VIRAL PATHOGENESIS

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Medical Virology-Theory and MA 403

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Outline

- Host cell infection
- Viral pathogenicity

Objectives

- Learn about pathogenic viruses
- Get knowledge about viral pathogenicity
- Get more information about host cell receptor recognition, attachment and viral entry
- Learn about factors influence the viral pathogenesis
- Importance of understanding viral pathogenesis

Pathogenic viruses

Pathogenic viruses are viruses that have the capability to cause disease in their host organisms.

- These viruses are equipped **with specific molecular** and **genetic features** that enable them to

1. Infect host cells
2. Evade the host's immune response, and
3. Potentially induce tissue damage, resulting in various clinical symptoms and health problems.

Pathogenic viruses

- **Clinical Symptoms:** Infection with pathogenic viruses often leads to the development of clinical symptoms, such as fever, cough, fatigue, and other signs of illness. These symptoms can vary widely depending on the

1. **Specific virus** and
2. **Host's response**.

- Pathogenic viruses can range in their degree of virulence, from **mild infections** to **severe**, **life-threatening diseases.**

Viral pathogenicity

- **Viral pathogenesis** refers to the process by which viruses cause **disease within a host organism**
- **Viral pathogenesis** is the process of disease production following **infection**.
- **Viral Disease**: the **proliferation** of a harmful virus inside the host body that causes disease.

Three problems must be solved by viruses to make disease

1. Viral reproduction
2. Spread
3. Evasion of the immune response.

Steps in viral pathogenesis

1. Transmission of the virus from an external source.
2. Attachment of virus to host cell.
3. Entry into the host.
4. Replication of virus in the target cell and damage to it.
5. Spread of the virus to other cells
6. Host tissue damage and clinical symptoms
7. Evasion of the immune response.

Sources of viral infection

1. **Human:** is a common source of infection (patients or carriers).

- A carrier is a person who recovered from the disease but harbored the virus in his body.
- The infectious agent is transmitted from person to person in various ways such as direct contact, kissing, inhalation of aerosols and faecal-oral.

2. Animals: The virus can be transmitted from infected animals to humans when direct contact with animals.

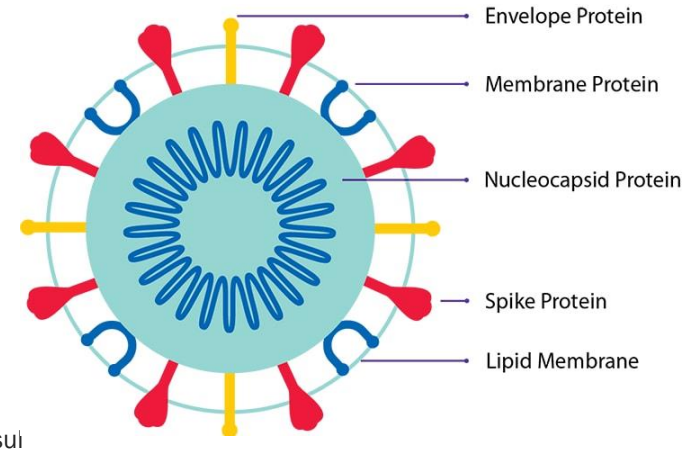
3. Food: foods are the most important media for transporting viruses to humans during consumption of **contaminated food**, and therefore act as food-borne infection.

4. Water: many viruses may be found in water. The infectious agents are transmitted to humans by consumption of water or when swimming in it, therefore acting as water-borne infections.

Host cell receptor recognition and attachment

Host cell receptor recognition and attachment is a crucial step in the process of infection. Viruses have evolved to interact with specific receptors on the surface of host cells, allowing them to attach and gain entry into the cell.

Viral attachment proteins: Many viruses have specialized proteins on their surfaces known as **viral attachment proteins or viral glycoproteins**. These proteins play a key role in host cell receptor recognition and attachment. They often project from the viral envelope or capsid.

