveoli may also occur and due to the complication of influenza

- The systemic symptoms, such as severe myalgias, are due to cytokines circulating in the blood.

Transmission

- People who are infected can transmit influenza viruses through breathing, talking, coughing, and sneezing, which spread respiratory droplets and aerosols that contain virus particles into the air.
- In healthy adults, the virus is shed for up to 3–5 days.
- In children and the immunocompromised, the virus may be transmissible for several weeks.
- Children ages 2–17 are considered to be the most efficient spreaders of influenza.
- Children who have not prior exposures to influenza viruses shed the virus at greater quantities and for a longer duration than other children
- A variety of factors encourage influenza transmission, including
  - lower temperature

- lower humidity,
- less ultraviolet radiation from the Sun, and crowding.

- Influenza viruses that infect the upper respiratory tract like H1N1 is mild but more transmissible.
- whereas those that infect the lower respiratory tract like H5N1 tend to cause more severe illness but are less contagious.

Measles

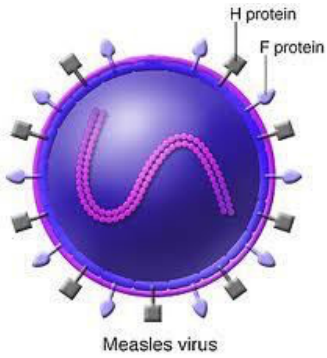
is an infection of the respiratory system caused by enveloped, single-stranded, RNA viruses, specifically a paramyxovirus

Symptoms include fever, cough, runny nose, red eyes and a generalized, maculopapular, erythematous rash

Measles is spread through respiration (contact with fluids from an infected person's nose and mouth, either directly or through aerosol transmission),

Transmission

- respiratory droplets produced by coughing and sneezing both during the prodromal period and for a few days after the rash appears.
- Measles occurs worldwide, usually in outbreaks every 2 to 3 years, when the number of susceptible children reaches a high level.
- The WHO estimates there are 30 million cases of measles each year worldwide.



Pathogenesis & Immunity

- After infecting the cells lining the upper respiratory tract, the virus enters the blood and infects reticuloendothelial cells, then spreads via the blood to the skin.
- The rash is caused primarily by cytotoxic T cells attacking the measles virus–infected vascular endothelial cells in the skin.
- Shortly after the rash appears, the virus can no longer be recovered and the patient can no longer spread the virus to others.
- Lifelong immunity occurs in individuals who have had the disease.
- The importance of cell mediated immunity are protected by immunization.
- Maternal antibody passes the placenta, and infants are protected during the first 6 months of life.

Laboratory Diagnosis

- **Most diagnoses are made on clinical grounds, but the virus can be isolated in cell culture.**
- **antibody titer can be used to diagnose difficult cases.**
- **PCR assay is also used.**

Treatment

- **There is no antiviral therapy available**
- **Vaccination rates have been high enough to make measles relatively uncommon**