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Mini Review

Diseases Transmitted by Vectors: Possible Examples of Lymphatic Filariasis, Malaria and Schistosomiasis

Jeyatheepan Jeyaretnam*

SP.MSC, International Medical and Scientific Coordinator, Leg Clinics Net (Klinik Piano AG), Department of General Medicine, Instrumental Lymph Drainage Approaches, Switzerland

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***Corresponding author:** Jeyatheepan Jeyaretnam, SP. MSC, International Medical and Scientific Coordinator, Leg Clinics Net (Klinik Piano AG), Department of General Medicine, Instrumental Lymph Drainage Approaches, Switzerland, E-mail: jeyanjeyaretnam@gmail.com

ORCiD: https://orcid.org/0000-0002-7811-2075

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Abstract

Human health is affected by climate change, which has a significant impact on pathogens (parasites, viruses, and bacteria), vectors, and reservoir hosts, affecting the transmission of many vector-borne diseases. Multiple vectors have expanded their latitudinal and altitudinal range, and the length of the season in which they are active is increasing. It is expected that these trends will continue as the climate continues to warm. In this review, it is presumed that lymphatic filariasis, malaria, and schistosomiasis are a concern, and emphasis is placed on the treatment options for these diseases. This will provide awareness and emphasize the importance of preventative measures such as vaccinations, vector control, and personal protective measures.

Introduction

Diseases transmitted by vectors are human diseases caused by parasites, viruses, and bacteria that are transmitted by vectors. Each year, more than 700,000 people die from diseases such as malaria, dengue, schistosomiasis, African trypanosomiasis, leishmaniasis, Chagas disease, yellow fever, Japanese encephalitis and onchocerciasis [1]. These diseases have the highest burden in tropical and subtropical areas and disproportionately affect the poorest sections of the population. There have been major outbreaks of dengue, malaria, chikungunya, yellow fever, and Zika in many countries since 2014, devastating populations, claiming lives, and overwhelming health systems. Whereas other diseases such as chikungunya, leishmaniasis, and lymphatic filariasis lead to chronic suffering, lifelong morbidity, disability, and sometimes stigmatization.

The term vector-borne diseases refers to human diseases caused by the transmission of parasites, bacteria, or viruses by vectors. These vectors are living organisms such as ticks, mosquitoes, or other flies that transmit pathogens from person to person or from animal to person [2]. Diseases caused by the vectors can range from asymptomatic or mild to severe, life-threatening illnesses or chronic diseases with the possibility of permanent disability. These illnesses include dengue fever, malaria, yellow fever, and Japanese encephalitis. Here, it is assumed that lymphatic filariasis, malaria, and schistosomiasis are an issue, and draw attention to these diseases, and their treatment options.

The lymphatic filariasis

Better known as elephantiasis, is a disease of the lymphatic system. It may lead to the enlargement of the limbs due to severe swelling and thickening of the tissue. Although most cases are asymptomatic, damage to the kidneys and lymphatic system can occur. Regrettably, as there are no signs of disease, humans the infected, contributing to the transmission cycle between humans and mosquitoes. We use the term acute lymphatic filariasis to describe episodes of local inflammation of the skin, lymph nodes, and lymphatic vessels, which may

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be a reaction to the parasite or an infection. The secondary, acute episodes are often accompanied by the chronic form of the disease. During its chronic stage, lymphatic filariasis causes lymphedema, which contributes to limb hypertrophy and hydrocele. This disease is painful and leaves the limbs disfigured as elephantiasis, which can lead to permanent disability, job loss, and social stigmatization. Also, chronic lymphatic filariasis can have a significant impact on patients' mental health.

While most people become infected during childhood, the disease usually only occurs in adulthood. Males are more frequently affected by lymphatic filariasis than females. Globally, there are an estimated 15 million cases of lymphoedema, 25 million cases of hydrocele in men, and at least 36 million cases of disfigured limbs. Approximately 65% of cases come from the South East Asia region and 30% from the Africa region. The remaining cases are found in tropical regions, including parts of the Americas and the Pacific West Coast [3,4].

Transmission Lymphatic filariasis is an infection caused by parasitic nematodes (roundworms) of the Filariodidea family. These worms live as adults in the lymphatic vessels and disrupt the normal functioning of the system. These nematodes produce larvae, also called microfilariae, which live in the blood vessels. Breeding mosquitoes become infected when they ingest these microfilariae while feeding on the blood of infected animals or humans. These microfilariae develop inside the mosquito and are transmitted to human skin when the mosquito feeds. The transmission cycle continues as the worms migrate from the skin into the lymphatic vessels, become adults, and produce more larvae [3,4].

Malaria

One of the world's biggest health problems is malaria. This acute febrile illness is caused by parasites of the genus *Plasmodium*, which are transmitted by female *Anopheles* mosquitoes. Being infected with malaria parasites can lead to a variety of symptoms, ranging from no or very mild symptoms to severe illness and death. However, malaria is generally a curable disease if diagnosed quickly enough and treated appropriately. In places where malaria is endemic, people can develop partial immunity so that asymptomatic infections can occur. For a non-immune person, symptoms usually appear 10 to 15 days after the bite of an infectious mosquito. Initial symptoms can be easy to recognize, but can also be difficult to detect, as malaria manifests clinically with symptoms such as fever, chills, sweating, headache, nausea and vomiting, body aches, and general malaise. Unless the disease is treated immediately with effective medication, it can progress to a severe illness that often leads to death. Severe malaria manifestations include cerebral malaria with behavioral disturbances, impaired consciousness, convulsions, coma, or other neurological abnormalities; severe anemia and hemoglobinuria due to hemolysis; acute respiratory distress syndrome, which may still occur even after parasite counts have decreased in response to treatment; clotting disorders; hypotension due to cardiovascular collapse; acute renal insufficiency; hyperparasitemia, in which more than 5% of red blood cells are infected with parasites; and metabolic acidosis, often associated with hypoglycemia. Major malaria is a medical emergency and must be treated urgently and aggressively. There are certain populations at significantly higher risk of contracting malaria and developing severe disease. Among these are infants, children under the age of five, pregnant women and HIV/AIDS patients, unvaccinated migrants, mobile populations, and travelers. Prompt diagnosis and treatment reduce the course of the disease, prevent deaths, and help to reduce transmission. [5]

