HIV / AIDS

This section of the learning program provides an overview of HIV, a virus that affects the immune system, and the disease, AIDS, that it causes. Since its recognition in 1981, AIDS has become a major epidemic in the U.S. and throughout the world.

Treatments for HIV infection have recently become available that show promise of prolonging the lives of people infected with HIV and slowing, or perhaps preventing, progression to AIDS. Because patients with AIDS have nutritional deficiencies, these new treatments have increased the need for nutritional support of these patients.

After you have read and studied this section you should be able to:

- Name the cells infected by HIV.
- State the levels of CD4+ cells in normal individuals and those with AIDS.
- Explain why HIV is called a *retrovirus*.
- Identify methods by which HIV spreads.
- Identify why the antibody response is ineffective in stopping HIV infection.
- Identify some of the early signs of AIDS.
- List four conditions that can contribute to wasting in HIV-infected patients.
- Explain why food-borne infections and intravenous feeding are particularly serious for HIV-infected patients.
- Name the four vitamins and two minerals that are especially needed in HIV-infected patients.
- Identify when nutritional support for HIV-infected patients should be started.
- State two reasons explaining why dietary fiber is important in patients with HIV infection.
- Identify the most desirable route of nutrition for HIV-infected patients.

HIV INFECTION AND AIDS

The virus that causes **acquired immunodeficiency syndrome** (**AIDS**) is called **human immunodeficiency virus** (**HIV**). HIV, like all other viruses, is not a complete cell. Instead of containing all the enzymes and other systems that cells have to carry out their metabolism, viruses infect cells and use the cells' metabolic machinery. Viruses do not grow; instead, the genetic information contained in the infecting virus becomes inserted in the cells' machinery, causing the cell to make new virus particles. In most virus infections, the cell dies after it has made the new virus particles, releasing the particles that then infect other cells.

HIV infection

Different types of viruses infect cells in different ways. Some infect just about any cell in a host, and some infect hosts of many different species. Others are not only very specific with respect to the host species, but may infect only one or a few types of cells in the host species. HIV is a good example of the latter. Not only does it infect only humans, it mainly infects one type of cell in the immune system. Many of the manifestations of the resulting disease, AIDS, occur as those cells are depleted and their functions in the immune system fail.

The cells that are principally infected by HIV are called CD4+ cells, a major subset of T cells, which are lymphoid cells. These cells are called T helper cells, because they assist other cells in the immune system respond to a threat. Without them, the immune response does not occur properly, and the patient becomes immunosuppressed. HIV also infects certain other nonlymphoid cells, however, such as scavenger cells in the lungs, brain, and skin.

The level of CD4+ cells in the blood is used as an indicator of the stage and severity of HIV infection. Normally, circulating CD4+ cell numbers are 1000 to 1300/µL. Within months of HIV infection, the level may drop to 600 to 800/µL. One to two years before AIDS develops, the level drops again. In AIDS, the level is usually less than 200/µL.

Properties of HIV infection

HIV infection of a cell has some special characteristics that offer possibilities for stopping the ability of the virus to be replicated by an infected cell. HIV contains RNA as its genetic material, and is a member of a group of RNA-containing viruses called

retroviruses. After a retrovirus enters a cell, its RNA is released, like other RNA viruses. But then a unique enzyme it carries, **reverse transcriptase**, makes a copy of the viral RNA in the form of DNA. The DNA is then incorporated into the cell's DNA (this is the reverse direction of the usual flow of genetic information; hence, "reverse transcriptase"). Once in the cell's DNA, the viral DNA is transmitted to each daughter cell when the cell divides. The virus does not need to be formed as a complete virus particle to be passed on to further generations. The viral DNA is referred to as a **provirus**, and it can remain **latent** (sometimes also called dormant) in the cells for many years before being again expressed as RNA in new virus particles.

Reverse transcriptase is not present in normal human cells. The enzyme is a viral function, and is only in cells infected by HIV. Thus, finding an inhibitor of reverse transcriptase offers a means to selectively block a key event in virus infection without harming uninfected cells. Protease is another enzyme important to viral replication. Like reverse transcriptase, this protease is not present in uninfected cells. The enzyme helps shape certain proteins needed for viral replication, and selectively blocking the enzyme might be expected to inhibit viral replication. Several such inhibitors have recently been introduced to the market, and have been found to reduce drastically the virus level in infected individuals. Blood levels of CD4+ cells rise. The nature and progress of the disease changes dramatically. However, these drugs may not reach all infected cells, such as those in the brain, so that complete eradication of virus may not be possible yet.

