Tabari Biomedical Student Research Journal

OPEN ACCESS

REVIEW: A Review on the Co-infection of HIV and Parasitic Diseases

Hamid Mohammadi Student Research Committee, Amol School of Paramedical Sciences, Mazandaran University of Medical Sciences, Sari, Iran.

Mahdi Shooraj Student Research Committee, Amol School of Paramedical Sciences, Mazandaran University of Medical Sciences, Sari, Iran.

Yahya Ehteshaminia Student Research Committee, Amol School of Paramedical Sciences, Mazandaran University of Medical Sciences, Sari, Iran.

Seif Ali Mahdavi Department of Paramedicine, Amol School of Paramedical Sciences, Mazandaran University of Medical Sciences, Sari, Iran.

ARTICLE INFO

Submitted: 16 Oct 2021
Accepted: 14 Jan 2022
Published: 01 Mar 2022

Keywords:
Co-infection;
HIV;
Parasitic Diseases

Correspondence:
Seif Ali Mahdavi, Department of Paramedicine, Amol School of Paramedical Sciences, Mazandaran University of Medical Sciences, Sari, Iran.
Email:
seifalimahdavi@gmail.com
ORCID: 0000-0003-1522-7796

Citation:
Mohammadi H, Shooraj M, Ehteshaminia Y, Mahdavi SA. A Review on the Co-infection of HIV and Parasitic Diseases. Tabari Biomed Stu Res J. 2022;4(1):23-29.

10.18502/tbsrj.v4i1.8775

ABSTRACT

Introduction: The human immunodeficiency virus (HIV) and its associated disease, acquired immunodeficiency syndrome (AIDS), have become a global epidemic today. Approximately, 38 million people worldwide who are living with HIV are exposed to a variety of opportunistic infections. Opportunistic infections, continue to be a major cause of death among HIV-positive people. The high prevalence of specific opportunistic parasites among HIV-positive individuals is well known. These types of parasitic infections occur in HIV-positive individuals with more severe symptoms which are difficult to treatment.

Material and Methods: In this study, the databases of PubMed, Scopus, SID, Magiran, Web of Science, IranDoc and Google Scholar were searched and articles related to the title from 2002 to 2021 were reviewed.

Results: Toxoplasmic encephalitis is the most common cause of focal brain lesions due to opportunistic infections complicating the course of AIDS. In tropical countries, the pathophysiological, clinical, and epidemiological interactions between HIV and pathogenic organisms such as malaria are a major public health concern. About 11.2% of people living with HIV also have Cryptosporidium. Visceral leishmaniasis can accelerate the progression of the disease in HIV-positive individuals and leads to AIDS.

Conclusion: Due to the resistance of Co-infection of HIV and parasitic diseases to treatment, the best solution seems to be HIV prevention, medical and health care for HIV-positive individuals. HIV prevention strategies include screening, use of protective equipment during sexual intercourse, non-use of shared syringes, treatment as prevention, post-exposure prevention and pre-virus prevention.

Introduction

Human Immunodeficiency Virus (HIV) and the resulting disease besides Acquired Immune Deficiency Syndrome (AIDS) has become an ongoing global epidemic in today's world (1). According to the World Health Organization (WHO) about 38 million people worldwide are infected with HIV (2) and they are prone to a variety of opportunistic infections. This number increases to 1.7 million annually.

[DOI: 10.18502/tbsrj.v4i1.8775]

Based on the current growth rate, the number of patients in 2030 will reach 42 million (3). Nearly two-thirds of those infected with the virus are diagnosed annually in Africa (4). However, HIV remains a public health problem in high-income countries. Subsequently in 2018, 68 thousand new cases have been recognized in Western and Central Europe as well as North America (4).

