The Battle Against HIV Immune Evasion: Could Vaccines Be Possible One Day?

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In 1984, the Human Immunodeficiency Virus (HIV) was identified as the causative agent of the Acquired Immunodeficiency Syndrome (AIDS), yet there is still no effective vaccine. Since 1981, around 84.2 million infections have occurred and 40.4 million deaths. HIV, a retrovirus attacking CD4+ T cells, has two types, HIV-1, causing the global epidemic and HIV-2. After four decades of epidemic, a vaccine would be crucial in combatting HIV, but its development faces significant challenges. Therefore, this review will investigate reasons for this difficulty and determine if a vaccine is possible. One major difficulty is HIV's high mutation rate being 10,000 to 100,000 times faster than eukaryotes, resulting in frequent changes in protein composition that hinders antigen specificity, and new strains that limit vaccine development. Moreover, HIV evades the immune system by infecting CD4+ T cells, which are then destroyed by CD8+ T cells. However, our review found some promising clinical trials. The HIV Merck vaccine clinical trial suggested triggering CD4+ and CD8+ T cell proliferation via recombinant adenovirus. Additionally, SARS-CoV-2 vaccines highlighted the potential of mRNA technology for HIV vaccine development. One vaccine candidate has been tested experimentally using macaques, but researchers have suggested using human data due to genetic differences. An HIV vaccine would be cost-effective compared to lifelong antiretroviral treatment, which has unequal accessibility, side effects and drug resistance risks. An HIV vaccine would be a major breakthrough in infectious disease research, ending a four-decade epidemic and providing relief for those infected.