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"Diseases Caused By Common Intestinal Protozoa of Humans: Symptoms, Prevention and Treatment, a Review of Literature"

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Abstract
Background*: In the world there are plenty of parasites such as intestinal parasites and freshwater parasites. Protozoa is one of the most well-known intestinal parasites; which also lives in humans' intestine. Those which survive in the guts of humans can cause severe and serious disease. These protozoa are like amoeba, flagellates, ciliates and coccidians.*
Objective: *This article was aimed to evaluate the diseases caused by the common intestinal protozoa of humans and their symptoms, prevention & treatment.*
Methods:*Survey of different literatures on the topic.*
Results: *Toxoplasmosis, leishmaniasis and dysentery were the most common diseases caused by intestinal parasites.*
Conclusion: *Concerned organizations like WHO and UNFDP have to emphasize in preventive and curative aspects of the intestinal parasites.*
Keywords: *Protozoa, literature survey, Treatment, Intestines*

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I. Introduction

The meaning of protozoa is derived from Greek word. Proton, meaning "first" and zoo, "animal" they are subkingdom of a microorganism. Most protozoans range usually from 10 to 52 μm (Smothers, 1994).

A protozoan is a complete organism in which all life activities are carried on within the limits of a single plasma membrane. Protozoa are found wherever life exists. They are highly adaptable and easily distributed from place to place. They require moisture, whether they live in marine of fresh water habitats, soil, decaying organic matter, or plants and animals (Hickman, Roberts, Larson & Anson, 2004).

They may be sessile or fresh living and they form a large part of the floating plankton. The same species are often found widely separated in time as well as in space. Protozoa play an enormous role in the economy of nature. Their fantastic numbers are attestedby the gigantic ocean soil deposits formed over millions of years by their skeletons. About 10,000 species of protozoa are symbiotic in or on animals or plants, sometimes even other protozoa (Hickman et al., 2004).

The intestinal protozoa of humans belong to four groups: Amoeba, Flagellates, ciliates, and coccidian. Most and almost all protozoa are small in size means they are microscopic. They varies from 5 - 100 micrometers, depending on species, among the many species of intestinal protozoa, Entamoeba histolytica and Giardia lamblia are potentially pathogenic and in many parts of the world either or both organisms constitute a public health problem (WHO, 1987).

II. Characteristics of protozoa

Structures and physiology of protozoan cells are largely the same as those of cells of multicellular organisms. However, because they must conduct all functions of life as individual organisms, and because they show such enormous diversity in form, habitat, and feeding various protozoan cells have unique features. They are unicellular, mostly microscopic without germ layer or organ-tissues. Locomotion is by pseudopodia, flagella, and cilia. Protozoans provided with a simple endoskeleton or exoskeleton. They have nutrition of all types, autotrophic, heterotrophic, saprozoic (using nutrients dissolved in the surrounding medium). They reproduce asexually by fission, budding and cysts and sexually by conjugation or syngamy (union of male and female gametes to form a zygote) (Hickman et al., 2004).

Protozoa are both single cells and entire organisms. Many of their functions are carried out by organelles specialized for the unicellular life-style. Many protozoa live in symbiotic relationship with other organisms, often in a host-parasite relationship (Miller & Harley, 1994).

The plasma membrane of many protozoa is under laid by a regular arrangement of microtubules. Together, they are called the *pellicle.* The pellicle is rigid enough to maintain the shape of the protozoan, but it is also flexible (Miller & Harley, 1994).

III. Classification and Definition of Common IntestinalProtozoa of Humans

Human Intestinal protozoans are classified into four types these are Amoeba, Flagellates, Ciliates and Coccidian.

3.1 Amoeba

Amoeba is one of the intestinal protozoa, which have five species that live in the intestinal tract of humans. These are *Entamoeba histolytica*, *Entamoeba hartmanni*, *Entamoebacoli, and Endolimax nana* and *lodam butschlii*. *Entamoeba histolytica* is one of the main species of amoeba that they may ingest red blood cells. During this conditions the trophoziote "slow down ",stop feeding and round up into a precyst stage which become a cyst. Cyst is a structure with a resistant cellwall which able to resist during adverse condition (Brooke, Melvin & Healy, 1983).

About 90% infectious with *E.histolytica* are asymptomatic, but some can develop symptoms including ameobic colitis and ameobic liver, lung or brain abscess (Weinke Friedrich-Janicke & Hopp, 1990).