Opportunistic infections caused by viruses, parasites, bacteria, fungi and other pathogens are one of the leading causes of death among people with HIV (5, 6). Recent studies have shown that parasitic infections can distraught the balance of anti-HIV immune responses and play dominant role in its proliferation (7, 8) which promotes the activity of the virus and causes AIDS (8). Besides, decreased immune response to the HIV virus can predispose people to parasitic infections. The high prevalence of specific opportunistic parasites among HIV-positive individuals is known (9). These types of parasitic infections occur with more severe symptoms among people. Furthermore, they face difficulty in responding to the treatment (10). Based on the outcomes of some studies, HIV infection increases the risk of infection with intestinal worms (11). On the contrary, the results of the other studies do not confirm this claim (8, 12). This can be due to changes in health-related behaviors in HIV-positive people, who are aware of their infection and receive psychotherapy and health care, in comparison with those who are HIV-negative (8). It worth mentioning that in HIV-positive people, a decrease in interleukin-2 is observed. Due to the role of T lymphocytes in the combat against comorbid infections, it makes these people particularly sensitive to opportunistic infections (8, 13).

Methods

In this study, the databases of PubMed, Scopus, SID, Magiran, Web of Science, IranDoc and Google Scholar, were searched and articles related to the title from 2002 to 2021 were reviewed.

Results

Toxoplasma

Almost 30% of the world's population have antibodies to the intracellular protozoan parasite Toxoplasma gondii. People with HIV have a very high burden of Toxoplasma gondii infection, especially in sub-Saharan Africa. In the general population, high prevalence of Toxoplasma gondii infection has been reported in Ghana, Ethiopia, Tanzania, Brazil, Iran and Mexico and low prevalence has been reported in India Singapore and China (14). Toxoplasmic encephalitis has been reported to be the most common cause of focal brain lesions due to opportunistic infections complicating the course of AIDS (15). The results of studies emphasis the importance of routine surveillance for Toxoplasma gondii infection in all HIV-infected people (14).

Plasmodium

Malaria is a mosquito-borne disease produced by a parasite called Plasmodium. It includes four species of P. falciparum, P. vivax, P. ovale and P. malariae. It is conveyed from person to person through the bite of the female Anopheles mosquito (16). It is one of the most common parasitic diseases around the world. Half of the world's population live in areas which are at risk for this disease (17). According to the World Health Organization (WHO) in 2016, 212 million new cases were identified around the world. Among these people, 90% are in Africa, 7% in Southeast Asia and 2% in the Eastern Mediterranean region (17). In 2016 about 429,000 people died due to malaria (17). When malaria parasites enter a person's bloodstream, they infect and kill red blood cells (16). Obliteration of these stem cells leads to fever and flu-like symptoms such as chills, headache, muscle aches, fatigue, nausea, diarrhea, and vomiting (16). If Malaria, left untreated, it can lead to coma and death (16).

Malaria and HIV are two deadly pathogens today (18, 19). In areas such as South Africa, where malaria and HIV are prevalent, co-infection of these two is also common (19). In

[DOI: 10.18502/tbsrj.v4i1.8775]

tropical countries, pathophysiological, clinical and epidemiological interactions between HIV and pathogenic organisms is the main perturbing factor of public health (6, 20).

Pregnant women and children are at the highest risk of malaria mortality (19, 21). The findings of a cohort study conducted in western Kenya showed that co-infection with malaria and HIV doubles the risk of severe anemia in pregnant women (19, 22).

This infection has adverse consequences such as low birth weight, preterm delivery, increase in infant mortality, severe anemia, slow growth during pregnancy, and decreased transmission of maternal antibodies to the fetus. Besides, in some cases it increases the risk of HIV transmission from mother to fetus (19, 23).

In the case of malaria treatment, HIV infection can also disrupt the effectiveness of anti-malarial treatment and increases side effects (19, 24). Malaria also increases the viral load of HIV. Additionally, it increases the likelihood of transmitting the virus which leads to an increase in the prevalence of HIV eventually (19, 25).