Exposure to malaria occurs mainly in low-income tropical and subtropical regions of the world. In 2018, nearly half of the world's population in 91 countries and territories lived in areas at risk of malaria transmission, and there were an estimated 228 million malaria cases and 405,000 malaria deaths worldwide. Among children, those under five are the most vulnerable group, accounting for 67% of all malaria-related deaths worldwide in 2018. There is a disproportionate share of the global disease burden in Africa. In 2018, 93% of all malaria cases worldwide and 94% of malaria-related deaths were recorded in this region. During the same year and according to the regions defined by the WHO, *Plasmodium falciparum* accounted for the majority of estimated cases in Africa (99.7%), Eastern Mediterranean (71%), Western Pacific (65%) and Southeast Asia (50%). But *Plasmodium vivax* is the predominant parasite in the Americas region, where it is responsible for 75% of malaria cases [6].

It is transmitted to humans through the bite of infected female *Anopheles* mosquitoes and is caused by *Plasmodium* parasites. *Anopheles* mosquitoes come in more than 400 different species, and about 30 of them are the main vectors of malaria. The five species of parasites that cause malaria in humans (*P. falciparum*, *P. vivax*, *P. ovale*, *P. malariae*, and *P. knowlesi*), two of which (*P. falciparum* and *P. vivax*) are particularly dangerous. The main vector species all bite between dusk and dawn. How intense the transmission is depends on factors related to the parasite, the vector, the human host, and the environment. It is transmitted by the cyclic infection of humans and female *Anopheles* mosquitoes. In order for malaria transmission to occur, the conditions for the most important components of the life cycle must be present: This is the presence of *Anopheles* mosquitoes that can feed on humans and whose parasites spend half of their life cycle in an invertebrate host [6].

Schistosomiasis (Bilharzia)

Shistosomiasis (or schistosomiasis) caused by parasitic trematodes of the genus *Schistosoma*. The disease is classified as both acute and chronic. Two main forms of schistosomiasis exist, the intestinal and urogenital forms, which result from the host's reaction to the parasite's eggs when they are excreted from the body. Enteric schistosomiasis is characterized by abdominal pain, diarrhea, blood in the stool, high blood pressure in the abdominal blood vessels, hepatomegaly, and splenomegaly. Although the main feature of urogenital schistosomiasis is hematuria, it can also cause bladder and ureteral damage and fibrosis, kidney damage, and

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bladder cancer. Furthermore, urogenital schistosomiasis is also considered a risk factor for HIV infection, especially in women, and can lead to irreversible infertility.

The schistosomiasis occurs in tropical and subtropical areas. Poor communities dependent on agriculture and fishing and those without adequate sanitation are most affected by the disease. The burden is borne by those with existing sanitation systems. These areas are home to more than 700 million people, mainly in sub-Saharan Africa [2,7].

However, *Schistosoma mansoni*, *S. haematobium*, and *S. japonicum* cause disease in humans; more rarely, *S. mekongi* and *S. intercalatum* can also cause disease. They are transmitted when humans come into contact with infested water, from which the larval forms of the parasite released by the water snails penetrate the skin. In the human body, the larvae then develop into adults and live in the blood vessels, where the females lay their eggs. When these eggs leave the body via urine or feces and contaminate other freshwater sources, the parasite's life cycle continues. All symptoms associated with schistosomiasis are reactions to the worm eggs, which are deposited in various tissues, and not to the worm itself. Aquatic snails are found as vectors in freshwater sources ranging from small temporary bodies of water to long-standing lakes and rivers. The snails are found in shallow waters, most commonly in shallow waters and most commonly in slightly polluted waters, such as sewage. Since snails can live in a variety of water sources, it is likely that humans will come into frequent contact with the vector during occupational, domestic, hygienic, or recreational activities, increasing the risk of infection [2,7].

Conclusion

The insects cause many vector-borne infectious diseases and have become a major threat to human health. Despite many control measures being taken, some insects are resistant to them, which is exacerbated by environmental changes and poses a major challenge for control measures. Targeting the genome of insects with genetic studies could be an alternative strategy. Emerging genome engineering technologies have expanded our ability to target any genomic sequence in eukaryotes, including insects. Such genome engineering tools as Zinc Finger Nucleases (ZFNs), transcription activator-like effector nucleases (TALENs), and the recently discovered Clustered Regularly Interspaced Short Palindromic Repeats (CRISPR) and CRISPR-associated protein 9 (Cas9) systems have the potential to control vector-borne diseases. Such approaches will be very worthwhile in the future to control the possible examples of lymphatic filariasis, malaria, and schistosomiasis.

Prevention of diseases is the key to combating them. Prevention is better than treatment. When it comes to disease treatment, it is a sad fact that for many diseases there is no definitive cure. Symptom relief, rehydration, rest, and prevention of secondary infections are appropriate for all diseases, but in general, for the diseases mentioned above, preventative measures are crucial.

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