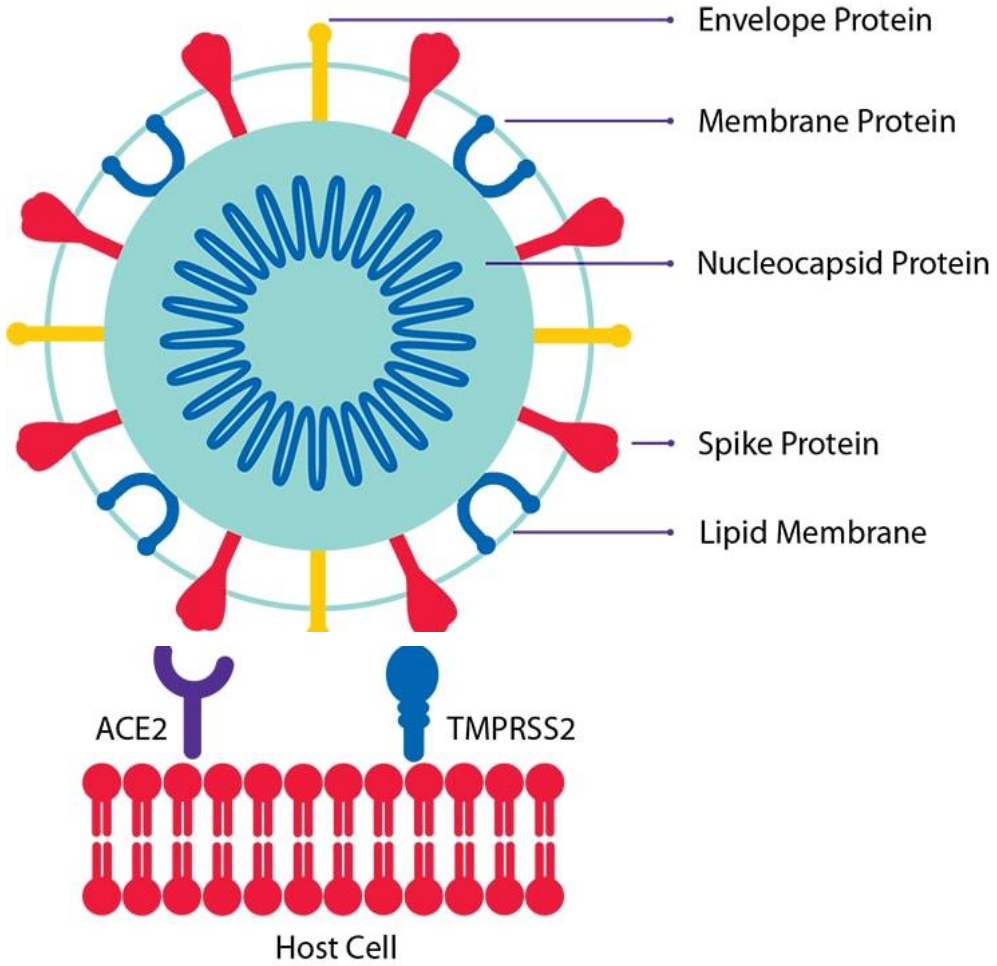


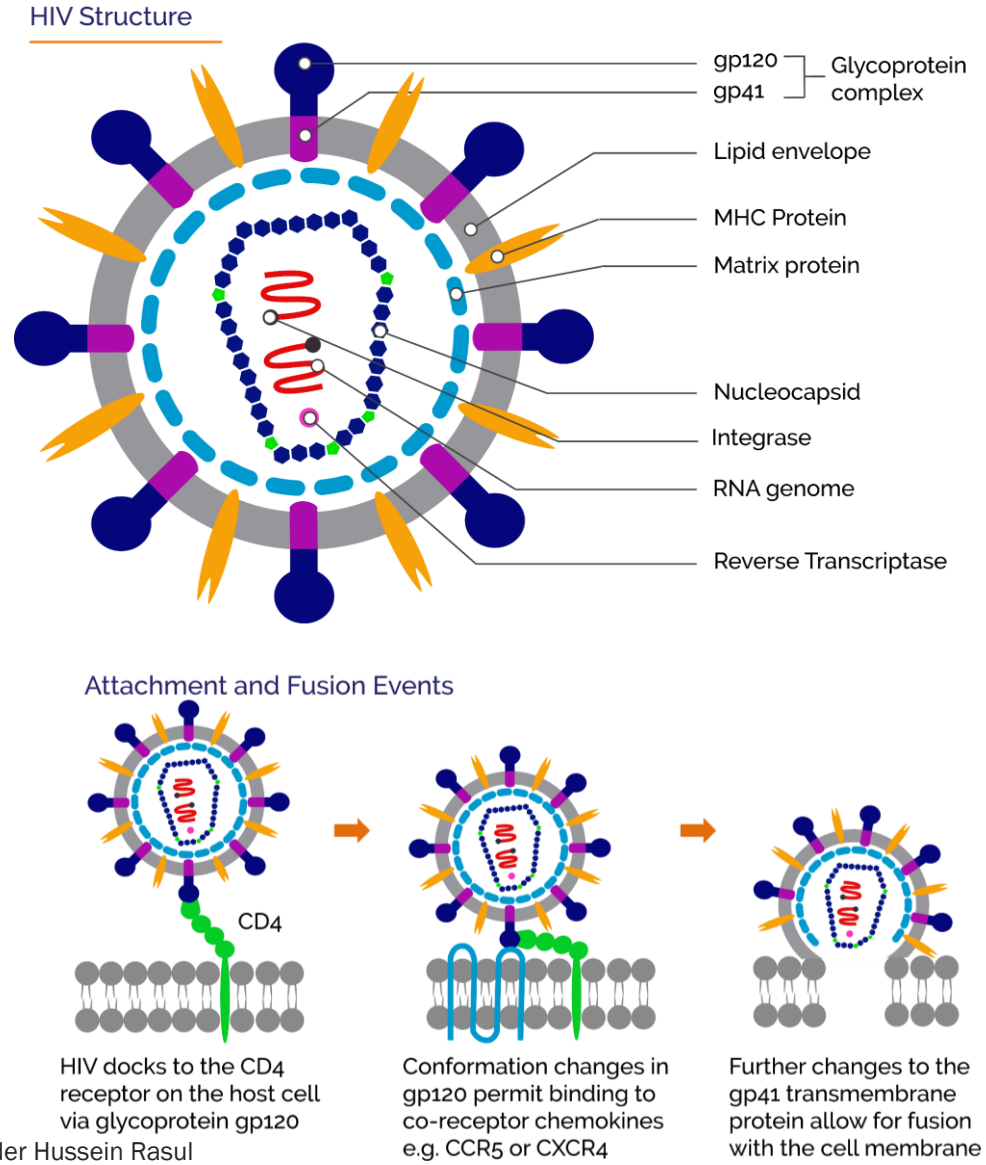
Host cell receptor recognition and attachment

Some viral attachment proteins

1. **Hemagglutinin (HA): Influenza viruses** use hemagglutinin as their viral attachment protein. Hemagglutinin binds to **sialic acid receptors** on the surface of **host respiratory epithelial cells**.
2. **Spike protein:** SARS-CoV-2 viruses employ spike proteins to attach to and enter host cells. Spike proteins bind to **ACE2 receptors** on the host cell surface.
3. **CD4 binding site (gp120):** HIV has a glycoprotein complex composed of **gp120 and gp41.** Gp120 specifically interacts with the **CD4 receptor on T cells**, allowing the virus to enter these immune cells.
4. **Glycoprotein B:** Herpesviruses, like herpes simplex virus (HSV) and cytomegalovirus (CMV), use glycoprotein B as their viral attachment protein. Glycoprotein B can bind to **nectin.**

