Journal of Pharmacy and Pharmacology 8 (2020) 309-313
doi: 10.17265/2328-2150/2020.10.002

Vaccine-Preventable Diseases in HIV (+) Persons

Nikolay Todorov Vatev

Dept. Epidemiology and Disaster Medicine, Faculty of Public Health, Medical Universit-Plovdiv, Plovdiv 4000, Bulgaria

Abstract: The article discusses the risk for the origin of vaccine-preventable diseases in HIV (+) people and the possibilities for their prevention. HIV (+) people are with 4-8 times greater risk to be infected with influenza and 1.5 times higher to die. They belong to a risk group of 35-100 times possibility to acquire invasive pneumococcal disease in comparison with non-infected people. The risk for origin of invasive meningococcal disease for them is 5-13 times greater. There is significantly higher risk for HIV (+) persons to be infected with pertussis, hepatitis A, B and C and also human papilloma virus infection. That is why the HIV-infected have to be immunized with the vaccines for which they have not contraindications. Inactivated, polysaccharide, recombinant vaccines and toxoids may be administered to HIV (+) patients: inactivated poliomyelitis; against diphtheria, tetanus and pertussis (inactivated whole cell or acellular); only diphtheria and tetanus; tetanus toxoid; polysaccharide against typhoid fever; haemophilus influenza type B; hepatitis A and B; influenza; meningococcal and pneumococcal infections. Passive immune prophylaxis may also be applied to HIV (+): with human normal immune globulin—after contact with infected people from hepatitis A, measles, mumps, rubella, meningococcal infection; or with specific hepatitis B immune globulin, immune globulin against rabies and immune globulin for varicella-zoster virus. Live vaccines have not to be applied to HIV-infected: BCG, MMR, OPV, Vivotif, rotavirus, varicella and yellow fever. In conclusion, as soon as possible after the diagnosis of HIV infection is confirmed, we have to check the immune status of this person for the routine immunizations. The necessary immunizations have to be done if they lack. And then it is appropriate to do the recommended vaccines.

Key words: HIV (+) persons, vaccine-preventable diseases, immune prophylaxis.

1. Introduction

Vaccines are important for the prevention of vaccine-preventable diseases (VPDs), especially in immune compromised individuals, such as those with HIV infection. HIV (+) people have reduced protection (cellular and humoral immunity) and are therefore at higher risk of contracting VPDs and their severe course compared to the immune competent population [1]. Effective antiretroviral therapy (ART) has allowed HIV infection to become a chronically controlled disease. Despite ART, systemic inflammation and immune activation persist in HIV-infected individuals, which are associated with adverse health effects [2].

In addition, immune reconstruction after the onset of ART is incomplete. This can lead to a lack of immunological memory, previously built up by a natural infection, if a vaccine is given earlier in childhood. Immunization and possible re-immunization would be an important addition to ART to prevent future complications in this population [3]. The impact of VPDs on HIV (+) individuals is not only associated with acute mortality, but also leads to a high incidence of these diseases in the HIV population, with effects of long-term morbidity and mortality [4].

1.1 Risk of VPDs in HIV (+) Persons

1.1.1 Influenza

Influenza is a seasonal viral infection that leads not only to high morbidity, but sometimes to high mortality in immune compromised individuals. The annual number of flu deaths in South Africa is 6,000-11,000. A study found that HIV (+) had a 4-8 times higher risk of contracting influenza and 1.5 times a higher risk of death than those not infected [5, 6]. Influenza immunization is effective in preventing

Corresponding author: Nikolay Todorov Vatev, PhD, research fields: immune prophylaxis, HIV/AIDS, viral hepatitis.

infection and reducing the severity of influenza-associated diseases in HIV-infected individuals [7].

1.1.2 Invasive Pneumococcal Disease (IPD)

Invasive pneumococcal disease (IPD) in HIV-infected people is a significant cause of morbidity and mortality [8]. Even with the availability and increasing access to universal ART in South Africa, the relative risk of developing IPD in HIV (+) is 35-100 times higher [9-11]. Available evidence from Africa shows that pneumococcal conjugate vaccine (PCV) is effective against vaccine strains when given to HIV-infected adults. There is evidence that the use of PPV23 or PCV13 is safe in HIV (+) individuals on ART or if CD4 + cell counts are greater than 200 cells/μL [12].