Certain cellular enzymes must be active for the dormant proviral DNA to begin to make RNA that can be packaged in new virus particles. These cellular enzymes are active only when the cell divides. However, CD4+ are T-helper lymphocytes, and this type of cell may not divide for a long period of time. This may account for the long period of dormancy after initial HIV infection and the delayed onset of AIDS.

Spread of HIV infection

HIV is not transmitted by casual contact or even the close, nonsexual contact that normally occurs at work, in school, or at home. Transmission requires transfer of body fluids containing infected cells or plasma from a person with HIV infection. HIV may be present in any body fluid that contains cells or plasma. HIV has been transmitted in blood, semen, vaginal secretions, breast milk, and saliva. Transmission has not been documented by saliva or droplets produced by coughing or sneezing, nor by shaking an infected person's hand. Transmission has also occurred in medical and dental personnel by accidental needlesticks. Early in the epidemic before appropriate changes were made, the virus was transmitted in blood transfusions and in other blood products administered to patients.

Two types of human immunodeficiency viruses have been isolated. HIV-1 is the predominant cause of AIDS in the U.S., and HIV-2 is in Africa and certain other parts of the world. This discussion focuses on HIV-1.

AIDS: the disease

Acquired immunodeficiency syndrome (AIDS) is the disease that usually results from HIV infection. Response to infection with HIV varies considerably. Often, for up to several years after infection, there is an asymptomatic carrier state, during which antibody tests for the virus are negative. During this time, extremely sensitive biochemical tests for the virus may detect it. Other patients, within 2 to 4 weeks after infection, may have a 3- to 14-day period of fever, malaise (general feeling of weakness), rash, joint pains, and generalized lymph node enlargement. Symptoms may be so mild that the patient ignores them. After another 1 to 3 months, antibody to HIV becomes detectable. Otherwise, however, the patients may feel and appear normal.

The antibody response is ineffective at stopping the infection. The virus can be in a latent state in a cell and can be passed directly to daughter cells as proviral DNA. Virus in mature form can also be passed directly to another cell. In both cases, the virus is not exposed to the blood and is therefore not subject to inactivation by antibody. Further, HIV tends to mutate rapidly, so that antibody may not be effective against the new mutants.

Onset of AIDS may occur many years, usually seven to 10, after initial infection with HIV. AIDS is defined by the occurrence of any of a long list of certain infections or cancers, or both, known to be characteristic of AIDS. For example, although pneumonia caused by *Pneumocystis carinii* is ordinarily quite rare, it occurs with high frequency in patients with AIDS, and often is the first sign that a person has developed AIDS.

The same is true for a kind of skin cancer, Kaposi's sarcoma, which is also rare except in patients with AIDS. These conditions, and the many other types of infections and cancer that occur with high frequency in patients with AIDS, result from impairment of the patient's immune system. Many of the infections are caused by microorganisms that most people have in their bodies, but that do not cause disease. They are able to cause disease in a patient with AIDS, because of the immunosuppression. For this reason, the infections are said to be **opportunistic**.

Profound weight loss may occur even before there are any definitive infections or cancers. Patients may lose 10% to 15% of their ideal weight over a period of months. The weight loss may be accompanied by fatigue and chronic diarrhea.

Medical Management of AIDS

Overall management of AIDS consists of:

- Directly attacking HIV, to attempt to eradicate the virus, or at least to minimize its replication and the patient's viral load.

- Treating opportunistic infections as they arise. These infections are common in patients with AIDS because of the inadequacy of their immune response, and can be life threatening.

- Educating the patient in how to minimize exposure to prevent infections from environmental organisms.

- Maintaining nutrition: because of the increased effectiveness of decreasing the viral load and preventing infections, patients with AIDS are living longer (many patients are able to return to work) and need more nutritional support than before.

Management of AIDS

- Eradicate or decrease HIV
- Treat opportunistic infections
- Minimize exposure to infectious agents
- Provide nutritional support