3.1.1 Entamoeba Histolytica

E.histolytica is an intestinal amoeba (protozoan) that causes a serious disease. Many people can die through invasion of this amoeba. It is about 40-50 million people, this result in up to 100,000 deaths globally per year (Ali, Clark & Petrri, 2008).

E.histolytica infectious occur world wide but more prevalent, in the topics. Recognized high risk group include travelers, immigrant from endemic areas, immunocompromised individuals, and men who have sex with men (MSM) (Weinke et al., 1990).

Most tropic people always are in danger by the *Entamoeba histolytica*, because it is more prevalent in tropics, even though it infects all about the world. *E.histolytica* infections are 90% asymptomatic, 10% only of infected people or individuals show symptoms. The high risk people are those who are travelers, immigrants from endemic areas. They mostly attack liver, lung, or brain. The most danger thing of the *Entamoeba histolytica* is that able to transmit by Fecal-oral transmission (Brooke et al.,1983).

Life Cycle of*Entamoeba Histolytica*

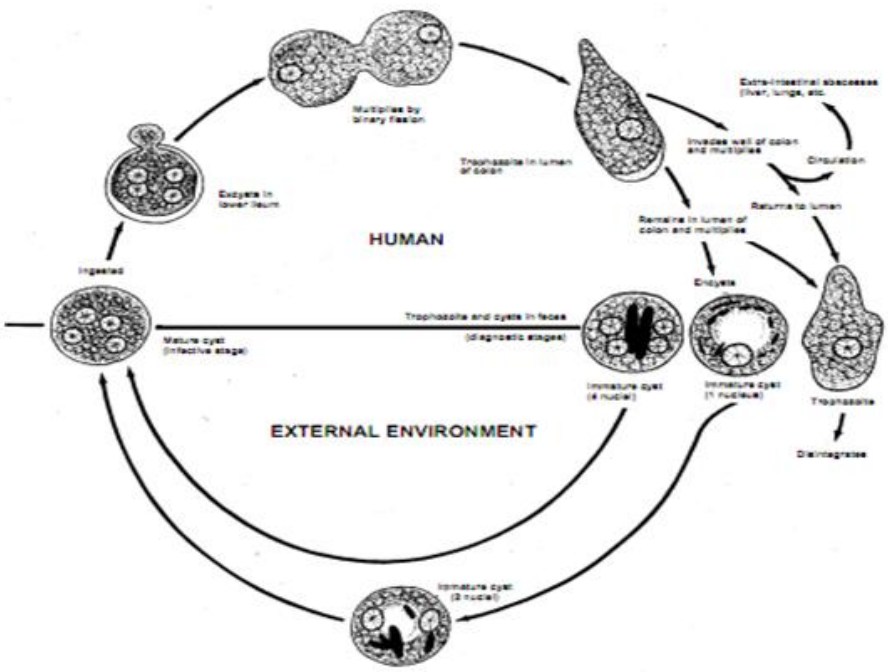

Fig.1 life cycle of *Entamoeba histolytica* (Brooke et al., 1983).

3.2 Flagellates

Flagellates are also a group under classification of protozoa. Unlike amoeba, they are of four species that parasitize the intestinal tract of humans and are; *Giardia lamblia, Chilomastix mesnili, Pentatrichomonas hominis, and Dentaoeba fragile.* Flagellates have flagella, sucking disc, undulating membrane and nuclear details for species identification (Brooke et al., 1983).

Flagellates possess one marked advantage over their amoeboid relatives; they can swim (Smyth, 1994).

Euglena is a phytomastigophorean found in fresh water. Euglenoid flagellates are haploid and reproduce by longitudinal binary fission (Miller & Harley, 1994).

3.2.1 ***Giardia lamblia***

Giardia lamblia is a flagellate species which causes a disease called Giardiasis. Giardia infects humans but also one of the common most protozoans that infect cats, dogs, birds. They are host also for mammalian like cow, beaver, deer and sheep (Meyer, 1998).

Excystation is initiated when environment stimuli like gastric acid and pancreatic enzymes are detected across the cyst wall. A single trophozoite containing four nuclei is released; this divides twice without further DNA replication, resulting in four daughter trophozoites. These, under certain conditions in the jejunum encysted and are passed in the stools (Cabada, 2007).

If a human or animal infected by the parasite defecates close to a body of water, the durable cysts can infect someone else who drinks the water even 2 to 3 months later (Miller & Harley, 1994).