Host cell receptor recognition and attachment





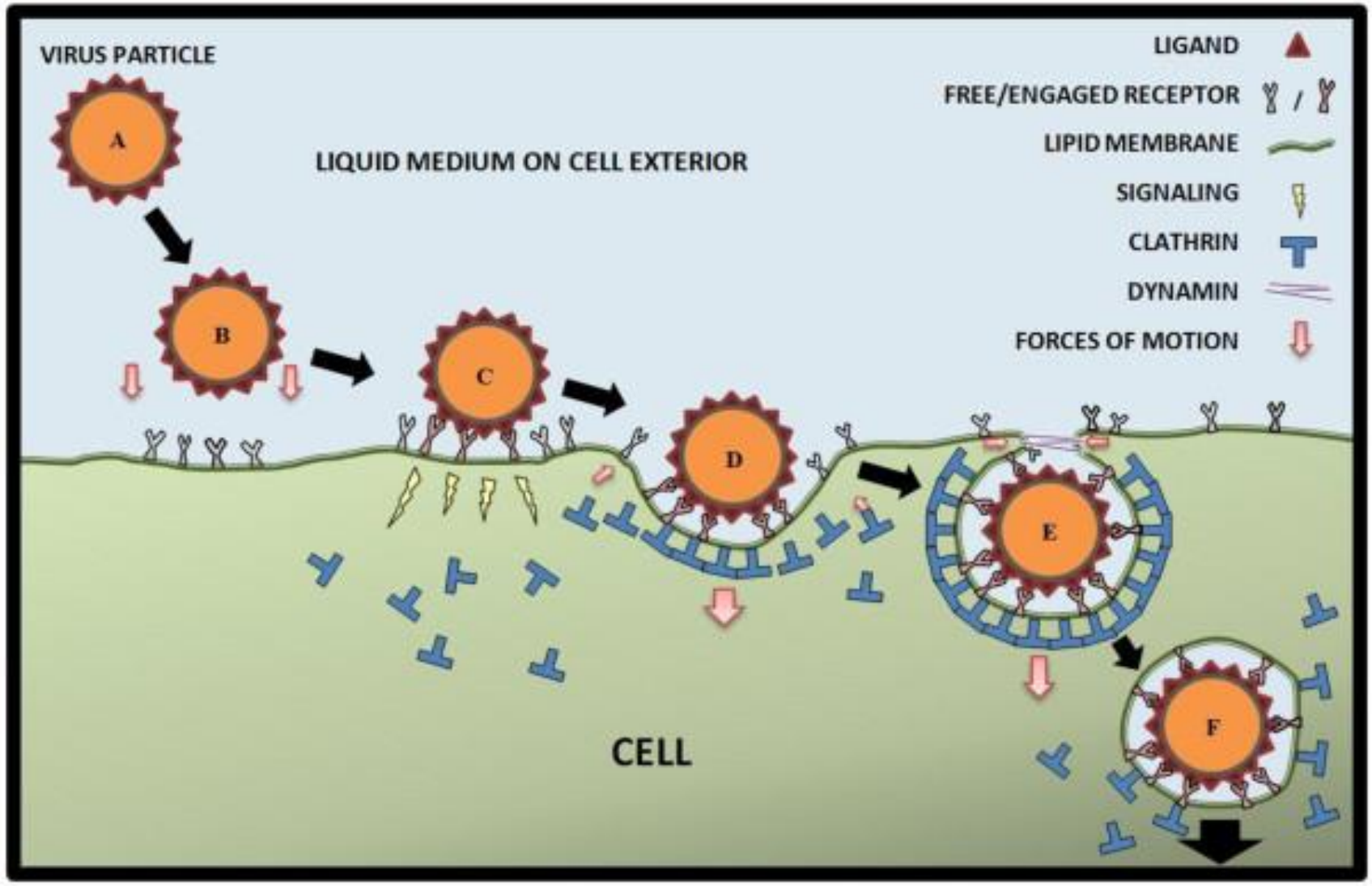
Viral entry

Different viruses use various mechanisms to enter host cells, and the specific method often depends **on the virus type** and **the host cell type**.

