Human Immunodeficiency Virus (HIV)

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Human Immunodeficiency Virus (HIV) is an infection that weakens the immune system, and if untreated, can lead to Acquired Immunodeficiency Syndrome (AIDS). Despite advancements in treatment, HIV remains a global public health issue, with millions affected worldwide.

What is HIV

Human Immunodeficiency Virus (HIV), one of the most popular viruses that are deadly to human beings, are viruses that attack the human immune systems. HIV is one of the most serious public health challenges in recent decades, as of August 12, 2024, HIV.gov announced that there were 39.9 million people across the globe with HIV in 2023. HIV is a major cause of immune system deterioration, a decline in the effectiveness of the body's immune system, and Acquired Immunodeficiency Syndrome (AIDS), weakening the cells that help you fight diseases and infections.

HIV can be sorted into two groups: HIV-type 1 (HIV-1) and HIV-type 2 (HIV-2). The well known disease AIDS is caused by HIV-1; whereas HIV-2 is present limited only in regions of Western and Central Africa.

HIV by far does not have a cure to it, however, treatments are available to prevent HIV from replicating. Thus, it is very important to not only learn how to prevent the spread of HIV but also stop the spread in your body if infected

History of HIV

The discovery of HIV, the virus that causes AIDS, was a significant event in modern medical history. HIV remains a major global public health issue, having claimed an estimated 42.3 million lives due to HIV-related illnesses since the beginning of the epidemic (World Health Organization, 2023). It is spreading in all countries around the world. In 1983, French scientist Luc Montagnier and his team isolated a novel virus from a patient with swollen lymph nodes (Montagnier et al., 1983). They identified this virus as a retrovirus, which is now mainly known as Lymphadenopathy Associated Virus (LAV). Around the same time, American scientist Robert Gallo and his team also identified this virus, which he termed as HTLV-III (Gallo et al.,1984). Later, it was confirmed that both teams had discovered the same virus, which was then renamed as HIV. By the late 1980s, scientists had developed the first Antiretroviral Therapies (ART) to help manage HIV infections. These therapies, though can not fully cure HIV, but can help suppress the virus, enabling individuals to live longer lives (Joint United Nations Programme on HIV/AIDS, 2022).

Spread of HIV

HIV is spread mainly from interactions of body fluids from an infected person. This is mostly caused through direct contact of blood, semen, and vaginal fluids which makes sexual behaviors the greatest way one gets infected with HIV. Transmitting through sexual behaviors can also defer between anal or vaginal sex without the use of protection like use of condoms or medications to prevent HIV. Direct contact can also include sharing of needles, syringe or other injection instruments with infected HIV patients. Another famous way one gets infected with HIV is through heritage, from mother to fetus. In addition, transfer of HIV between mother and baby can also be through breast feeding.

Symptoms of HIV

The symptom at first could be very hard to distinguish from other small common viral infections. After initial HIV infection, clinical conditions of Acute Retroviral Syndrome, associated with Primary HIV Infection (PHI), will strat to manifest within 1-4 weeks and the symptoms include fever, headache, rash, sore throat and more resemble influenza or other viral illnesses, which can confuse a patient's judgment and therefore delay proper diagnosis. As HIV progresses, it will gradually weaken the immune system. In the prior 3 months, symptoms such as night sweats, pharyngitis (an inflammation of the back of the throat), lymphadenopathy (swollen lymph nodes), arthralgia (joint pain), and weight loss are some further signs that should prompt further examination.

Beside the physical symptoms, long-term severe HIV infection can also show various neurological and psychological symptoms. Overtime, HIV virus can damage individuals' brain and mental well-being as it enters the central nervous system (CNS) and lead to neurological and neurocognitive symptoms resulting in patients to experience obvious body weakness, reduced mental concentration, and short-term memory loss. Psychological impacts on people having HIV infections had also been proved through data that individuals diagnosed with HIV frequently report high levels of depressive symptoms, leading to an growing risk of suicidal thoughts and behaviour.