1.1.3 *Neisseria meningitidis*

Neisseria meningitidis is endemic in South Africa and manifests as meningococcal bacteremia or meningitis. HIV infection is an important risk factor for acquiring invasive meningococcal disease (IMD), with a relative risk 5-13 times higher than in the general population [13]. Epidemiological data from South Africa evidences an increase in the incidence of IMD in HIV-infected patients (20% vs. 11% in HIV-uninfected), which can be explained by the more common bacteremia compared to meningitis. Two tetravalent vaccines A, C, W135 and Y were used—one was a polysaccharide and the other was a protein-conjugated polysaccharide. It is recommended that HIV (+) persons receive a conjugate vaccine.

There are currently no studies on the immunogenicity and efficacy of pertussis vaccine for HIV-infected adults. Evidence from studies in children shows that HIV infection reduces the immune response after vaccination, but a high number of CD4+ cells improve the antibody response [14]. It is recommended that pregnant women, regardless of CD4+ cell count or viral load, be vaccinated (with a cell-free vaccine). This can be done at any time during pregnancy. This immunization will lead both to an increase in their antibodies and to their transmission through the placenta to the fetus, which would otherwise be at high risk of pertussis infection [15].

There is no consensus on the benefit of routine immunization of HIV (+) adults against hepatitis A (HAV). This is recommended in the presence of other risk factors (medical, behavioral, epidemiological or occupational). High-risk groups for HAV infection are MSM, injecting drug users, people traveling or working in high or moderately endemic HAV countries, with chronic liver disease (including hepatitis B and C), immunesuppressed and transplanted.

Hepatitis B (HBV) immunization is highly recommended for HIV-infected people. The introduction of the hepatitis B vaccine as a routine has led to a significant reduction in HBV infection globally [16]. Co-infection with HBV and HIV is considered endemic in sub-Saharan Africa, incl. South Africa. The two viruses have the same routes of transmission and chronic HBV is estimated to occur among HIV (+) from 0.4% to 23% in South Africa [17]. The incidence of co-infection in the world is about 10%, but it varies greatly from region to region. The incidence of HBV infection in HIV (+) is 20 times higher than in HIV (-).

Human papilloma virus (HPV) infection is common in HIV (+) and the virus persists in adults. HPV vaccines are safe and immunogenic for HIV-infected adults [18]. As with other vaccines, the immune response after administration of the HPV vaccine is better at CD4+ cell counts above 200/μL and suppressed viral load. There are insufficient data on the efficacy and duration of protection from HPV vaccines in HIV (+) adults and whether they are immunized before or after infection. There is also no evidence that a booster dose is appropriate [19].

1.2 Opportunities for Immunization of People Living with HIV/AIDS

The BCG vaccine should not be given to HIV-infected children in areas with a low prevalence

of tuberculosis, regardless of their clinical stage or immune deficiency status. In areas with a high prevalence of tuberculosis, BCG can only be given to asymptomatic HIV (+) children. BCG is not used in adolescents and adults HIV (+) due to poor efficacy in the elderly.

MMR or other measles vaccines should not be given to people living with HIV/AIDS (children and adults). In severe epidemic conditions, MMR can only be considered in HIV-infected individuals who are asymptomatic or with mild immune suppression (CD4 > 30% of total lymphocyte count in young children or > 350 for children over 5 years and adults).

The rotavirus vaccine should not be given to HIV (+) children, regardless of their immunodeficiency status (until safety evidence is gathered).

Polio vaccines: OPV should not be given to HIV (+) children and adults regardless of immunodeficiency. IPV should be given to HIV (+) children, regardless of immunodeficiency, as well as to family members and nursing staff who come into contact with HIV (+) people.

Typhoid vaccines: the oral live vaccine Ty21a (Vivotif), which is given 4 times every 2 days, should not be given to HIV (+) people (children and adults). The polysaccharide vaccine (Vi CPS)—Typhim Vi (administered 1×, 0.5 mL) can be given to HIV (+) people traveling to endemic regions.

The chickenpox vaccine should not be given to HIV-infected adults, regardless of their immunodeficiency, or to HIV (+) children with moderate or severe immune suppression (CD4 < 30%). The chickenpox vaccine should be limited to children with asymptomatic HIV infection or mild immune suppression (CD4 > 30%). Those from the family of a HIV (+) person, who are susceptible to varicella, should be vaccinated, so that they could not infect the HIV (+) if they become ill with varicella.

The yellow fever (live) vaccine should not be given to HIV (+) children and adults, regardless of their immunodeficiency. The vaccine is mandatory for healthy people traveling to endemic countries—29 in Africa and 13 in South America. Vaccine strain 17D, 0.5 mL, subcutaneously is used. Since 2013, the World Health Organization (WHO) has been of the opinion that 1 dose of the vaccine leads to the development of lifelong immunity. The vaccine can only be given to HIV (+) if there is a very high risk of infection.