Here are some common mechanisms of viral entry into host cells

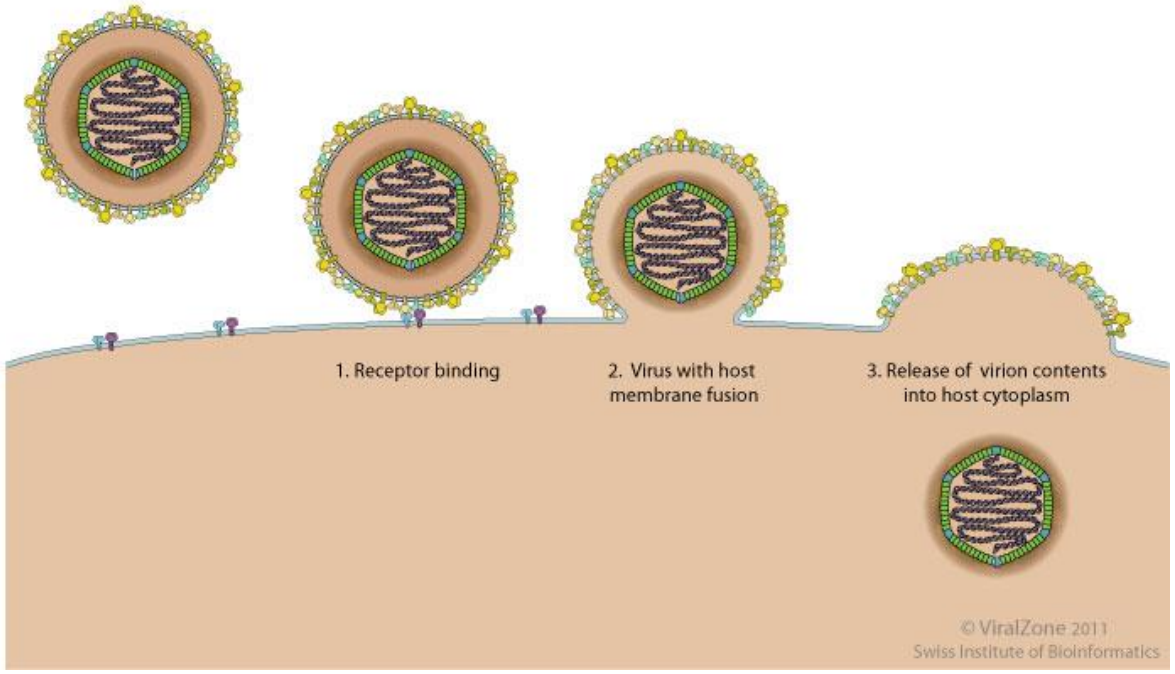
1. **Receptor-mediated endocytosis:** Many viruses, including **influenza**, and some **adenoviruses**, enter host cells by **receptor-mediated endocytosis**. In this process, the virus attaches to specific cell surface receptors, which triggers the formation of a vesicle (endosome) that engulfs the virus particle. The virus can then escape from the endosome and release its genetic material into the host cell's cytoplasm.

Vial entry-Receptor-mediated endocytosis



Vial entry-Fusion with host cell membrane

2. **Fusion with host cell membrane:** Enveloped viruses, such as **HIV**, **herpesviruses**, and **SARS-CoV2**, have a lipid envelope derived from the host cell membrane. These viruses can directly fuse their envelope with the host cell membrane, allowing the viral core or genome to enter the host cell's cytoplasm. Fusion typically requires specific viral and host cell surface proteins to interact.



Factors influence the viral pathogenesis

Viral pathogenesis process is influenced by various factors, including

1. The characteristics of the virus
2. The host's immune response, and
3. The specific target cells or tissues that the virus infects.

Importance of understanding viral pathogenesis

Understanding viral pathogenesis is crucial for

1. Diagnosing viral diseases.
2. Treating viral diseases.
3. Preventing viral diseases.

References (in APA style)

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- Barrow, E., et al. (2013). "Multiscale perspectives of virus entry via endocytosis." Virol J **10**: 177.
- D. E. White, Frank J. Fenner - Medical Virology-Academic Press (1994)