Life Cycle of*Giardia Lamblia*

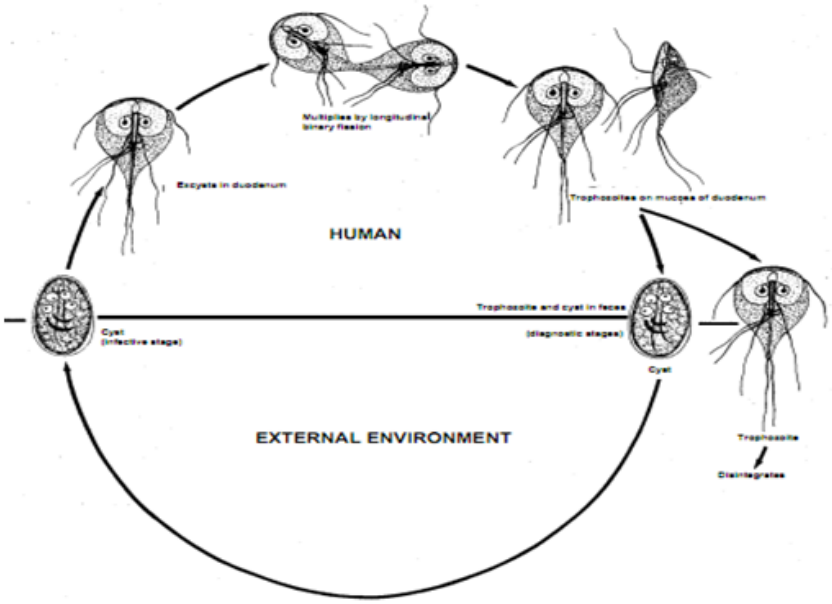

Fig.2 life cycle of *Giardia lamblia* (After Brooke et al., 1983)

3.3 **CILIATES**

Ciliates are also the common intestinal protozoan of human they are known by their ciliate (cilia). *Balantidium coli*, is a classified ciliate which is the only ciliate that parasitize humans, it is distinctive from others in many ways. This is the largest human parasite protozoan, its length ranges from 50 micrometer to over 100micrometer long, they have only one contractile vacuole, and the only one possessing both a macronucleus and a micronucleus. As ciliates, the *balantidiumcoli* multiples and reproduced by transverse binary fission (Brooke et al., 1983).

Ciliates are capable of no division occurs in the cyst. They covered by a momentary structure that is cilia. They are also gives a rotary, slow motion. In short, they are parasites that attack human being's intestine (Brook et al., 1983).

Ciliates are widely distributed in freshwater and marine environments. A few ciliates are symbiotics (Miller & Harley, 1994).

Ciliates use cilia for locomotion and for the generation of feeding currents in water. They are distinct cytome (mouth) structure. And they have dimorphic nuclei (Miller & Harley,1994).

Sexual reproduction of ciliates occurs by conjugation. Some ciliates, such as paramecium, have a ciliated oral groove along one sides of the body. Cilia of the oral groove sweep small, organic particles toward the cytopharynx where a food vacuole is formed. When a food vacuole reaches an upper size limit, it breaks free and circulates through the endoplasm (Miller & Harley, 1994).

3.3.1 *Balantidium Coli*

Balantidium coli is widely distributed in warmer climates, which is where humans infections most and chiefly occur. They are obvious that survive in intestines, especially they prefer the large intestine, cecum and terminal ileum where they feed on bacteria. The most common hosts being humans, pigs and rodents. The structure and morphology of the cyst of *balantidium coli* is spherical or ellipsoid and measures from 30-200 micrometer by 20-120 micrometer. They contain macro and micronucleus. Even the young ones possess cilia for movement and there by achieving locomotion. They rotate and after long time the cilia disappear. We can identify in saline preparations than permanently stained fecal smears (Brooke et al., 1983).

*Balantidium coli*areimportant parasitic ciliates that live in the large intestines of humans,pigs,and other mammals. It is potentially worldwide in distribution most common in the Philippines (Miller & Harley, 1994).

