PARASITIC DISEASES IMPORTED FROM THE TROPICS

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Abstract

With the increasing number of travelers around the world, the risk of contracting parasitic diseases increases, especially when tourists decide to visit tropical and subtropical countries. This paper presents the most frequently imported parasites from the tropics and the diseases caused by them. These parasites belong to both the group of protozoa and helminths. They attack all organs of the human body. They can be found in body fluids and tissues. The work also presents methods of preventing tropical diseases.

Keywords: parasites imported from the tropics, parasitic disease, prevention

INTRODUCTION

Nowadays, more and more people travel the world. More distant destinations, where the climate is significantly different from that in Europe, are becoming more and more popular. When going abroad, however, you should remember not only about different weather conditions, but also about parasites present in tropical and subtropical countries.

Infectious diseases, including parasitic diseases, account for the largest proportion of deaths worldwide. Despite the progress of medicine and spreading awareness among the public, a significant part of it still seems to be deprived of knowledge about the risks associated with trips to tropical countries. Diseases caused by parasites are therefore a significant problem, which is caused by many factors. Tourism plays a significant role in their spread. People are more and more willing to leave, forgetting about getting acquainted with the potential threat and possible prevention of infection. When deciding to go abroad, it is worth remembering about the different ways in which parasite infection can occur. This will allow appropriate precautions to be taken.

It can be alimentary and then, to avoid infection, you should eat only washed fruits and vegetables and meat after heat treatment. Many species of parasites are transmitted via vectors, which can be various species of insects. Then it is worth thinking about using insecticides. The

spread of parasitic diseases is also affected by non-compliance with basic hygiene rules. Tourists going especially to countries with a subtropical and tropical climate should exercise extreme caution. Few people who feel ailments after staying on the continent of Asia or Africa report to a doctor of tropical medicine. This means that when returning to the country, there is a high risk of developing a parasitic disease and thus its possible further spread.

Parasites and the diseases they cause

Plasmodium spp. and Malaria

Malaria is the most common parasitic disease in the world. The protozoans of the genus Plasmodium that cause it are transmitted to the human body by mosquitoes belonging to the genus Anopheles. The definitive host is the female mosquito, which introduces the invading sporozoites into the bloodstream during prick and blood sucking. According to WHO, approximately 220 million people fall ill with malaria annually, mainly in Africa and Southeast Asia. Climate plays a major role in the occurrence and spread of malaria. This is due to the environmental conditions that are necessary for the life of mosquitoes, which are vectors of the disease. Their number depends on temperature, humidity, rainfall and the length of daylight. Mosquitoes have developed certain strategies that allow them to survive in lower temperatures, but the most optimal conditions for their development, and thus the spread of malaria, are temperatures of 20-33°C and humidity above 60%. The risk of infection for tourists and populations living in tropical and subtropical areas also depends on certain cultural characteristics: the circadian rhythm of the day, building houses in the vicinity of mosquito breeding areas, access to mosquito nets and healthcare.

Typical symptoms of malaria are a high, rapidly increasing fever and chills. Diarrhea, headaches and muscle aches are possible. Fever subsides after a few hours, and its episodes are repeated in the patient every 48/72 hours, depending on the species of the parasite. In severe forms of malaria, once Plasmodium reaches the central nervous system, the patient may fall into a coma, which is referred to as cerebral malaria.

The species Plasmodium falciparum is considered to be particularly dangerous for human life. As many as 85 countries are considered endemic for this species, and 2.6 billion people live in the area at risk of infection (1). These are mainly areas of Africa and Asia.

P. vivax was recognized by WHO in 2015 as the parasite most frequently causing malaria outside of Africa (2). It shows the widest range of occurrence resulting from a relatively wide range of temperature tolerance. It requires a minimum temperature of 16°C to live, while

P. falciparum, by comparison, can live at temperatures as low as 21°C (1). It prevails in the regions of Southeast Asia and South America.

The species P. ovale occurs in sub-Saharan Africa. Infection with this parasite does not result in future immunity, but a reduction in parasitemia and fever has been observed in re-infected patients (1).

