Collage of Dentistry **Date:17/4/2024**

Medical Microbiology for Third Stage Undergraduate Students

Virology Lec. Human Immunodeficiency Virus (HIV)

HIV from retrovirus family, HIV types derived from primate lentiviruses, are etiologic agent of acquired immune deficiency syndrome (AIDS). There are two types: HIV-1 is the most prevalent; HIV-2 is a variant that originated in West Africa and has spread to Central Africa, Europe and South America. Type 1 was isolated by the end of 1983. Since then AIDS has become a world wide epidemic. Type 2 HIV, except for its antigenic and nucleic acid profile, has similar biological properties to HIV-1. HIV-1 comprises three distinct virus groups (M,N, and O); the predominant M group contain at least 10 subtypes (A-J).

Properties, Structure and composition

The virus has a diameter of 100 nm.

The structure of HIV is shown in Fig. 1. It consists of

1-An envelope containing virus-specific ‘coat’ proteins (such as gp120), which can act as antigens. Glycoprotein gp120 plays an important role in the initial events leading to infection. These coat proteins undergo almost continual structural changes, which hamper the development of effective vaccines.

2- Three core proteins antibodies to this protein is the basis of most serological testing (the HIV test).

3- A genome of RNA comprising two identical molecules of single-stranded RNA, two molecules of an enzyme, reverse transcriptase (an RNA-dependent DNA polymerase), essential for transcribing the RNA code of the virus to a DNA code during viral multiplication (so that it may integrate into the host cell DNA).

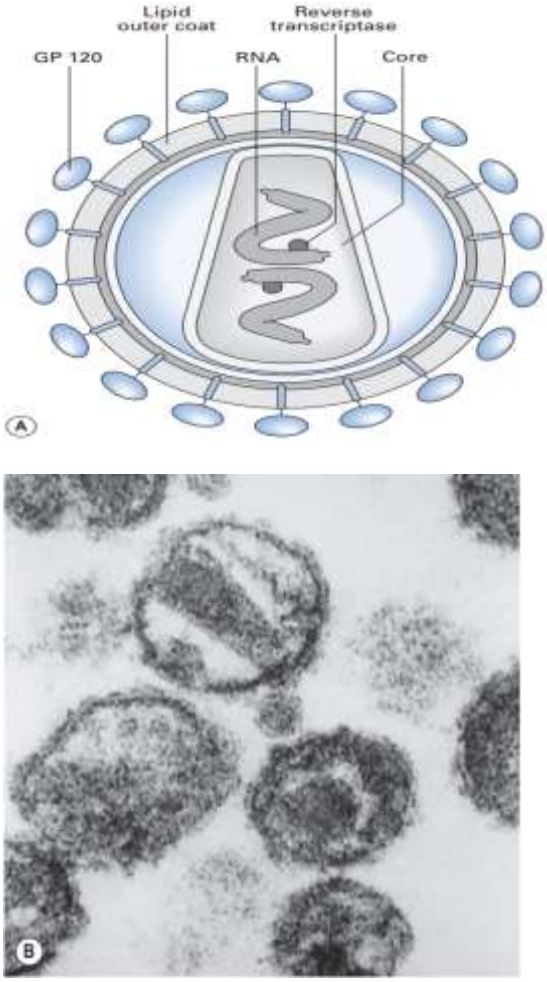

Fig. 1 Human immunodeficiency virus. (A) Structure; (B) scanning electron micrograph of virions showing the pyramid-shaped central core.

Stability of HIV

The survival of HIV under varying conditions has been investigated. HIV is destroyed by heat (autoclave and hot-air oven); the temperature over 60°C. The virus may survive up to 15 days at room temperature and at body temperature (37°C).

HIV is totally inactivated (>10^5 units of infectivity) by exposure for 10 min at room temperature to the following disinfectants: 2% glutaraldehyde, sodium hypochlorite (10000 ppm available chlorine, equivalent to 1:10 dilution of domestic bleach)50% ethanol, 35% isopropanol or 0.3% hydrogen peroxide.

When HIV is present in clotted blood in a syringe or other material, exposure to undiluted bleach for at least 30 s is necessary for its inactivation.

Viral replication

Key stage of viral replication cycle include:

1-HIV release content in to target cell after adsorption of HIV particles.

