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Commentary

Acquired Immunodeficiency Syndrome (AIDS) Vaccination: An Effective Method to Prevent HIV

Yang Kerley*

Department of Medicine and Health Science, University of Peking, Beijing, China

DESCRIPTION

The HIV/AIDS epidemic continues to be a major global health concern, putting enormous demand on healthcare resources in Sub-Saharan Africa. According to the United Nations Programme on HIV/AIDS (UNAIDS), around 37.9 million persons worldwide were infected with HIV in 2018. Also, despite widespread use of antiretroviral medication, there were 1.7 million new infections and nearly 770,000 AIDS-related deaths in the same year. The worldwide Human Immunodeficiency Virus (HIV) incidence-to-prevalence ratio of 0.05 suggests that the number of HIV-infected persons will continue to grow until more effective preventative efforts to minimize transmission are implemented.

There is strong scientific agreement that developing a preventative Acquired Immunodeficiency Syndrome (AIDS) vaccine that is safe, effective, cost effective, and freely available globally is the most effective method to controlling and finally ending the HIV pandemic. Unfortunately, after more than 30 years of intense HIV research and countless vaccination trials, there is presently no approved HIV vaccine on the market.

HIV infection has been turned into a clinically treatable chronic condition because to the discovery of strong antiretroviral treatments, which are currently taken as a single pill once a day. Worldwide, over 19 million individuals are now receiving life-long treatment, and test-and-treat techniques like oral Pre-Exposure Prophylaxis (PrEP) may help to cut HIV transmissions even further. Despite these impressive achievements, sustained combination Antiretroviral Therapy (cART)-mediated decrease of plasma viral loads to undetectable levels does not eliminate the virus, which frequently resurfaces after treatment discontinuation. Furthermore, while cART has reduced mortality and morbidity among people living with HIV, long-term cART therapy has been linked to an increase in the frequency of a variety of catastrophic non-AIDS events. The introduction of effective antiretroviral medicines, currently available as a single tablet once a day, has converted HIV infection into a clinically treatable condition. The numerous logistical and financial problems associated with providing life-long care to HIV patients underline the necessity for a preventative HIV vaccination.

HIV vaccine's desirable characteristics include eliciting long-lasting all-around protection with a small number of doses provided to the patient; the vaccine should also be inexpensive, convenient to administer, and store without the need for a cold chain. The introduction of effective antiretroviral medicines, currently available as a single tablet once a day, has converted HIV infection into a clinically treatable condition. The HIV vaccine can be either preventative or therapeutic, which means it can either prevent HIV infection or treat HIV-infected people.

The high rate of mutation and recombination during viral replication has been the most difficult barrier in producing an effective HIV vaccine throughout the years. The high rate of variability of the viral Envelope (Env) glycoprotein, which unfortunately happens to be the major target of neutralizing antibodies, is primarily responsible for HIV's huge genetic diversity. HIV diversity, which is primarily caused by the error-prone viral reverse transcriptase, has a variety of consequences for disease progression and ART response. The virus may avoid the effects of neutralizing antibodies and other immune responses due to its rapid mutation rate of roughly 1-10 mutations per genome every replication cycle, significant conformational plasticity, and substantial glycan shielding. Yet, despite the high rate of diversity, polyvalent HIV vaccines have been created and utilized to target conserved regions on the viral envelope.

The majority of current studies are focused on producing broadly Neutralizing Antibodies (bNAbs), which can neutralize the vast majority of HIV strains. The capacity of bNAbs to neutralize a large range of HIV strains (wide cross-reactivity) is a significant benefit. Moreover, pre-clinical and clinical investigations have established the safety and exceptional antiviral effectiveness of very powerful HIV specific bNAbs. Apart from high viral mutation and recombination rates, remarkable global genetic diversity is another barrier to vaccine development. HIV is divided into four categories: M (major), O (outlier), N (non-M/non-O), and P. (pending). The letters A, B, C, D, F, G, H, J, and K represent the nine subtypes/clades that comprise Group M. Amino acid differences within subtypes have been observed to be as high as 30%, with those across subtypes reaching as high as 42%. These amino acid changes are determined by the subtypes and regions of the genome under consideration. The problem of

Correspondence to: Yang Kerley, Department of Medicine and Health Science, University of Peking, Beijing, China, E-mail: kerley37@yahoo.cn

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generating a universal vaccine is exacerbated by the fact that 10-20% of HIV-infected patients in certain African countries are infected with two or more viral variations (subtypes and recombinant forms) that circulate in these areas.