Cholera vaccine: due to poor efficacy, the old inactivated parenteral vaccine *V. cholerae* O1 is not recommended. The vaccine containing killed whole cells of *V. cholerae* O1 in combination with a recombinant B-subunit of cholera toxin (WC/rBs) has been shown to be safe for pregnant women, nursing mothers and HIV (+). It can be used when traveling to endemic regions.

Vaccines against diphtheria, tetanus and pertussis (DTP, DTaP, DT, TT, Td): in HIV(+) children, regardless of their immune status, DTP, DTaP and DT are administered according to the same schedule and dosage as in uninfected children. TT and Td can be given to adults living with HIV, regardless of their immune status, according to the same regimen and dose, as well as to the uninfected. Special attention should even be paid to HIV (+), who use injecting drugs.

Vaccine against *Haemophilus influenzae* type B (HiB): HIV-infected children and adults are at increased risk of invasive HiB disease due to immune suppression. They may be immunized. HIV-infected people over 5 years of age who have not been immunized to date should receive at least 1 dose of the vaccine. Younger HIV (+) children are immunized as uninfected: 3 doses every 30 days and after 12 months—1 more booster dose.

Hepatitis A vaccine: the hepatitis A vaccine may be given to HIV (+) people, and it is even recommended. Two vaccines are licensed in Europe: Havrix and Avaxim. Two doses are administered after 6-12 months from the first. Other risk groups are: people with chronic liver disease; men who have sex with

men; injecting drug users; health care workers; working with food products; persons with coagulation factor disorders; people from non-endemic countries traveling to endemic regions.

Hepatitis B vaccine: hepatitis B vaccine may be given to HIV (+), regardless of their immune status, if they belong to the risk groups—homosexuals; promiscuous; patients with sexually transmitted infections; prostitutes; injecting drug users; prisoners; people on hemodialysis; health care workers. For HIV (+), 4 doses are recommended after 1, 2 and 12 months. Antibody formation may subsequently be monitored and if necessary, more doses should be administered.

Influenza vaccine: the flu vaccine may be given to HIV (+) children over 6 months and adults, and it is even recommended. This prevents cases with severe course and reduces complications.

Meningococcal vaccines: different types of meningococcal vaccines are licensed: mono-A; double-A + C; tetravalent-A, C, W135, Y; mono-B. Meningococcal vaccines may be given to HIV (+) routinely or as recommended when traveling to endemic regions.

1.3 Pneumococcal Vaccines

Pneumococcal conjugate vaccines (PCV)—10- and 13-valent, for children up to 2 years, may be (and should be) routinely administered to HIV (+) children: 2, 3, 4 months—1 dose; 12 months—1 more dose.

Pneumococcal polysaccharide vaccines (PPV)—for children > 2 years and adults. They may, even it is recommended, be given to HIV (+) people (regardless of their immune status) as soon as possible after the infection has been identified. One dose is administered, then 1 dose every 5 years.

1.4 Rabies Vaccine

The contemporary rabies vaccine is inactivated, cell cultured on Vero cells (Aventis Pasteur). It is used for pre- and post-exposure immune prophylaxis. For pre-exposure prophylaxis 3 doses with interval of 7 and 28 days are applied. After 1 year—1 more dose, subsequently, every 3 years—1 dose. For post-exposure prophylaxis 5 doses are applied on the following days after the bite: 0, 3, 7, 14 and 30. In larger wounds—(+) specific anti-rabies immunoglobulin (20 IU/kg). The rabies vaccine may be given to HIV (+) people.

1.5 Passive Immune Prophylaxis of HIV (+)

In HIV (+) individuals, passive immune prophylaxis may be performed with:

- normal human immunoglobulin (HNIg): after contact with patients with hepatitis A, measles, mumps, rubella, meningococcal infection;
- specific hepatitis B immunoglobulin (HBIg);
- specific anti-rabies immunoglobulin (HRIg);
- immunoglobulin for varicella-zoster (VZIg).

2. Conclusions

Immune prophylaxis is an important element in the comprehensive prevention of HIV (+) from vaccine-preventable diseases. These diseases are sometimes fatal for people living with HIV/AIDS.

Live vaccines should not be given to HIV(+): BCG, MMR, OPV, Vivotif, Rotavirus, Chickenpox, Yellow fever.

Inactivated, polysaccharide, recombinant vaccines and toxoids may be given to HIV (+): IPV, DTP, DT, DTaP, Td, TT, Typhim Vi, HiB, HAV, HBV, Cholera, Influenza, Meningococcal and Pneumococcal infections, Rabies.