Cryptosporidium

It is an intracellular parasitic parasite that infects the epithelium of the human gastrointestinal tract and a wide range of animals (26, 27). Among the 38 known species of Cryptosporidium, C. hominis and C. parvum are the main causes of Cryptosporidium infections among people (26, 28). Due to its prevalence in water sources, concomitant infection with multiple pathogens, including Cryptosporidium, is common among immunocompromised individuals around the world (29). Mortality from diarrhea among people living with HIV/AIDS is a significant challenge for clinicians and patients (30-32). Cryptosporidium species are known as one of the most important causes of diarrhea in children and adults. Additionally, it can cause chronic and life-threatening diseases in immunocompromised individuals, particularly among those with HIV/AIDS (33). Based on studies conducted in poor health area, HIV-positive people are more vulnerable to cryptosporidium than HIV-negative people (33). Based on the results of some studies, there is a significant relationship between increased mortality rate and co-infection with cryptosporidium in HIV/AIDS patients (26, 34).

It worth mentioning that 11.2% of HIV-infected people also have Cryptosporidium Whereas the prevalence of this parasitic disease among populations with healthy immune systems is estimated at a maximum of 1% in high-income countries and 5 to 10% in low-income countries (26). Some species of Cryptosporidium are C. parvum, C. hominis, C. muri and C. meleagridis which cause infections among people (8, 13, 35, 36).

Leishmania

Leishmaniasis is a vector-borne disease caused by Leishmania species. It has a wide range of clinical manifestations, from self-healing skin lesions to fatal (visceral) forms, and has been reported in nearly 100 countries worldwide (37).

More than 350 million people are at risk for this disease (37, 38). In Asia, Europe, Africa, Phlebotomus sandflies and in America Lutzomyia are the most important carriers of leishmaniasis (37). Clinically, leishmaniasis is divided into three types: cutaneous, visceral and cutaneous-mucosal. Visceral can be deadly in the absence or delay in diagnosis and treatment (37).

Visceral leishmaniasis is a monotonous disease that is more prevalent in tropical and subtropical regions. The World Health Organization (WHO) estimates about 200,000 to 400,000 cases and 20,000 to 40,000 deaths each year due to this disease (39). Since the first report of visceral leishmaniasis in Iran in the year 1994, the four main centers of this disease in Ardabil, Fars, East Azerbaijan and Bushehr provinces have been investigated (37).

Likewise, Mediterranean leishmaniasis is caused by L. infantum. It is the most common type of leishmaniasis in Iran and it is transmitted to humans by sandflies from infected dogs (37). Co-infection with Leishmania and HIV has been reported in 35

[DOI: 10.18502/tbsrj.v4i1.8775]

countries (39).
The first case of co-infection with leishmaniasis-HIV was reported in Europe in 1985 (40). Immune system failure, particularly a decrease in the number of CD4 + T lymphocytes, is triggered by HIV infection. Due to the vulnerability of HIV-positive people, visceral leishmaniasis can accelerate the progression of the disease in these people. Consequently, it causes AIDS (39). Clinical indicators in patients with co-infection are the same as patients with visceral leishmaniasis with a healthy immune system (39, 41).
People with co-infection, in some cases, instead of the symptoms of fever, paleness and hepatosplenomegaly, as seen in patients with healthy immune systems, experience some symptoms such as weakness, cough, diarrhea, malnutrition, and weight loss. Besides, in these patients, hepatosplenomegaly and fever are less common and more gastrointestinal symptoms are observed (39, 40). Diagnosis of patients with visceral leishmaniasis in HIV-positive individuals via serology has little sensitivity. In this regard, parasitological methods are mostly used procedure (39).

