AIDS

ABSTRACT

Acquired Immunodeficiency Syndrome (AIDS) is a life-threatening condition caused by the *Human Immunodeficiency Virus* (HIV), which weakens the immune system and makes individuals vulnerable to infections and diseases. Despite advancements in treatment and prevention, AIDS remains a global public health challenge, especially in low-income regions. Millions of people are affected and die from it. Global cooperation, scientific advancements, and increased accessibility to healthcare services for every individual are essential to ending the HIV/AIDS epidemic. This chapter explores the structure of the causative agent (HIV), pathophysiology, symptoms, and prevention and control of AIDS.

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I. INTRODUCTION

AIDS (Acquired Immuno Deficiency Syndrome) is principally an acquired sexually transmitted disease (STD) of humans. It is caused by a virus called HIV (Human Immunodeficiency Virus). The virus weakens the immune system of the body, which results in its inability to fight infections. In India, more than one million new cases of AIDS are registered per year. If AIDS is caused, it has no treatment its prevention is only its treatment. No vaccine to prevent AIDS has been developed so far. AIDS is a chronic disease. It lasts for years or even a lifetime. Persons having HIV are called HIV positive. HIV-positive people may look healthy for up to 5 to 10 years but can transmit HIV to healthy people through sexual contact and infected blood. Symptoms of AIDS in an HIV-positive person may appear after 5 to 10 years after entry of the HIV into the body. The time taken in appearing the symptoms of a disease after entering its causal organism in the body is called the incubation period of that disease. Different diseases have different incubation periods. The incubation period of AIDS is 5 to 10 years. It means if HIV enters the body, the symptoms of AIDS may appear after 5 to 10 years of its entry. AIDS is mainly a sexually transmitted disease.

Causal Organism

AIDS is caused by the Human Immunodeficiency Virus (HIV), which belongs to the *Retroviridae* family in the *Lentivirus* genus containing a single-stranded RNA genome that relies on reverse transcription for replication. HIV was first identified in 1983. HIV primarily targets the body's immune system, specifically the CD4+ T cells. There are two main types of HIV:

HIV-1 : is the most widespread globally.

HIV-2: Less common, primarily found in West Africa.

HIV is part of the *Retroviridae* family in the *Lentivirus* genus.

II. STRUCTURE OF HIV

HIV contains a single-stranded RNA genome that replicates via reverse transcription. The structure of HIV consists of several key components:

Envelope: An outer lipid bilayer, derived from the host cell membrane, containing embedded glycoproteins that are essential for viral entry into cells, including gp120 and gp41.

p24: A protein shell composed of p24 that encases the viral RNA and enzymes, protecting the genetic material during transmission and infection.

RNA Genome: The viral genetic material, two identical single-stranded RNA molecules encode structural and enzymatic proteins, important to the virus replication process.

Enzymes

Reverse Transcriptase: Converts genomic RNA into DNA after the virus enters a host cell.

Integrase: Integrates the newly synthesized viral DNA into the host's genome.

Protease: Cleaves viral polyproteins into functional units necessary for the creation of new viral particles.

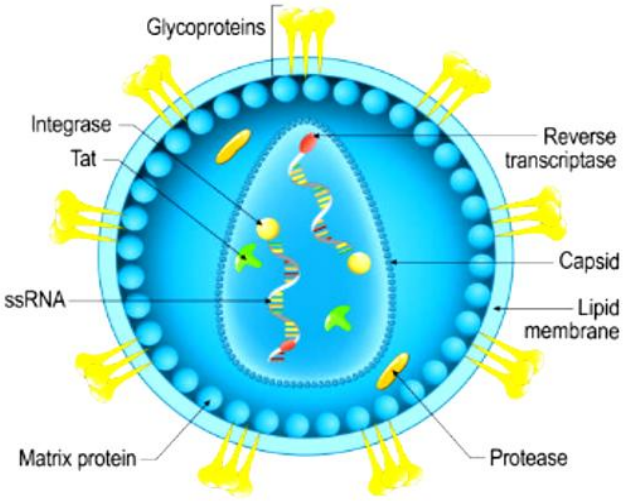

Figure 26: Structure of HIV

Incubation Period: Symptoms of AIDS develop after 5 – 10 years after the HIV virus enters the body.

Mode of Infection

The HIV virus gets transmitted from person to person through the following:

1. Seminal or preseminal fluid.
2. Vaginal fluids.

3. Rectal fluids.
4. Blood.
5. Infected drug needles.
6. Syringe.
7. Blood contact by deep kissing.
8. Breastfeeding.
9. Tatooing
10. Blood contact by any mean.

The HIV is transmitted if the above fluids come in contact with:

1. The mucous membrane presents inside the buccal cavity.
2. Damaged tissues that have been cut or scrapped.
3. Blood stream.