References

[1] Geretti, A. M., and Doyle, T. 2010. "Immunization for HIV-Positive Individuals." *Curr Opin Infect Dis* 23 (1): 32-8.

[2] Slim, J., and Saling, C. F. 2016. "A Review of Management of Inflammation in the HIV Population." *BioMed Res Int*, Article ID: 3420638.

[3] Tan, D. H., et al. 2015. "Effect of Intercurrent Infections and Vaccinations on Immune and Inflammatory Biomarkers among Human Immunodeficiency Virus-Infected Adults

on Suppressive Antiretroviral Therapy." *Open Forum Infect Dis* 2 (2).

[4] Nicolini, L. A., et al. 2015. "Insights on Common Vaccinations in HIV-Infection: Efficacy and Safety." *J Prev Med Hyg* 56 (1): E28-32.

[5] Cohen, C., et al. 2015. "Epidemiology of Severe Acute Respiratory Illness (SARI) among Adults and Children Aged ≥ 5 Years in a High HIV-Prevalence Setting, 2009-2012." *PLoS One* 10 (2): e0117716.

[6] Cohen, C., et al. 2013. "Severe Influenza-Associated Respiratory Infection in High HIV Prevalence Setting, South Africa, 2009-2011." *Emerg Infect Dis* 19 (11): 1766-74.

[7] Remschmidt, C., et al. 2014. "Influenza Vaccination in HIV-Infected Individuals: Systematic Review and Assessment of Quality of Evidence Related to Vaccine Efficacy, Effectiveness and Safety." *Vaccine* 32 (43): 5585-92.

[8] Cohen, C., et al. 2015. "*Streptococcus pneumonia* Serotypes and Mortality in Adults and Adolescents in South Africa: Analysis of National Surveillance Data, 2003-2008." *PLoS One* 10 (10): e0140185.

[9] French, N., et al. 2010. "A Trial of a 7-Valent Pneumococcal Conjugate Vaccine in HIV-Infected Adults." *N Engl J Med* 362 (9): 812-22.

[10] Lombardi, F., et al. 2016. "Immunogenicity and Safety of the 13-Valent Pneumococcal Conjugate Vaccine versus the 23-Valent Polysaccharide Vaccine in Unvaccinated HIV-Infected Adults: A Pilot, Prospective Controlled Study." *PLoS One* 11 (6): e0156523.

[11] Meiring, S., et al. 2016. "HIV Infection and the Epidemiology of Invasive Pneumococcal Disease (IPD) in South African Adults and Older Children Prior to the Introduction of a Pneumococcal Conjugate Vaccine (PCV)." *PLoS One* 11 (2): e0149104.

[12] Iyer, A. S., et al. 2015. "Response to Pneumococcal Polysaccharide Vaccination in HIV-Positive Individuals on Long Term Highly Active Antiretroviral Therapy." *J AIDS Clin Res* 6 (2): 421.

[13] MacNeil, J. R., et al. 2016. "Recommendations for Use of Meningococcal Conjugate Vaccines in HIV-Infected Persons—Advisory Committee on Immunization Practices, 2016." *MMWR Morb Mortal Wkly Rep* 65 (43): 1189-94.

[14] Troy, S. B., et al. 2016. "Brief Report: Seroprevalence of Pertussis Infection in HIV-Infected Adults in the United States." *J Acquir Immune Defic Syndr* 73 (3): 282-6.

[15] Dangor, Z., et al. 2017. "Vaccination of HIV-Infected Pregnant Women: Implications for Protection of Their Young Infants." *Trop Dis Travel Med Vaccines* 3.

[16] Mena, G., et al. 2015. "Hepatitis B and A Vaccination in HIV-Infected Adults: A Review." *Human Vaccines & Immunotherapeutics* 11 (11): 2582-98.

[17] Stabinski, L., et al. 2015. "Prevalence of HIV and Hepatitis B Virus Co-infection in Sub-Saharan Africa and the Potential Impact and Program Feasibility of Hepatitis B Surface Antigen Screening in Resource-Limited Settings." *J Acquir Immune Defic Syndr* 68 (Suppl. 3): S274-85.

[18] Denny, L., et al. 2013. "Safety and Immunogenicity of the HPV-16/18 AS04-Adjuvanted Vaccine in HIV-Positive Women in South Africa: A Partially-Blind Randomised Placebo-Controlled Study." *Vaccine* 31 (48): 5745-53.

[19] Kojic, E. M., et al. 2016. "Human Papillomavirus Vaccination in HIV-Infected Women: Need for Increased Coverage." *Exp Rev Vaccines* 15 (1): 105-17.