HIV Treatment

Treatment for HIV infection requires life-long therapy. When selecting treatment and medicine for patients, they are usually based on the medicine's: efficiency, side effects, pill dosing frequency, drug–drug interaction potential (how one drug affects another), resistance test results (drug resistance), social status, and cost.

Treatment goals for experienced patients as well as new patients are to stop virus replication, enable immune recovery, and minimize side effects of drugs. Pills and shots are the most common treatments used among patients. Pills are more often used for patients that just started their HIV treatments; while shots are long lasting treatments that are usually given less frequently. Efficiency and safety/tolerability are both required for successful long term HIV therapy. Also without an effective vaccine, the use of combination Antiretroviral Therapy (cART, ART for short), a HIV treatment that uses 3 drugs together to suppress the virus replication, is very important. This therapy significantly decreased AIDS death rate and secondary HIV transmission rates. Often immediately after a patient's diagnosis, cART drugs are used to improve tolerability and safety.

Prevention of HIV

The prevention of Human Immunodeficiency Virus (HIV) is an important part of global public health efforts. According to the Centers for Disease Control and Prevention (2022), effective prevention methods can greatly reduce the risk of HIV transmission. Condoms are one of the best methods for preventing HIV transmission (World Health Organization, 2021). Additionally, pre-exposure prophylaxis (PrEP) is a daily medicine that can reduce the risk of getting HIV when taken consistently(CDC, 2022). Regular HIV testing on a yearly basis is also

crucial in reducing the risk of infection for individuals as it helps find and treat people with HIV as early as possible, before massive replications begin (UNAIDS, 2022). Education and awareness are key in fighting the stigma around HIV and encouraging people to take preventive steps (UNAIDS, 2022).

Furthermore, targeted prevention strategies for specific populations, like men who have sex with men and people who inject drugs, have been effective (CDC, 2022). As scientific research advances, the development of an HIV vaccine continues, hoping for more effective future prevention options (WHO, 2021).

Cell Replication of HIV

HIV has a complex structure. The HIV genome is composed of two identical copies of single-stranded RNA, though the organization can differ in HIV-1 and HIV-2. All HIV has genes that encode for protein for different functions. For example, there is the "pol" gene encodes for a protein that is crucial for the virus's replication.

HIV-1 is a virus that specifically targets and weakens the immune system by attacking a type of white blood cell called the CD4 cell, which is essential for coordinating immune responses and defending the body against infection. The virus attaches itself to these cells, enters them, and then uses an enzyme to convert its RNA into DNA. This new viral DNA integrates with the cell's genetic material, allowing HIV to remain hidden and make copies of itself each time the cell divides. This stealthy (doing something in a secretive or sneaky way to avoid being noticed or detected) replication makes it difficult for the immune system to effectively detect and

eliminate the virus. In addition, HIV-1 mutates frequently, producing many variations that help it avoid the immune response and adapt quickly to medical treatments, making the virus even more difficult to control. Although antiretroviral therapy (ART) can suppress HIV by blocking its replication process, the virus can remain dormant (inactivated) in certain cells, such as memory T cells. This latency allows the virus to reactivate if treatment is interrupted, meaning that lifelong ART is often necessary to keep HIV levels low. HIV-2, however, only differs in having a slower process of replication, while other major replication processes remain the same.

Takeaways

Public health campaigns have been important in raising awareness about the importance of safe practices to reduce the spread of HIV. Despite these advancements, HIV remains a major global health challenge (UNAIDS, 2022). Additionally, the stigma surrounding HIV/AIDS continues to search for a permanent solution to HIV/AIDS (Gates Foundation, 2021). They required continuous research and preventive measures. As of right now, one can maximize the effect of HIV treatments, use as prescribed, they will help reduce viral load, which can lessen drug resistance and prevent more people from getting HIV. Use condoms when having sexual behaviors, avoid usage of contaminated equipment, do at least one HIV testing per year, and regular check ups can help early detection and prompt treatments. If you feel similar symptoms happening in your body that are matching with HIV, check with your doctor as soon as possible.

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