

HIV/AIDS

Microbiology lecture 7

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Etiology

Pathogen (human immunodeficiency virus)

Family: Retroviridae

Genus: Lentivirus

Species: HIV-1: most common species worldwide

HIV-2: restricted almost completely to West Africa

Structure: icosahedral with a conical capsid and a spiked envelope.

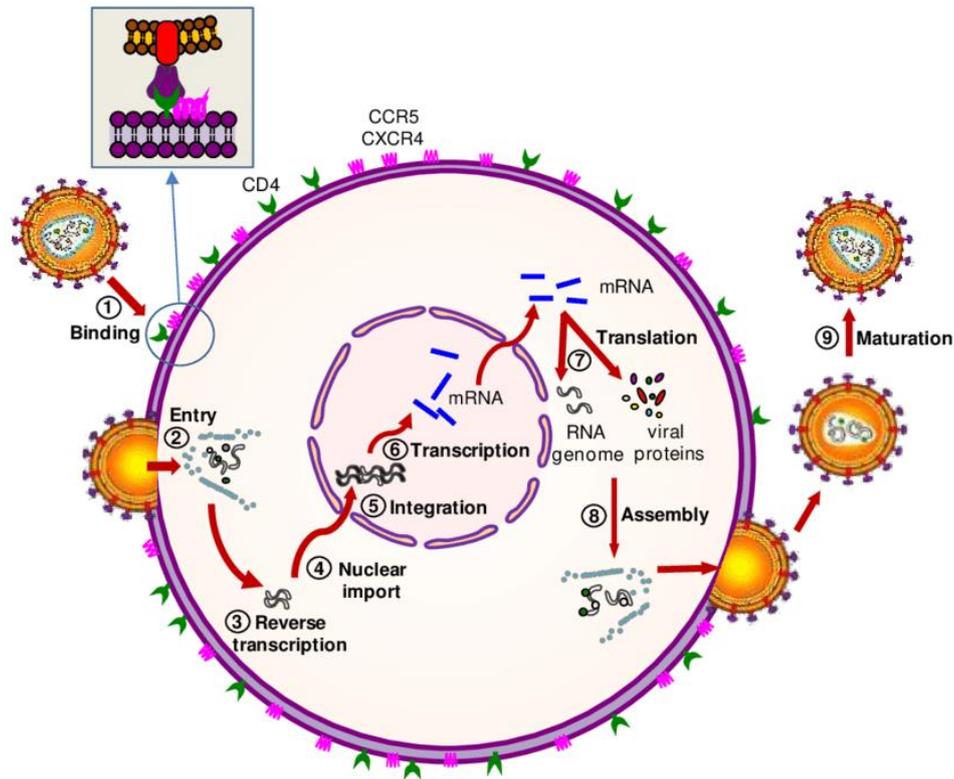
Genome: it carries single-stranded RNA as its genetic material rather than the double-stranded DNA human cells carry.

Routes of transmission

- Sexual: responsible for ~ 80% of infections worldwide.
- Parenteral transmission: Needle sharing, Needlestick injuries, Infectious blood on mucous membranes, and Blood transfusions.
- Vertical transmission: from mother to child during childbirth or through breastfeeding after birth.

Initial infection and HIV replication cycle

1. HIV enters the body (e.g., via mucosal lesions), then attaches to the CD4 receptor on host cells (binding)
Cells that have CD4 receptors: T lymphocytes (e.g., T helper cells), macrophages, monocytes, dendritic cells.
2. Viral envelope fuses with host cell, capsid enters the cell.
3. A virion's RNA is transcribed into dsDNA by viral reverse transcriptase and then integrated into the host's DNA by viral integrase.
4. Viral DNA is replicated, and virions are assembled.
5. Virion repurposes a portion of the cell's membrane as an envelope and leaves the cell (budding) → cell death.



Progression to chronic immunodeficiency

- HIV infects CD4+ lymphocytes, then reproduces and spreads to other CD4+ lymphocytes near the original site of infection → infection of CD4+ lymphocytes concentrated in specialized lymphoid tissue → explosive growth and dissemination → acute HIV syndrome with high viral load.
- After the acute stage, viral load decreases, and remains at roughly that level for approximately 8–10 years (clinical latency stage).
- Increasing loss of CD4+ lymphocytes impair immune function and, thereby, facilitates opportunistic infections and development of malignancies (AIDS). These secondary diseases are usually the cause of death in individuals with HIV.
- Increased viral load generally leads to a decreased number of CD4+ lymphocytes and vice versa, but the relation is not linear.

Clinical features

General considerations: There are no clinical features specific to HIV infection.

In early HIV infection, patients are often asymptomatic.

Acute HIV infection: Also referred to as acute retroviral syndrome (ARS). Patient presented with:

- Fever, Fatigue, headache
- Myalgia and arthralgia

- Generalized nontender lymphadenopathy, Generalized rash
- Gastrointestinal symptoms (nausea, diarrhea, weight loss)
- Oropharyngeal symptoms (sore throat, ulcerations, painful swallowing)

AIDS-defining conditions

AIDS (also known as advanced HIV) is defined as the development of an AIDS-defining condition or a CD4 count of < 200 cells/ μ L in HIV-infected patients.

AIDS-defining conditions are a set of potentially life-threatening conditions that indicate the progression of HIV infection to AIDS. As the CD4 count declines, the immune system is weakened and many pathological processes may occur, such as:

- Development of malignancies e.g., non-Hodgkin lymphomas, and invasive cervical cancer
- Rapid spread of opportunistic and non-opportunistic bacterial and fungal infections (e.g., coccidioidomycosis, pneumocystis pneumonia, mycobacterial infections)
- Reactivation of latent infections (e.g., tuberculosis, herpes simplex infections, shingles).

Diagnostics

Serological assays

Serological assays are commonly used for both screening and diagnosis and may detect HIV antigen, antibodies, or both.

HIV antigen alone: detects HIV p24 antigen

HIV antibody assays: Detect IgM and IgG antibodies using enzyme-linked immunosorbent assays (ELISA).

Virological testing:

Virological tests are most commonly used for screening infants and confirmation of disease in both infants and adults. Can detect HIV-1 RNA and/or DNA through nucleic acid testing (NAT).

Can measure the amount of viral RNA in the blood and detect HIV infection earlier than antibody/antigen-based tests.

Management

- All individuals with HIV infection, regardless of CD4 count, should begin antiretroviral therapy (ART) as soon as possible.
- The antiretroviral drugs such as abacavir target the viral reverse transcriptase enzyme, preventing the conversion of viral RNA to cDNA.
- Antiretroviral drugs are combined to prevent resistance.
- Establish regular monitoring to assess treatment response.

- If CD4 count is < 200 , start prophylaxis for opportunistic infections.
- Treat AIDS-defining condition if present.
- Immunizations: in addition to routine vaccinations, the following vaccines should be prioritized in this population: Hepatitis A&B, Human papilloma virus vaccine
- Influenza vaccine (annually), Meningococcal and Pneumococcal vaccine, Herpes zoster, and COVID vaccine.

Prognosis

Untreated, HIV leads to death on average 8–10 years after infection.

Progression varies among individuals: Some patients may die within a few years while others can remain asymptomatic for decades.

The average life expectancy of HIV-infected individuals who receive adequate antiretroviral treatment is approaching that of noninfected individuals of the same age.