Life Cycle of*Balantidium Coli*

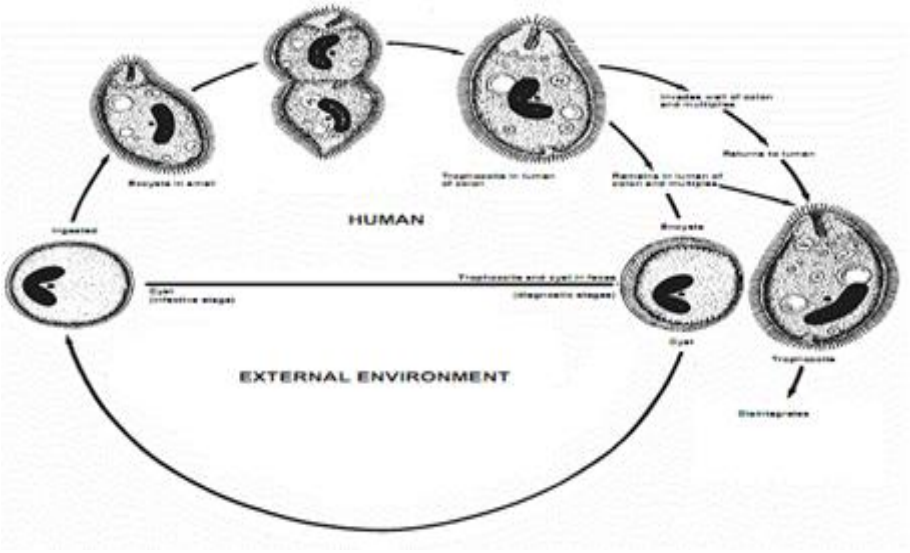

Fig.3 Life cycle of *BalantidiumColi* (Brooke et al., 1983).

3.4 Coccidian

The coccidian belong to the class sporotozoa and they are intestinal parasite of humans. They include parasites of human these are Isospora, Sarcocystis and Cryptosporidium. They are chiefly intestinal ones. Most of the time they are found in the entire places of the small intestine of humans. Isospora belli lives with in the epithelial cells lining the small intestine, primarily the duodenal and the Jejunal areas. In the world they may cause diarrhea, fever, weight loss, and headache (Brooke et al., 1983).

Plasmodium is a parasite of mammals, birds, and lizards. Exo-erythrocytic schizogony; sexual reproduction in blood-sucking insects. Almost all coccidian are endoparasites, and their hosts are found in many animal phyla and locomotor organelles are less obvious in these groups than in other protozoa. Tiny contractile fibrils can form waves of contraction across the body surfaces to propel the organism through a liquid medium (Smyth, 1994).

3.4.1 Isospora Belli

Isospora belli is a coccidian protozoon of cosmopolitan distribution, occurring especially in warm regions of the world infecting both humans and animals. They involve asexual and sexual stages of life cycle. The immature oocyste with sporoscyts may ingest them after matured. The sporozoite like other intestinal

parasite of humans develops in the epithelial cell to form a schizont, which ruptures the epithelial cell containing it, liberatin merozoite in to lumen (Brooke et al., 1983).

Life Cycle of *Isospora Belli*

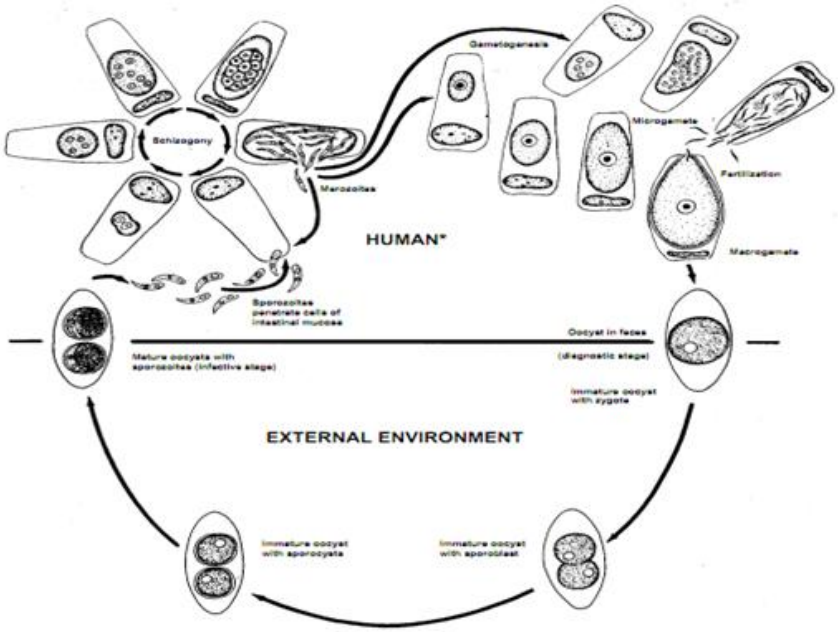

Fig.4 life cycle of *Isospora belli* (After Brooke et al., 1983).