In the development of P. vivax and P. ovale, sporozoites introduced with mosquito saliva remain dormant in hepatocytes as so-called hypnozoites, which are responsible for the relapse of the disease. For this reason, the elimination of these species is more difficult than P. falciparum.

Slightly different symptoms are observed in P. malariae infection than in other cases. Malaria caused by this species is believed to be the mildest form of the disease. There is a fever lasting, due to the long life cycle of the parasite, 72 hours. P. malariae is considered to be the agent responsible for the so-called chronic malaria. It is common in sub-Saharan Africa and Asia (1).

On the other hand, the species P. knowlesi found in Southeast Asia is characterized by a relatively short, 24-hour period of reproduction, which means that the level of parasitemia in this case is very high (3). For infection, it is necessary to be bitten by a mosquito that feeds on the blood of macaque monkeys. Human-to-human transmission has not been reported (2).

Preventing the spread of malaria involves draining mosquito-infested areas, using insect repellent chemicals, taking antimalarial drugs, and vaccinating. Currently, WHO recommends vaccination of children living in areas with a high risk of P. falciparum infection, and the most effective treatment is artemisinin-based therapy (4).

Trypanosoma spp. and trypanosomiasis

Trypanosomatidae is a family of protozoa belonging to the Kinetoplastida class and the Euglenata type, parasitizing many species of vertebrate animals (including humans) and invertebrates. In the case of vertebrates, the biotope of Trypanosomatidae is blood plasma, lymph, cerebrospinal fluid and organ parenchyma, and in invertebrates its developmental forms are located mainly in the intestine and salivary glands. Trypanosomes reproduce asexually, and in their development cycle there are usually two hosts - a vertebrate animal and an insect (5).

Trypanosomes are an important epidemiological factor in people in tropical regions of the world - mainly in sub-Saharan Africa, Central and South America, but sporadic infections are also recorded in Europe.

Trypanosoma brucei gambiense and T. b. rhodesiense are the etiological agents of African trypanosomiasis, however, the disease is characterized by some differences depending on which trypanosome subspecies is responsible. The more aggressive subspecies T. b. rhodesiense is widespread in the savannah and lake regions of East and South Africa, while T. b gambiense causes a chronic, milder form of sleeping sickness and can be transmitted in areas of West and Central Africa. The sole vector of the parasite is the tsetse fly (Glossina palpalis), and its habitat is a strip of land extending south of the Sahara and north of the Kalahari Desert (6). It feeds on the blood of humans and animals and during the puncture introduces invasive forms of trypomastigotes into the bloodstream with saliva - metacyclic trypomastigotes, which reproduce asexually and spread throughout the body. The tsetse fly itself becomes infected by drinking the blood of infected mammals (including humans) that are the reservoir of the parasite. At the puncture site, a characteristic inflammatory nodule called a shank forms, which disappears after 3-4 weeks. Then begins the acute phase of parasitemia characterized by general weakness, itching of the skin, headaches and joint pains, enlarged lymph nodes and, above all, high fever, which occurs with periods without fever. T. brucei evades the immune response by periodically changing a variant of the VSG glycoprotein that is expressed on the parasite's body surface (7). The disease continues to progress and myocarditis and nephritis, hemolytic anemia and hepatosplenomegaly may occur. In the late period of infection, even after several years, the protozoa penetrate the central nervous system. The patient then shows symptoms of encephalitis and disturbance of consciousness, and then falls into a coma ending in death. In contrast to Rhodesian sleeping sickness, the disease caused by T. brucei gambiense is characterized by enlarged cervical lymph nodes (Winterbottom's sign) and slower progression (6). Trypanosomiasis is also a serious threat to people traveling in endemic areas. An epidemiological history indicating a stay in Africa, the presence of a nodular lesion on the skin, high fever and symptoms from the nervous system should prompt physicians to immediately diagnose T. brucei infection. Regardless of the subspecies causing sleeping sickness, untreated it always leads to death (8). The methods of preventing trypanosomiasis are protection against the bite of the tsetse fly, so wearing long clothes, using mosquito nets and repellents. Given the high degree of antigenic variability of the surface glycoprotein, the development of a vaccine for this disease is unlikely (9).

