AIDS (ACQUIRED IMMUNO DEFICIENCY SYNDROME)

AIDS, which stands for acquired immunodeficiency syndrome, represents a deficiency in the immune system acquired during an individual's lifetime, indicating that it is not a congenital disease.

The virus has been identified under various names:

HCLV-III: Abbreviation for Human Cell Leukemia Virus-III

HTLV-III: Acronym for Human T-Lymphotropic Virus-III

LAV: Short for Lymphadenopathy Associated Virus

HIV-I: Predominant in India, with a size ranging from 90 to 120 nanometers, and found extensively across the globe.

HIV-II: Prevalent in West Africa, with a size range of 90 to 120 nanometers.

Note: AIDS was initially reported in the United States among homosexual populations in 1981. Over the last few decades, it has spread worldwide, claiming the lives of over 25 million people. In India, AIDS infections were first detected in 1986.

Pathogen

AIDS is caused by the Human Immunodeficiency Virus (HIV), a name assigned in 1986 by the International Committee on Viral Nomenclature. HIV belongs to the retrovirus group, characterized by an envelope comprising a lipid bilayer derived from the host cell membrane, adorned with knob-like glycoprotein spikes featuring pedicels formed from virus-coded glycoproteins. This envelope encapsulates the RNA genome, which consists of single-stranded RNA with two identical filaments, coupled with a reverse transcriptase enzyme. HIV comprises a core RNA containing Reverse Transcriptase, surrounded by a protein coat primarily composed of a protein known as P24. Surrounding this protein coat is a layer composed of another protein named P17.

The outermost envelope comprises a phospholipid bilayer embedded with glycoproteins (GP120 and GP41). Being a retrovirus, HIV can synthesize DNA from RNA using the enzyme reverse transcriptase. Once HIV transcribes DNA from its RNA, the DNA becomes integrated into the host cell's DNA. It can remain dormant without showing signs of its presence, or it may hijack the host cell's genetic machinery to produce more viruses. The primary cell infected by HIV is the Helper T-lymphocyte, bearing the CD4 receptor site. The virus attaches to the CD4 receptor site with the aid of GP120 on the virus's protein coat.

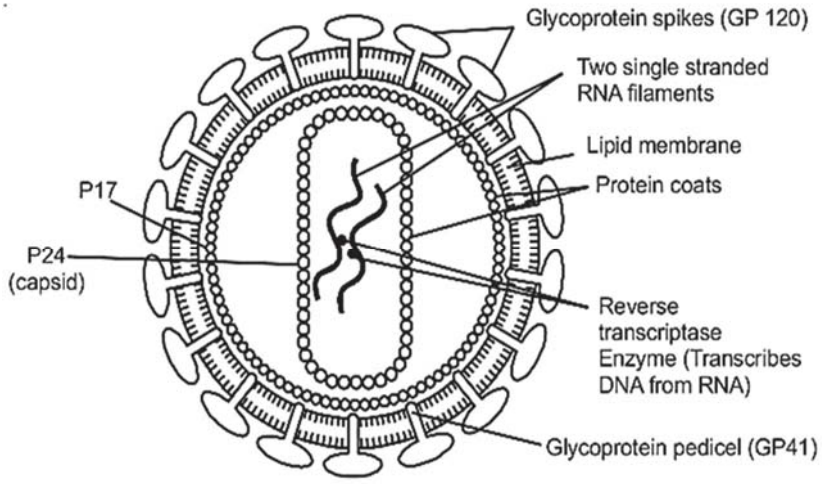


Fig.: Diagrammatic representation of HIV

Transmission Routes

The transmission of HIV infection typically occurs through several modes, including:

(a) Sexual contact with an infected person.
(b) Transfusion of contaminated blood and blood products.
(c) Sharing infected needles, as seen among intravenous drug abusers.
(d) Transmission from an infected mother to her child through the placenta.