Discussion

In this review study, a number of opportunistic factors causing co-infection in people living with HIV were investigated. Weak immune system in these people creates a situation for opportunistic pathogens and this issue is one of the main causes of death in people living with HIV. According to the World Health Organization (WHO), nearly 38 million people worldwide are infected with HIV. Additionally, every year 1.7 million people are added to the total number of patients (2, 3).
All types of opportunistic infections caused by viruses, parasites, bacteria, fungi and other pathogens can threaten the lives of people living with HIV. In this investigation, three common parasitic diseases were mentioned in concomitant HIV infections. Plasmodium, Leishmania and Cryptosporidium are among the most common causes of parasitic diseases in humans. Furthermore, malaria and visceral leishmaniasis have significant mortality rates in the world. They can be very dangerous in case of infection in people with HIV. Additionally, parasites such as Cryptosporidium, which cause diarrhea, can also be life-threatening for those people.

Conclusion

Due to the resistance of HIV-co-infected infections to treatment, the best solution is to prevent HIV infection and provide medical and health care for HIV-positive people. Concerning the strategies to prevent and reduce the prevalence of HIV some factors are highlighted as follow. As an example, screening people in the community, applying protective equipment during sexual intercourse and non-use of shared syringes are considered as common preventing procedures. Besides, Treatment as Prevention (TasP), which is recommended to prevent the disease from being spread from one infected person to another, Post-exposure prevention (PEP), which should be done 48 to 72 hours after exposure and Pre-Virus Prevention (PrEP) should be considered concerning this issue (4). Likewise, the dominant factor concerning prevention is to increase the awareness of people in the community about the HIV virus. It is recommended that such awareness raising be implemented in a planned and codified manner at the community level via relevant institutions.

Acknowledgments

The authors of the article express their gratitude to the Student Research Committee of Mazandaran University of Medical Sciences for supporting this study.

Authors' contributions

All authors have intellectually committed to the study design and process. The final manuscript was revised and accepted by all authors.

[DOI: 10.18502/tbsrj.v4i1.8775]

References

1. Bourgeois A-C, Edmunds M, Awan A, Jonah L, Varsaneux O, Siu W. Can we eliminate HIV?: HIV in Canada—surveillance report, 2016. Canada Communicable Disease Report. 2017;43(12): 248.
2. Jiang H, Zhou Y, Tang W. Maintaining HIV care during the COVID-19 pandemic. The Lancet HIV. 2020;7(5):e308-e9.
3. Dybul M, Attoye T, Baptiste S, Cherutich P, Dabis F, Deeks SG, et al. The case for an HIV cure and how to get there. The Lancet HIV. 2020.