Trypanosoma cruzi in animals, including humans, causes a disease known as American trypanosomiasis (Chagas disease), which is completely different from African sleeping sickness. It affects 16-18 million people worldwide - endemic areas are found mainly in Latin and South American countries, and about 50,000 people die annually. It is found almost

exclusively in rural areas. The vector of this trypanosome are blood-sucking bugs of the family Reduviidae and subfamily Triatominae (also known as "kissing bugs"). Infection occurs as a result of contact of the excretions (faeces) of the bug containing invasive forms of trypomastigotes with damaged skin or mucous membranes (10). In Brazil and Colombia, cases of American trypanosomiasis epidemics have been reported after consumption of fruit or sugar cane juice contaminated with bug faeces (11). Blood transfusions, mainly from T. cruzi-infected immigrants from Latin America, are becoming increasingly important from the point of view of parasite transmission (12,13).

Inflammation (infiltration called chagoma) forms at the site of the parasite's penetration through the skin, and the initial acute systemic symptoms are similar to influenza. There are also edema and hepatosplenomegaly.

The characteristic symptom of Chagas disease is unilateral, painless swelling of the eyelid and orbital tissues (Romana's sign). The disease is most often fought off by the body at this stage, but in some of the infected it turns into a chronic form and within a few years leads to the destruction of key organs and tissues, including the heart, ganglia of the parasympathetic system, intestines, and stomach. Advanced symptoms of the chronic phase appear even many years after the primary infection (6). Reducing the incidence of Chagas disease can be achieved by fighting the bugs carrying T. cruzi, so the use of insecticides is effective.

Leishmania spp. and Leishmaniasis

Leishmaniasis is caused by flagellates of the genus Leishmania, which are transmitted by flies of the genera Lutzomyia and Phlebotomus.

The reservoir of protozoa are people, domestic and wild animals (rodents, cattle, dogs and cats), and mosquitoes are the vector. Human infection most often occurs as a result of being bitten by a female mosquito or crushing and rubbing a mosquito into a wound, blood transfusion or intravenous drugs, and also from mother to fetus. After entering the body, Leishmania protozoa infect macrophages, as a result of which the pathogen spreads, including to the liver, spleen and bone marrow.

There are three clinical forms of leishmaniasis: cutaneous, mucocutaneous and visceral. Leishmania species that cause cutaneous leishmaniasis in humans include L. major, L. tropica, L. infantum, L. mexicana, L. amazonensis, L. braziliensis, L. guyanensis and L. panamensis (14).

Visceral leishmaniasis (kala-azar, black fever, dum-dum fever) – caused by flagellates L. donovani and L. infantum. This is one of the most dangerous varieties of the disease.

Symptoms include recurring fever lasting more than two weeks, increasing weakness and wasting, weight loss, anemia, profuse sweating, diarrhea, nausea, skin hyperpigmentation, enlarged lymph nodes, enlarged liver and spleen, presence of fluid in the abdominal cavity, edema. Immune disorders in the course of leishmaniasis predispose to secondary bacterial infections of the lungs and gastrointestinal tract, tuberculosis and sepsis. The incubation period of the disease is 3-6 months. The course of the disease can be sudden, fulminant, but in most cases the disease lasts secretly for many months, and sometimes years. Untreated visceral leishmaniasis leads to death in 95% of patients within 2 years of the onset of symptoms. Most deadly epidemics occur in India, Nepal, Bangladesh, Ethiopia, Sudan and Brazil. According to the WHO report (15), there were about 50-90 thousand new cases of visceral leishmaniasis.