IV. Human disease that caused by protozoans

In the world there are plenty of disease, some may be caused by virus, some by bacteria and some also by parasites. Protozoans are parasite that capable causing serious diseases, most of them are caused by amoeba, ciliate, flagellates and coccidian. Majority and serious disease can cause by *Giardia lamblia* by its infective stage cyst in most cases. And it is asymptomatic. The diseases that caused by the agents of protozoans are Toxoplasmosis, Malaria, Amoebiasis, Cryptosporidiosis, Lieshmaniasis, Giardiasis, Dysentery,Trichomoniasis and sleeping sickness. They have different level of pain and symptoms (Smothers, 1994).

4.1 Toxoplasmosis

Toxoplasmosis is a parasitic disease caused by the protozoan *Toxoplasmosis gondi*. The Parasites infect most of the warm-blooded animals, including humans. Toxoplasmosis can cause damage to the brain or the eyes especially for those young children and patients (Randall Parker, 2003).

Toxoplasmosis is a disease of mammals, including humans and birds. Sexual reproduction of toxoplasma occurs primarily in cats (Miller & Harley, 1994).

Infections occur when oocytes are ingested with food contaminated by cat feces, or when meat containing encysted sporozoites is eaten raw or poorly cooked (Miller & Harley, 1994).

About 13% of the world population is infected. In 1976 the global prevalence of toxoplasmosis was estimated at over 500 million. In countries like France, where raw meat is popular, the prevalence may be higher, in Paris, for example, it may be as high as 50%. In the United States, about 3500 infants are born each year with severe infections, costing $300million annually in care and treatment (Schmidt & Roberts, 1996).

4.1.1 Symptoms

In humans toxoplasma causes little or no ill effects except in AIDS patients or in woman infected during pregnancy, particularly in the first trimester. Such infection show great symptoms increase the chances of a birth defect in baby, rupture of a tissue cyst, which would be contained easily in a person with normal immune system, becomes a source of life-threatening infection (Hickman et al., 2004).

Fetuses that survive frequently show signs of mental retardation and epileptic seizures (Miller & Harley, 1994).

Since there seems to be an age resistance, infection of adults or weaned juveniles are asymptomatic, although exceptions occur. Asymptomatic infections can suddenly become fulminating if immunosuppressive drugs such as corticosteroids are employed for other conditions (Schmidt & Roberts, 1996).

According Schmidt and Roberts symptomatic infections can be classified as acute, sub-acute and chronic.

In most **acute infections** the intestine is the first site of infection. The most common symptoms of **acute toxoplasmosis** are painful, swollen lymph glands in the cervical, supraclavicular, and in genial regions. These symptoms may be associated with fever, headache, muscle pain, anemia and sometimes lung complications. Acute infection can, although rarely does, cause death. If immunity develops slowly, the condition can be prolonged and is then called sub-acute (Schmidt & Roberts, 1996).

In **sub-acute infections** pathogenic conditions are executed. Tachyozoites continue to destroy cells, causing extensive lesions in the lung, liver, heart, brain and eyes. Damage may be more extensive in the central nervous system than inn unrelated organs because of lower immunocompetence in these tissues (Schmidt & Roberts, 1996).

Chronic infection results when immunity builds up sufficiently to depress tachyzoites proliferation. Chronic active or relapsing infections of retinal cells by tachyzoites causes blind spots and extensive infection of the central, macular area, which may lead to blindness. Cysts and cyst rupture in the retina can also lead to blindness. Other kinds of extensive pathological conditions such as myocarditis, with permanents heart damage and with pneumonia, can occur in chronic toxoplasmosis (Schmidt & Roberts, 1996).

4.1.2 Transmission

In most cases for all the parasitic protozoa disease are transmitted through many factors. And they also capable of transmission may occur through ingestion of raw or partly cooked meat, especially pork, lamb or venison containing a parasite. Man normally acquires infection either by direct ingestion oocyste from a cat by eating raw or undercooked meat. Cooks or butchers or those who handle raw meat are particularly at risk. Man and animals can be infected by the congenital route. In **France**, where there is a preference for under cooked meat, 90% for adults have been reported and 78% in Beirut (Smyth, 1994).

We may ingest oocyste or may be by hand-to-mouth contact. And can be transmitted by unclean knives, utensils or cutting boards contaminated by raw meat. Also by touching or ingestion of contaminated cat feces. Almost all of these organisms are transmitted by a **fecal-oral route** (Absar, Rubino & Ijaz, 2010).

