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Commentary

The Impact of Human Immunodeficiency Virus (HIV) on Human Health

Angela Conway*

Department of Medicine, Women's College Research Institute, Toronto, Canada

DESCRIPTION

The CD4 cells of the body's immune system, which are in control of countering away infections, are especially targeted by the Human Immunodeficiency Virus (HIV), a viral infection. The virus is primarily transmitted through sexual contact, sharing of needles, and from mother to child during pregnancy, childbirth, or breastfeeding. HIV is a chronic infection, and if left untreated, can progress to Acquired Immune Deficiency Syndrome (AIDS), which can be fatal. HIV therapeutics has evolved significantly over the past few decades, from the first antiretroviral drug, Azidothymidine (AZT), in 1987, to the current Highly Active Antiretroviral Therapy (HAART) regimens [1]. HAART consists of a combination of three or more antiretroviral drugs that work in different ways to target different stages of the HIV life cycle. The goal of HAART is to reduce the amount of virus in the body (viral load) to undetectable levels, which allows the immune system to recover and prevents the progression of HIV to AIDS.

The first class of antiretroviral drugs developed were Nucleoside Reverse Transcriptase Inhibitors (NRTIs), such as AZT, which inhibit the reverse transcriptase enzyme that HIV uses to convert its RNA genome into DNA, thereby preventing viral replication [2]. However, NRTIs have significant toxicities, including bone marrow suppression and mitochondrial toxicity, which can lead to lactic acidosis and liver failure. Newer NRTIs, such as tenofovir and emtricitabine, have less toxicity and are better tolerated.

The second class of antiretroviral drugs developed were Protease Inhibitors (PIs), such as indinavir and ritonavir, which inhibit the protease enzyme that HIV uses to cleave viral proteins into their functional components, thereby preventing viral maturation and release. PIs were initially associated with significant toxicities, including gastrointestinal side effects and metabolic abnormalities, but newer PIs, such as darunavir and atazanavir, have fewer side effects and are better tolerated [3].

The third class of antiretroviral drugs developed were Non-Nucleoside Reverse Transcriptase Inhibitors (NNRTIs), such as efavirenz and nevirapine, which bind to a different site on the reverse transcriptase enzyme than NRTIs and inhibit viral replication. NNRTIs are generally well-tolerated and have less toxicity than NRTIs or PIs, but they are associated with a high rate of resistance development, which limits their long-term efficacy.

The fourth class of antiretroviral drugs developed was integrase inhibitors, such as raltegravir and dolutegravir, which inhibit the integrase enzyme that HIV uses to insert its DNA into the host cell genome, thereby preventing viral integration and replication. Integrase inhibitors are generally well-tolerated and have high potency, but they can be associated with drug interactions and resistance development.

The fifth class of antiretroviral drugs developed was entry inhibitors, such as enfuvirtide and maraviroc, which block viral entry into host cells by targeting either the viral fusion or co-receptor binding process. Entry inhibitors are generally reserved for patients with limited treatment options due to drug resistance or intolerability [4].

The sixth class of antiretroviral drugs is post-attachment inhibitors. Post-attachment inhibitors prevent the virus from entering the host cell by targeting viral proteins that are involved in the post-attachment process. Examples of post-attachment inhibitors include ibalizumab, which targets the CD4 receptor on the host cell surface, and fostemsavir, which targets the *gp120* protein on the viral envelope. Despite the availability of effective antiretroviral therapy, challenges remain in the management of HIV. One challenge is drug resistance [5]. HIV can mutate rapidly, leading to the emergence of drug-resistant strains. The use of a combination of antiretroviral drugs, called Highly Active Antiretroviral Therapy (HAART), reduces the risk of drug resistance. HAART combines drugs from different classes to target multiple stages of the viral life cycle.

CONCLUSION

Another challenge is adherence to treatment. HIV treatment requires lifelong daily medication, and non-adherence can lead to treatment failure and the emergence of drug-resistant strains. Adherence can be improved through patient education, counseling, and support programs. The current standard of care for HIV treatment is a combination of three or more antiretroviral

Correspondence to: Angela Conway, Department of Medicine, Women's College Research Institute, Toronto, Canada, E-mail: angelaconway@gmail.com

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drugs from different classes, which is referred to as combination Antiretroviral Therapy (cART) or HAART. The goal of cART is to achieve and maintain viral suppression, which is defined as having an HIV viral load below the limit of detection (<50 copies/mL) on two consecutive tests.

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