Cutaneous leishmaniasis (white leprosy, Aleppo ulcer) – caused by flagellates L. major, L. tropica, L. mexicana, L. aeothiopica. Usually, within a few weeks of being bitten by a mosquito, skin lesions appear, most often on the exposed parts of the limbs and face. The first symptom is a red papule up to 2 cm in diameter, which transforms into a characteristic ulceration with raised edges with serous exudate or central necrosis and crusts. The lesions may be diffuse. Enlargement of the surrounding lymph nodes is usually also observed. Within 2-10 months, the skin lesions heal spontaneously, leaving scars. Occurs e.g. in Brazil, Afghanistan, Algeria, Colombia, Iran, Syria and Peru. According to the WHO report (15), there were about 600,000 up to 1 million new cases of cutaneous leishmaniasis.

Cutaneous-mucosal leishmaniasis (pendine) – caused by L. brasiliensis. Typical skin changes are initially observed. After many years, inflammatory and ulcerative lesions may develop within the mucosa of the upper respiratory tract. The first symptom is nosebleeds and blockage. Then there is the development of painful ulcerations within the mucous membranes, destruction of the tissues of the nose, palate, lips, larynx, which leads to disfigurement and disability. It mainly affects the inhabitants of Bolivia, Brazil and Peru.

Currently, the disease is common in tropical and subtropical countries and in southern Europe, with a geographical distribution of about 90 countries. According to WHO reports, apart from Australia and Antarctica, the disease can be found in people on every continent. In the Old World, leishmaniasis has been reported in parts of Asia, tropical and northern parts of Africa, southern Europe and the Middle East. In the New World, it is widespread in parts of Mexico, South and Central America. The estimated number of reported new cases per year is between 0.7 and 1.2 million. There has been a decrease in the incidence of the visceral form of the disease, for over 400,000 years. to less than 100,000 cases (16). The disease affects the

world's poorest people and is linked to malnutrition, population displacement, poor housing, weak immune systems and lack of financial resources.

In Europe, cutaneous leishmaniasis is most often found in tourists and truck drivers returning from the Middle East or people who have spent their holidays at the Mediterranean Sea (in Spain, Portugal, France, Greece, Bulgaria).

Neutralizing the source of infection consists mainly in spraying insecticides at breeding sites of mosquitoes. In order to protect against infection, it is necessary to use personal protective equipment and repellents that effectively repel insects when traveling to areas where the disease is present. It is also important to avoid going outside at the time of greatest mosquito feeding, i.e. in the early morning and at dusk, and to use clothing that covers parts of the body exposed to bites.

Entamoeba histolitica and Amoebiasis

The multitude of parasitic diseases imported from the tropics does not allow for a precise description of all of them, but among them there are those that cannot be overlooked. One of them is amoebiasis, otherwise - amoebiasis - caused by the dysentery amoeba (E. histolytica). The occurrence of this parasite is present all over the world, but its particularly characteristic place of residence are countries where poor socioeconomic and sanitary conditions prevail. It is estimated that 480 million people worldwide are infected with E. histolytica and 40,000 to 110,000 people die from it annually (17).

It can be observed that the occurrence of amoebiasis is caused by the increased popularity of tourism and emigration from areas where this parasite occurs. The probability of infection is not dependent on gender and age, it depends only on the geographical location and susceptibility of the host organism. Infection can take many forms, such as: asymptomatic colonization, amebic enteritis, or amoebic abscess formation. Symptoms may appear months or years after exposure to the pathogen. Fortunately, most infections are asymptomatic and the phenomenon of tissue invasion is a rare phenomenon (18).

The life cycle of this parasite begins with the ingestion of its cysts with food or water contaminated with feces. After passing through the stomach, the parasite leaves the cyst and functions as an active trophozoite in the large intestine, which reproduces by simple division. Cysts are excreted in the faeces and can survive in a humid environment for a long time - weeks or even months (18).

Characteristic symptoms of amebic enteritis are abdominal pain and bloody diarrhea (which may be watery or mucus). The disease can also have a chronic form, where intermittent

abdominal pain, diarrhea and weight loss occur over many years. In isolated cases, amoebic dysentery trophozoites enter the bloodstream and spread throughout the body, most often to the liver, as metastases from the intestine via the portal vein - then it is an amoebic liver abscess (18).