2- Reverse transcriptase copies viral RNA into DNA

3- Viral DNA is transported across the nucleus and inserted in to cellular DNA

4- Many copies of viral RNA and proteins are made

5- New viral particles assemble and bud from cell, potentially killing it.

Retroviruses are different from other RNA viruses, since they replicate and produce viral RNA from a DNA copy of the virion RNA through the action of reverse transcriptase. The CD4 molecule, present on T helper lymphocytes, monocytes, macrophage, dendritic cells and microglia, acts as a high-affinity binding site for the HIV-1 envelope glycoprotein gp120.

HIV and AIDS Transmission

The main routes of transmission are summarized in the following table:

HIV TRANSMISSION	
Inoculation of blood	Transfusion of blood and blood products Needle sharing by intravenous drug users Needlestick accidents and open wound or mucous membrane exposure in health care workers
Sexual transmission	Male homosexuals Heterosexual contact
Perinatal transmission	Intrauterine Peripartum Breast milk

Pathogenesis

The main determinant in both the pathogenesis and the disease caused by HIV is the tropism of this virus for CD4 expressing cells, namely the helper and delayed-type hypersensitivity T cells, together with macrophages and some brain cells.

The interactions between HIV and the immune system are now known to be significantly more dynamic than was first thought. Recent evidence indicates that HIV replicates prodigiously and destroys many cells of the immune system every day. However, this growth is countered, usually for several years, by a vigorous host defense response that prevents the virus from multiplying out of control. Destruction of CD4 T cells is achieved, resulting in the severe immunodeficiency characteristic of AIDS. Opportunistic infections occur when CD4 cell counts have dropped to less than 200 cells/μL.

Acquired immune deficiency syndrome

AIDS is an insidious disease, characterized by Lymphadenopathy and fever, opportunistic infections (fungal (candidosis), viral and mycobacterial), malignancies (especially Kaposi's sarcoma and lymphomas that may be virally induced) and autoimmune disorders, AIDS related dementia, (Fig. 2).

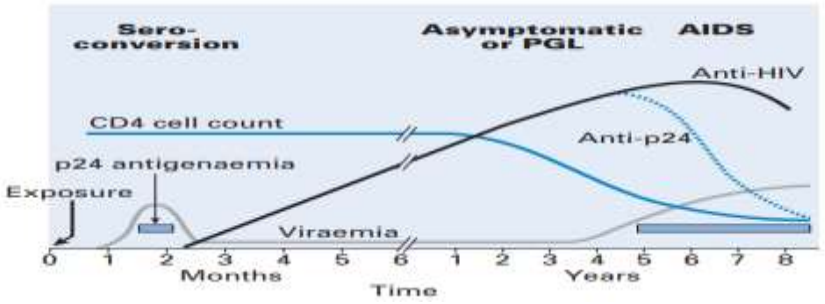

Fig. 2 Key events in HIV infection. PGL, persistent generalized Lymphadenopathy

Immunity

HIV infected persons develop both humoral and cellular immunity against HIV antigens, but these responses do not clear the infection.

Laboratory diagnosis of HIV infection

In practice, current laboratory tests depend on antibody detection. Patients must always be given appropriate counseling by a senior clinician or by a professionally trained counselor, before blood is submitted for testing. An enzyme linked immunosorbent assay (ELISA) test is performed for detection of HIV antibody. HIV can be also detected by virus isolation and detection of viral nucleic acid (RT-PCR, DNA PCR) or antigens.

Prevention of HIV infection

The emphasis in controlling this infection must be on risk reduction. Public education programmes have concentrated on the need for changes in sexual behaviour, particularly the use of barrier contraceptives. The problem of spread among the intravenous drug using population has been approached in some areas by the distribution of free sterile needles and syringes.

Treatment

In recent years, a range of anti-retroviral drugs have been developed. These include the nucleoside reverse transcriptase inhibitors (NRTIs), non-nucleoside reverse tran-scriptase inhibitors (NNRTIs), protease inhibitors (Pis) and fusion inhibitors. It has been shown that combinations of these different classes of drugs have a dramatic and positive effect on those with HIV infection, resulting in rapid

falls in plasma HIV load and rises in CD4 cell counts. Such combination treatment is known as highly active anti-retroviral therapy (HAART).

Reference

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