In United States HIV virus mainly spreads through vaginal and anal sex without using condom with the HIV infected person. Secondly it also spreads through needle sharing or other equipments used to inject drug with someone who has HIV.

Less Often HIV Spreads

1. From mother to her new-born: An HIV positive pregnant woman can transmit the virus to her fetus through her shared blood circulation or an HIV positive nursing woman can pass this virus to her new-born by breast feeding.
2. Through needle sticks or sharp objects contaminated with HIV.

HIV does not spreadby

1. Hugging.
2. Shaking hands.
3. Using used towel.
4. Mosquito bites.
5. Taking bath with HIV infected persons in swimming pool.
6. Participating in games and sports with HIV infected persons.
7. Touching items touched by the HIV infected person.
8. Eating food prepared by the HIV infected person.

Pathophysiology of HIV

When the HIV (Human Immunodeficiency Virus) enters the body, it primarily attacks and weakens the immune system by targeting CD4+ T cells, a type of white blood cell essential for fighting infections. As HIV continues to damage these immune cells, the individual becomes increasingly vulnerable to opportunistic infections and certain types of cancer. This condition, which results from severe immune system damage, is known as AIDS. In detailed pathophysiology of HIV involves several key stages, including viral entry in host immune cells, replication, immune system evasion, inflammation & progressive immunodeficiency.

1. **Viral entry into Host Cells**
   - HIV gp120 binds to CD4 receptor on T cells, macrophages, dendritic cells
   - gp41 mediates fusion → Viral RNA enters cytoplasm
     [Gp41 is viral envelope protein that interfere T cell receptor signailing to reduce T cell activation.]
   - The viral capsid enters the cytoplasm, releasing its RNA genome and enzymes.

2. **Viral Replication**
   - Reverse transcriptase converts RNA → DNA (Transcription)
   - Integrase inserts viral DNA into host genome
   - Host cell machinery form viral proteins
   - New virus particle formation that invades more CD4+T cells

3. **Immune Invasion and Inflammation**
   - Latent reservoir of HIV in CD4+ T cells avoids immune recognition.
   - Viral gp120 is heavily glycosylated avoids immune detection.
   - Chronic immune activation leads to persistent inflammation.
   - CD4+ T-cell Depletion

4. **Progression to AIDS**
   - High viremia, flu-like symptoms
   - Severe immune deficiency leads opportunistic infections

Symptoms

The symptoms of HIV and AIDS can vary depending on the individual and the stage of the infection. These symptoms may change as the disease progresses through different phases.

1. **Primary Infection (Acute HIV):** During primary infection some people with HIV virus have flue-like symptoms within 2 to 4 weeks after entering of the virus in the body. This stage may last for a few days to several weeks. Some people do not show any symptoms during this stage. Other possible symptoms seen during primary infection or Acute HIV are:

   - Fever.
   - Headache.
   - Sore throat and painful mouth sores.
   - Muscle aches and joint pains.
   - Rash.
   - Swollen lymph glands (Nodes) mainly on neck.
   - Diarrhoea.
   - Weight loss.
   - Cough.
   - Night sweats.

   These symptoms may be so mild that you might not notice them. However, the amount of HIV virus in your blood stream (called viral load) is at high at this time. As a result, the virus is transmitted to others more easily during primary infection than during the next stage.

2. **Clinical Latent Infection (Chronic HIV):** At this stage HIV virus remains still in the body and White Blood Cells (Immune system), but during this stage many people do not show the symptoms that HIV can cause. Chronic HIV can last for many years in the HIV infected people who are not getting Anti Retroviral Therapy (ART). Some people get more severely affected much sooner.

3. **Symptomatic HIV:** As the HIV virus continues to multiply and destroy White Blood Cells, the infected person may have mild infections or long-term symptoms such as:
   - Fever and Fatigue.
   - Swollen lymph glands which are seen as one of the first symptoms of HIV infection.

- Diarrhoea.
- Weight loss.
- Oral yeast infection (Also called thrush).
- Pneumonia.
- Shingles (HerperZootes).

Treatment: No treatment exists for AIDS, but strict adherence to anti retroviral treatments can slow the progression of disease. Anti retroviral treatments (ART) have greatly reduced the deaths from AIDS worldwide. Most of the people having HIV in United States today do not get AIDS. If HIV is untreated it turns in AIDS in about 5 to 10 years. One having AIDS means his/her immune system has been badly damaged and such people are more likely to develop various diseases.

Prevention: Vaccines for HIV are under trial, but no effective vaccine has been developed till date. However, prevention from AIDS can be done by:

- Using condom every time during vaginal or anal sex with unknown partners.
- Avoiding oral sex.
- Avoiding sex with one whom you do not know, if sex is to be done with one whom you do not know use condom every time during sex.
- Using tested and HIV free blood for blood donation.
- Avoiding blood contact by any mean.
- Avoiding use of drugs and sharing used needles.
- Avoiding deep kissing.

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