Clonorchis sinensis and Clonorchiasis

Clonorchis sinensis, otherwise known as the Chinese fluke, is a hemaphroditic parasite with a slender, leafy shape. It occurs mainly in poor areas of East Asia, e.g. in China, South Korea, northern Vietnam and also in Taiwan.

C. sinensis causes the disease clonorchiasis, which is one of the most common parasitic infections in the world. Currently, about 15-20 million people in the world are infected with it, of which as many as 13 million are in China alone. The World Health Organization has recognized C. sinensis as the parasite causing one of the most neglected tropical diseases. Men are more often infected with this fluke (19).

Infection with Chinese fluke is usually due to the consumption of raw or undercooked freshwater fish containing the metacercaria stage. In addition, due to the poor hygiene in areas particularly exposed to clonorchiasis, it is also possible to become infected by eating products that have been stored in close proximity to infected fish and kitchen utensils (19). The development of tourism turns out to be a growing problem in combating clonorchiasis. Travelers using local restaurants or street bars often unknowingly become infected with the parasite and then, returning to their home country, transfer the parasites to places where it was not originally present.

C. sinensis, after entering the human body, passes from the duodenum through the ampulla of Vater and then locates itself in the biliary system, where it can live up to 30 years. One individual produces up to 4,000 eggs a day through sexual reproduction (20). Initially, patients report to the doctor with a mild fever, malaise, abdominal pain, epigastric tenderness, and food aversion (21). With the development of the disease, the occurrence of jaundice and hepatomegaly is characteristic. Chronic invasion may lead to cholelithiasis, cholangitis or cholecystitis (20). The most severe complication of C. sinensis infection may be cholangiocarcinoma. It is estimated that out of 100,000 cases of cholangiocarcinoma, infection with this parasite is responsible for about 25-35 (19). In children, clonorchiasis may also lead to retardation of growth and mental development (20).

As tourism is currently developing at a surprising pace, the main preventive measures include education in the proper preparation of meals and assessment of the quality of nutrition.

Fasciola hepatica and Fasciolosis

Fasciola hepatica, or the liver fluke, is a flat fluke with a leafy shape and a brownish color. Parasite infections occur all over the world. However, most cases have been reported in North Africa, South America, Iran and Eastern Europe. They mainly concern populations living in poverty (22). The number of infections is extremely difficult to estimate, but it is currently assumed that about 2.6 million people are infected with fasciolosis. It is worth emphasizing that the main factors increasing the incidence of F. hepatica are massive tourism, population migrations, as well as globalization, as they create an opportunity to introduce these parasites to new, previously uninhabited areas (23).

The liver fluke has an intermediate host, a freshwater snail, in its life cycle. However, the definitive hosts are mainly farm animals such as goats or sheep, and humans are only accidental hosts. Infection occurs as a result of drinking water or aquatic plants. After ingestion of the metacercaria stage of the parasite, it pierces the host's intestine and enters the peritoneum, from where it then travels towards the bile ducts.

Symptoms of the disease appear after about 1-3 months after ingestion of metacercaria. In the case of the chronic phase, jaundice, pain in the right upper quadrant, cholangitis, and even liver abscesses occur most often. The greatest danger in the course of the disease concerns children who may experience delayed mental development and growth disorders (22).

For preventive purposes, it seems most reasonable to educate the public, especially in developing countries where a significant increase in tourism can be seen. It also seems justified to use molluscicide preparations and drain water reservoirs.

Paragonimus westermani and Paragonimiasis

Approximately 11% of diseases imported from the tropics involve the respiratory system. Bacterial infections are responsible for most of these, but it seems necessary to emphasize the significant role of Paragonimus westermani in causing pulmonary symptoms (24).

P. westermani is a hermaphroditic, reddish-brown fluke measuring 7.5-12 mm x 4-6 mm. Microscopically, the egg of this parasite has a distinctive operculum. Lung fluke spreads primarily in Southeast Asia and Japan (25).