4. Duteil C, de La Rochebrochard E, Piron P, Segouin C, Troude P. What do patients consulting in a free sexual health center know about HIV transmission and post-exposure prophylaxis? BMC public health. 2021;21(1):1-10.
5. Chang CC, Crane M, Zhou J, Mina M, Post JJ, Cameron BA, et al. HIV and co-infections. Immunological reviews. 2013;254 (1):114-42.
6. Jegede FE, Oyeyi TI, Abdulrahman SA, Mbah HA, Badru T, Agbakwuru C, et al. Effect of HIV and malaria parasites co-infection on immune-hematological profiles among patients attending anti-retroviral treatment (ART) clinic in Infectious Disease Hospital Kano, Nigeria. PLoS One. 2017; 12(3):e0174233.
7. Newton C. Interaction between Plasmodium falciparum and human immunodeficiency virus type 1 on the central nervous system of African children. Journal of neurovirology. 2005;11.
8. Tian L-G, Chen J-X, Wang T-P, Cheng G-J, Steinmann P, Wang F-F, et al. Co-infection of HIV and intestinal parasites in rural area of China. Parasites & vectors. 2012;5(1):1-7.
9. Mayer KH, Karp CL, Auwaerter PG, Mayer KH. Coinfection with HIV and tropical infectious diseases. II. Helminthic, fungal, bacterial, and viral pathogens. Clinical Infectious Diseases. 2007;45(9): 1214-20.
10. Corbett EL, Steketee RW, Ter Kuile FO, Latif AS, Kamali A, Hayes RJ. HIV-1/AIDS and the control of other infectious diseases in Africa. The Lancet. 2002;359 (9324):2177-87.
11. Mohandas K, Sehgal R, Sud A, Malla N. Prevalence of intestinal parasitic pathogens in HIV-seropositive individuals in Northern India. Japanese journal of infectious diseases. 2002;55(3):83-4.
12. Nielsen NO, Friis H, Magnussen P, Krarup H, Magesa S, Simonsen PE. Co-infection with subclinical HIV and Wuchereria bancrofti, and the role of malaria and hookworms, in adult Tanzanians: infection intensities, CD4/CD8 counts and cytokine responses. Transactions of the Royal Society of Tropical Medicine and Hygiene. 2007;101(6):602-12.
13. Benczik M, Gaffen SL. The interleukin (IL)-2 family cytokines: survival and proliferation signaling pathways in T lymphocytes. Immunological investigations. 2004;33(2):109-42.
14. Wang Z-D, Wang S-C, Liu H-H, Ma H-Y, Li Z-Y, Wei F, et al. Prevalence and burden of Toxoplasma gondii infection in HIV-infected people: a systematic review and meta-analysis. The Lancet HIV. 2017;4(4): e177-e88.
15. Nissapatorn V. Toxoplasma gondii and HIV: a never-ending story. The Lancet HIV. 2017;4(4):e146-e7.
16. Maxwell O, Mayowa BA, Chinedu IU, Peace AE. Biometry Investigation of Malaria-Disease, Mortality and Modeling; an Autoregressive Integrated Approach. Americal Journal of Mathematics and Statistics. 2019;9(1):11-6.
17. Piroozi B, Moradi G, Safari H, Faraji L, Sadi S, Alinia C, et al. Incidence, mortality, and burden of malaria and its geographical distribution in Iran during 2002-2015. Iranian Journal of Public Health. 2019;48:53-61.
18. Barley K, Murillo D, Roudenko S, Tameru A, Tatum S. A mathematical model of HIV and malaria co-infection in sub-Saharan Africa. Journal of AIDS and Clinical Research. 2012;3(7).