Therefore, individuals at a heightened risk of contracting AIDS infection encompass:

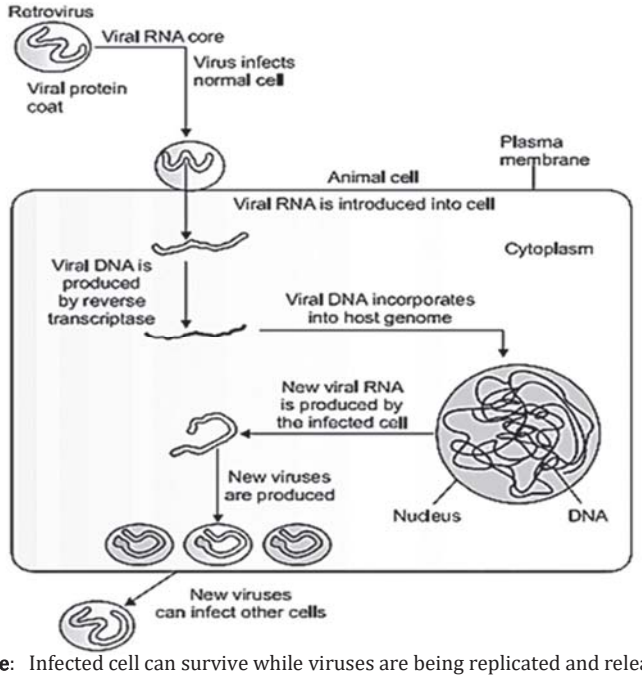
(a) Individuals engaging in sexual activities with multiple partners.
(b) Intravenous drug abusers who inject drugs.
(c) Individuals requiring frequent blood transfusions.
(d) Children born to an HIV-infected mother.

- It is crucial to understand that HIV/AIDS cannot be transmitted through casual touch or physical contact alone; transmission occurs solely through body fluids. Therefore, it is essential for the overall physical and psychological health of the infected individual that they are not socially or emotionally isolated from their family and society.
- There is consistently a period of time between HIV virus infection and the onset of AIDS symptoms. This interval may range from several months to numerous years, typically spanning 5 to 10 years.

Mode of Action of the AIDS-Causing Virus

Upon entry into the body through bodily fluids or blood, the virus infiltrates macrophages, where its RNA genome undergoes replication to produce viral DNA facilitated by the enzyme reverse transcriptase. This viral DNA becomes integrated into the DNA of host cells, instructing them to generate virus particles. Macrophages persistently churn out viruses, effectively acting as an HIV factory.

Concurrently, HIV infiltrates helper T-lymphocytes bearing CD4 receptors, replicating within them and generating new virus progeny that systematically destroy the helper T-cells. These progeny viruses released into the bloodstream further assault other helper T-cells, perpetuating the cycle and causing a progressive decline in their numbers within the infected individual's body. This stage is marked by symptoms such as fever, diarrhea, and weight loss.



Note: Infected cell can survive while viruses are being replicated and released

Fig.: Replication of retrovirus

As the count of helper T-lymphocytes dwindles below 200/mm^3, the individual becomes susceptible to opportunistic infections by bacteria, particularly Mycobacterium, as well as viruses, fungi, and even parasites like Toxoplasma. Immunodeficiency reaches a critical point where the body is unable to defend itself against these infections. Besides Pneumocystis carinii, now known as Pneumocystis jiroveci (causing pneumonia), AIDS patients commonly exhibit persistent diarrhea and are highly vulnerable to Toxoplasma infections, tuberculosis, Candidiasis (manifesting as whitish patches on mucous membranes due to fungal infections), Cytomegalovirus (resulting in blindness and dementia), Herpes simplex, along with various bacterial or fungal infections, and Kaposi's sarcoma.

Diagnosis

The Enzyme-Linked Immunosorbent Assay (ELISA) is widely employed as a diagnostic test for AIDS. Confirmation of ELISA positive cases is done through the Western blotting test.

Treatment

The treatment of AIDS with antiretroviral drugs is only partially effective, as it can only extend the patient's lifespan but cannot prevent death. Zidovudine, also known as AZT (Azidothymidine), was the first drug used and continues to be the preferred treatment for AIDS.

Prevention of AIDS

Since AIDS has no cure, prevention remains the most effective approach. No vaccine has been developed against the AIDS virus thus far. The World Health Organization (WHO) has initiated numerous programs to prevent the spread of HIV infections.

The following measures may aid in preventing AIDS:

(i) Ensuring proper blood testing to maintain blood safety from HIV.
(ii) Mandating the use of disposable needles and syringes in public/private hospitals and clinics.
(iii) Promoting the free distribution of condoms and advocating for safe sex practices.
(iv) Implementing measures to control drug abuse.
(v) Encouraging regular HIV check-ups for susceptible populations.
(vi) Conducting educational campaigns to raise awareness about AIDS.

World AIDS Day is observed every year on December 1^{st}. The National AIDS Control Organization (NACO) along with Non-Governmental Organizations (NGOs) are actively involved in educating the public about AIDS. Addressing AIDS requires collaborative efforts between society and the medical community to prevent its spread and explore new treatment modalities.