It is worth noting that the life cycle of this parasite requires intermediate hosts. The first host is usually a snail, followed by crustaceans such as crayfish or crabs, in which the parasite takes on an invasive form known as metacercaria. The definitive host can be humans, dogs,

cats, or pigs. These mammals can become infected with paragonimiasis after eating raw shellfish and ingesting infected water (26).

P. westermani causes paragonimiasis, which can occur in two forms: acute and chronic. Approximately 65-90 days after infection, the parasite lays eggs. Adult lung flukes can live in humans for up to 20 years. Chronic paragonimiasis is characterized by diarrhea, cough, fever, hepatitis, and splenomegaly, and, as with most parasitic diseases, eosinophilia. In the chronic phase, hemoptysis and expectoration of colored sputum may also occur. The most severe form of paragonimiasis occurs when the fluke affects the brain (25).

As with the parasites described previously, the risk of parasitic infection by tourists traveling to endemic countries increases significantly with the increase in tourism. For preventative purposes, it seems essential to eat in areas with high sanitary standards, clean water, and disinfected kitchen equipment used for food preparation. It is also worth ensuring proper food handling, with particular attention paid to crustaceans, which may be hosts of the fluke (25).

Schistosoma spp. i Schistosomiasis

Schistosomiasis, formerly known as bilharzia, is a disease found in many tropical and subtropical countries. It is caused by flukes of the Schistosoma genus, commonly known as blood flukes. These are dioecious organisms whose life cycle involves snails of the Bulinus genus, which serve as their intermediate hosts. After leaving the snail's body in the aquatic environment, the fluke assumes the form of furcocercaria, which is the invasive stage for humans. Furcocercaria have the ability to synthesize proteolytic enzymes, allowing them to enter the host directly from water through intact skin. Infection most often occurs during swimming in natural bodies of water inhabited by certain snail species. In humans, the parasite lives in veins and matures for 10 to 12 weeks, and the adult begins producing eggs (27). There are two main forms of the disease – urogenital and intestinal – caused by the five most common species.

Schistosomiasis is an endemic disease, with different Schistosoma species identified depending on the region of the world. Schistosoma haematobium (Africa, Middle East) causes the urogenital form of the disease. The four remaining fluke species listed below are responsible for causing schistosomiasis in the gastrointestinal tract (intestinal form). These include Schistosoma mansoni (Africa, Middle East, South America), Schistosoma japonicum (Asia), Schistosoma mekongi (Asia), and Schistosoma intercalatum (Africa).

After entering the human body, S. haematobium migrates to the venous plexuses of the urinary bladder and other pelvic veins. Eggs produced by adult worms are released into the urine, leading to chronic inflammation, an important diagnostic feature of this species. Infected individuals experience painful urination, frequent urination, and hematuria. In women, changes in the vaginal mucosa and vaginal secretions are observed, and in men, blood is present in the semen. Chronic and untreated infection can lead to infertility. Importantly, this parasite is a carcinogen, as infection can lead to the development of bladder cancer. In regions where S. haematobium is present, as many as 65% of bladder cancer cases are caused by infection (27).

The species causing the intestinal form of the disease – S. mansoni, S. japonicum, S. mekongi, and S. intercalatum – inhabit the human mesenteric veins, and the eggs they produce enter the intestinal lumen, causing granulomatous inflammation of the mucosa with microulceration (28). Patients experience acute abdominal pain, diarrhea, and bleeding from the lower gastrointestinal tract. Venous blood flow displaces the eggs into the portal vein, causing hepatomegaly and, associated with liver damage, fluid accumulation in the peritoneal cavity, also known as ascites. Blood and fluke eggs are present in the feces of infected individuals.

It is estimated that over 250 million people worldwide suffer from schistosomiasis, of which as many as 200 million live in Africa, and approximately 780 million are at risk of parasite infection (28). According to information published by the WHO, the estimated annual number of deaths worldwide caused by schistosomiasis is nearly 12,000. The occurrence of schistosomiasis depends on the spread of specific snail species, which are necessary to complete the parasite's life cycle, therefore preventative measures largely rely on eliminating snails from freshwater bodies. According to the Chief Sanitary Inspector, swimming in the ocean and sea is considered safe. For preventative purposes, avoid drinking water directly from natural sources. Children aged 5 to 15, fishermen, and rice farmers are most at risk.