[DOI: 10.18502/tbsrj.v4i1.8775]

19. Kwenti TE. Malaria and HIV coinfection in sub-Saharan Africa: prevalence, impact, and treatment strategies. Research and reports in tropical medicine. 2018;9:123.
20. Van Geertruyden JP. Interactions between malaria and human immunodeficiency virus anno 2014. Clinical microbiology and infection. 2014;20(4):278-85.
21. Kwenti TE, Kwenti TDB, Latz A, Njunda LA, Nkuo-Akenji T. Epidemiological and clinical profile of paediatric malaria: a cross sectional study performed on febrile children in five epidemiological strata of malaria in Cameroon. BMC infectious diseases. 2017;17(1):1-13.
22. Ayisi JG, Van Eijk AM, Ter Kuile FO, Kolczak MS, Otieno JA, Misore AO, et al. The effect of dual infection with HIV and malaria on pregnancy outcome in western Kenya. Aids. 2003;17(4):585-94.
23. Flateau C, Le Loup G, Pialoux G. Consequences of HIV infection on malaria and therapeutic implications: a systematic review. The Lancet infectious diseases. 2011;11(7):541-56.
24. Chijioke-Nwauche IN. Use of artemether-lumefantrine in the treatment of asymptomatic-malaria infection in HIV-positive and HIVnegative Nigerian adults: London School of Hygiene & Tropical Medicine; 2014.
25. Franke MF, Spiegelman D, Ezeamama A, Aboud S, Msamanga GI, Mehta S, et al. Malaria parasitemia and CD4 T cell count, viral load, and adverse HIV outcomes among HIV-infected pregnant women in Tanzania. The American journal of tropical medicine and hygiene. 2010; 82(4):556-62.
26. Ahmadpour E, Safarpour H, Xiao L, Zarean M, Hatam-Nahavandi K, Barac A, et al. Cryptosporidiosis in HIV-positive patients and related risk factors: A systematic review and meta-analysis. Parasite. 2020;27.
27. Chen X-M, Keithly JS, Paya CV, LaRusso NF. Cryptosporidiosis. New England Journal of Medicine. 2002;346(22): 1723-31.
28. Feng Y, Ryan UM, Xiao L. Genetic diversity and population structure of Cryptosporidium. Trends in parasitology. 2018;34(11):997-1011.
29. Han M, Xiao S, An W, Sang C, Li H, Ma J, et al. Co-infection risk assessment of Giardia and Cryptosporidium with HIV considering synergistic effects and age sensitivity using disability-adjusted life years. Water research. 2020;175:115698.
30. Opoku YK, Boampong JN, Ayi I, Kwakye-Nuako G, Obiri-Yeboah D, Koranteng H, et al. Socio-Behavioral Risk Factors Associated with Cryptosporidiosis in HIV/AIDS Patients Visiting the HIV Referral Clinic at Cape Coast Teaching Hospital, Ghana. The open AIDS journal. 2018;12:106.
31. Deeken JF, Tjen-A-Looi A, Rudek MA, Okuliar C, Young M, Little RF, et al. The rising challenge of non–AIDS-defining cancers in HIV-infected patients. Clinical infectious diseases. 2012;55(9):1228-35.
32. Deeks SG, Lewin SR, Havlir DV. The end of AIDS: HIV infection as a chronic disease. The Lancet. 2013;382(9903):1525-33.
33. Okosun K, Khan M, Bonyah E, Ogunlade S. On the dynamics of HIV-AIDS and cryptosporidiosis. The European Physical Journal Plus. 2017;132(8):1-25.
34. Xiao L, Cama VA. Cryptosporidium and cryptosporidiosis. Foodborne parasites: Springer; 2018. p. 73-117.
35. Cama V, Gilman RH, Vivar A, Ticona E, Ortega Y, Bern C, et al. Mixed Cryptosporidium infections and HIV. Emerging infectious diseases. 2006;12(6): 1025.
36. Traversa D. Evidence for a new species of Cryptosporidium infecting tortoises: Cryptosporidium ducismarci. Parasites & vectors. 2010;3(1):1-4.
37. Moradi-Asl E, Hanafi-Bojd AA, Rassi Y, Vatandoost H, Mohebali M, Yaghoobi-Ershadi MR, et al. Situational analysis of visceral leishmaniasis in the most important endemic area of the disease in Iran. Journal of arthropod-borne diseases. 2017; 11(4):482.
38. H Branquinha M, S Sangenito L, L

[DOI: 10.18502/tbsrj.v4i1.8775]

Sodre C, F Kneipp L, M d'Avila-Levy C, LS Santos A. The widespread anti-protozoal action of HIV aspartic peptidase inhibitors: focus on Plasmodium spp., Leishmania spp. and Trypanosoma cruzi. Current topics in medicinal chemistry. 2017;17(11):1303-17.
39. Lindoso JAL, Moreira CHV, Cunha MA, Queiroz IT. Visceral leishmaniasis and HIV coinfection: current perspectives. Hiv/aids (Auckland, NZ). 2018;10:193.
40. Coutinho JVSC, Santos FSd, Ribeiro RdSP, Oliveira IBB, Dantas VB, Santos ABFS, et al. Visceral leishmaniasis and leishmaniasis-HIV coinfection: comparative study. Revista da Sociedade Brasileira de Medicina Tropical. 2017;50(5):670-4.
41. Lindoso JA, Cota GF, Da Cruz AM, Goto H, Maia-Elkhoury ANS, Romero GAS, et al. Visceral leishmaniasis and HIV coinfection in Latin America. PLoS Negl Trop Dis. 2014;8(9):e3136.

[DOI: 10.18502/tbsrj.v4i1.8775]