FILARIOSIS

Wuchereria bancrofti is the most common nematode causing lymphatic filariasis (elephantiasis), which affects 120 million people globally, with 40 million being disabled (29). W. bancrofti is responsible for as many as 90% of lymphatic filariasis cases (30). This parasite preys on tourists and natives in tropical regions of Asia, Africa, the Americas, and the Pacific coast. Warm and humid conditions favor the vector of Wuchereria (31).

The invasive form of this parasite is the third-stage larva, which enters the human body via vectorial transmission. In the case of W. bancrofti, these are mosquitoes of the genera

Anopheles, Culex, Aedes, and Mansonia spp. Adult W. bancrofti reside in the host's lymphatic system and produce microfilariae. By biting a human infected with the nematode, a mosquito absorbs the microfilariae it has produced in its bloodstream. In the mosquito's digestive system, these larvae develop into larvae, which penetrate the stomach walls to reach the respiratory muscles, where they become invasive L3. By biting another human, the mosquito introduces the larvae into the circulatory system, which migrate to the lymphatic system, where they mature into adults (32).

Lymphatic filariasis can be asymptomatic, but it can also be acute or chronic. Most infected individuals have no visible symptoms, which does not mean the disease is harmless. The most common abnormality is "lymphangiectasia," or dilation of the lymphatic vessels. The asymptomatic course may be due to the inability of the mature worm to produce microfilariae, innate immunity, or a latency phase. When the disease manifests, filaria causes the walls of blood vessels to close and grow, leading to swelling and tumors that lead to deformities, especially in the limbs – the leg resembles an elephant's foot, hence the name elephantiasis. Other common symptoms include lymphangitis and hydrocele. Hydrocele is a swelling of the scrotum caused by fluid filling it. This condition causes both physical and psychological discomfort for men. It can lead to infertility and difficulties with daily functioning.

Before traveling to regions affected by filariasis, it's worth stocking up on mosquito repellent. These are available in spray form, cream form, bracelets, and stickers. Plugs that release a repellent scent or emit ultrasound can also be used. However, the most effective forms of personal protection are repellent sprays and wearing long-sleeved and long-legged clothing.

Brugia malayi causes brugiasis. It shares many characteristics with Wuchereria bancrofti. It is the second most common parasite causing lymphatic filariasis. Brugia is characterized by a long, thread-like body, but the adults are smaller than Wuchereria. Females are twice as large as males and reach a length of 5 cm. Brugiasis occurs in Malaysia and Indonesia (affecting approximately 13 million people). Travelers to South, East, and Southeast Asia risk contracting this nematode (30).

The adult forms of Brugia reside in the lymphatic system. Microfilariae circulate in the host's blood. Brugia enter the host in the same way and in the same form as Wuchereria.

Lymphatic filariasis, caused by W. bancrofti and B. malayi, has been categorized as a Neglected Tropical Disease (NTD). These are diseases that primarily affect the poor. Their elimination is not a priority for global organizations, which limit funding for treatment of patients with filariasis. The clinical picture of patients infected with Brugge's lymphangitis is

lymphangitis and elephantiasis. Patients experience fever, a general feeling of malaise, and chills. An acute attack of the disease is accompanied by visible enlargement of the lymph nodes. It lasts about a week and may recur. In addition to the most common leg swelling, i.e., the aforementioned elephantiasis, swelling of the scrotum, penis, vulva, and breasts is observed. After the acute attack, folds of loose skin develop at the site of the swelling, which eventually fibrosis. Due to the weakened immune system, patients are susceptible to bacterial and fungal infections of the swollen areas (33).

To prevent helminth infection, the same personal protective equipment as for W. bancrofti should be used.

Loa loa causes loasis. Known internationally as the "eyeworm," it is an endemic species of eyeball parasite. Its distribution is limited to Africa, primarily central and western Africa. The parasite vector prefers the moist and warm onditions of rainforests. It is estimated that 3 to 13 million people are infected. The risk of infection increases with age during the rainy season (34).

Loa loa has the ability to move by a wriggling motion within the host's tissues. It migrates in the subcutaneous tissue and appears under the conjunctiva of the eye. The parasite vector, a fly from the Tabanidae family of the genus Chrysops, bites humans, infecting them with the invasive form of Loa loa – the L3 larva. The worm matures in the host's subcutaneous tissues and subsequently produces microfilariae. Microfilariae can be found in the cerebrospinal fluid, urine, sputum, peripheral blood, and lungs. The Chrysops dimidiata fly then ingests microfilariae from the human via blood, which then penetrate the walls of the fly's digestive tract and migrate to the respiratory muscles, where they undergo subsequent stages of molting (35).The most common symptoms of Loa loa are angioedema and generalized itching. The characteristic name "calabar swelling" comes from the name of the city in Nigeria where this symptom was first discovered and named. The swelling appears mainly on the hand, wrist, and forearm. It is painless and non-doughy. The parasite is not permanently visible to the naked eye, as it appears under the conjunctiva or subcutaneously for about 10-15 minutes, then disappears without a trace. Other characteristic accompanying symptoms include joint pain and fatigue. A rarer, very dangerous complication of Loa loa is elastic fibrosis, neuropathy, and encephalopathy (36).

Infection control methods include personal protection and vector control. Unfortunately, no large-scale eradication programs have been implemented to date.

Onchocerca volvulus causes river blindness, or onchocerciasis, which affects Africans. Its geographic range extends from west to east across the sub-Saharan region, encompassing 31 countries, including Uganda, Congo, Senegal, and Ethiopia (37). In 2017, 21 million onchocerciasis infections were recorded, affecting 205 million people living in areas with high infection rates.

Residents of agricultural areas located near rivers, where the vectors-midges of the genus Simulium spp.- breed, are particularly at risk. The midge introduces L3 larvae into the human body, which migrate to the subcutaneous tissue, where they mature. They produce microfilariae, which can be detected in the skin, lymphatic organs, and connective tissue. They can be found in peripheral blood, urine, and sputum. The person is then bitten again by the insect, whose microfilariae undergo moulting in the respiratory muscles. Microfilariae can survive in the human body for up to two years. Adult females can produce microfilariae for up to 9 to 11 years (38).

Skin and eye lesions are the most common symptoms in infected individuals, associated with the parasite's destructive effects on tissue. Lumps appear on the skin, most often on the lower limbs, but can also appear anywhere on the body. Symptoms appear a long time after the larvae enter the human body. Initially, itching and dermatitis appear. The disease is often asymptomatic. In severe cases, a leopard-like skin rash appears, most often on the pretibia. This appears at the sites of vector bites. Patients experience pigment loss, collagen degeneration, and consequent weakening of the epidermis. Painless granulomas may appear subcutaneously on the legs. The name "river blindness" comes from a symptom of punctate keratitis, which is an immunological response to the presence of microfilariae in the eye. In this case, lumps can be observed on the eye, which can ultimately lead to corneal scarring, leading to blindness. Less common symptoms include weight loss, musculoskeletal pain, and sometimes even seizures (33).

Blindness prevents patients from working, so disease prevention is crucial. In addition to personal protection, vector control and antiparasitic chemotherapy are also implemented.

Summary

In the 21st century, a time of unprecedented globalization. The ease of travel resulting from advances presents medicine with new challenges. Diseases previously unknown in certain geographic locations are emerging. This requires medical personnel to possess increased knowledge in (for example) parasitology. Often, the best way to prevent parasitic infection is to practice proper personal hygiene, which is well-established in developed countries. However, there are places in the world where this approach is difficult to implement due to a lack or limited access to cleaning products. Avoiding infection is also hampered by the multitude of parasite transmission routes. The most sensible solution for long-distance travelers is to familiarize themselves with information about parasites in specific locations and, if alarming symptoms occur, consult physicians who specialize in diseases imported from the tropics.

Conflicts of Interest – None

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