The majority process that transmission takes place is **hand to hand contact**. Hands can transfer parasites from surfaces, current food and humans (Absar et al., 2010).

The transmission rate to the fetus from a maternal infection is about 45 %(Schmidt & Roberts, 1996).

4.1.3 Prevention and Controlling

The most important way of prevention is by knowing them through education and get rid of them. Since they may transmit through uncooked food, we must avoid eating uncooked food (fruits and vegetables). And also by adequate and safe water supply (Parker, 2003).

Washing our hands after defecation and before eating is the most important way of prevention; the human hand is the most common denominator in intestinal parasite transmission. Hands can act as conductors of parasites from surface of animals and humans (Absar et al., 2010).

4.1.4 Treatment

Since the infection of the parasites protozoans are very serious, treatment must be proceed. Infected individuals should be treated since the disease may persist and lead to chronic disease. Even though, there is no effective treatment, but there are some drugs that treat them easily, like quiacrine, tinidazole, furazolidone and pramomycin (Humatin). If it is asymptomatic the drugs are iodoquinol, paromomycin or diloxanide furate, while for symptomatic infections, the drugs are metronidazole or tinidazole, immediately followed by treatment iodoquinol, paromomycin, or diloxanide furate (Parker, 2003).

There is no cure for congenital toxoplasmosis (Miller & Harley, 1994).

Pyrimethamine and **sulfonamides** given together are drugs widely used against **Toxoplasma.** Possible side effects of this treatment are thrombocytopenia and/ or leucopenia, but these can be avoided by administration of folinic acid and yeast to the patient. Experimental chemotherapy may involve additional drugs in combination with the aforementioned compounds (Schmidt & Roberts, 1996).

4.2 Leishmaniasis

Cutaneous leishmaniasis is also known as "button d'orient", "oriental sore", "Baghdad boil", "Delhi sore" and "Aleppo button". This is normally caused by three species: *L. tropica, L. major* and *L. aethiopica.* Monocutaneous leishamaniasis initially produces lesions like those of cutaneous leishmaniasis and other is visceral leishmaniasis ("kala-azar") which is caused by *L. donovani* and its sub-species, and may be classified as endemic, sporadic or epidemic (Smyth, 1994).

The mammals most commonly infected with leishmania are humans, dogs, and several species of rodents. The parasites cause complex diseases called leishmaniaisis. In some cases, especially with some old world cutaneous infection, leishmaniasis is a zoonosis, with a wild mammal reservoir (Schmidt & Roberts, 1996).

Recent attempts to estimate the severity of leishmaniasis arrived at a figure of 400,000 new cases annually in 67 countries (Schmidt & Roberts, 1996).

The intermediate hosts and vectors of leishmaniasis are sandflies, small-sucking insects in the family psychodidae, subfamily phlebotominae (Schmidt & Roberts, 1996).

4.2.1 Symptoms

The first symptom of infection is a small, red papule at the site of bite (Schmidt & Roberts, 1996).

L.donovani infections may range from asymptomatic to progressive, fully developed kala-azar. The disease usually begins slowly with low grade fever and malaise and followed by progressive wasting and anemia, protrusion of the abdomen from enlarged liver and spleen, and finally death in two to three years (Schmidt & Roberts, 1996).

In some cases the symptoms may be more acute in onset, with chills, fever up to104F, and vomiting; death may occur within 6 to 12 months (Schmidt & Roberts, 1996).

Accompanying symptoms are edema, especially of the face, bleeding of the mucous membranes, breathing difficulty, and diarrhea (Schmidt & Roberts, 1996).

The immediate cause of death often is the invasion of secondary pathogens that the body is unable to combat (Schmidt & Roberts, 1996).

A skin condition known as **post-kala-azar dermal leishmanoid** develops in some cases. The condition usually becomes apparent about one to two years after inadequate treatment for kala azar. It is marked by reddish, depigmentated nodules that sometimes become quite disfiguring (Schmidt & Roberts, 1996).

4.2.2 Transmission

Transmission of visceral leishmania is related to the activities of human and the biology of sand flies (Schmidt & Roberts, 1996).

According to Miller and Harley leishmaniasis is insect-transmitted disease (Miller & Harley 1996).

4.2.3 Prevention and Controlling

Control of sand flies and reservoir hosts is required in endemic areas (Schmidt & Roberts, 1996).

4.2.4 Treatment

Treatments consist of injections of various antimony compounds (Schmidt & Roberts, 1996).

This problem (disease) has been resolved by improved techniques of antigen purification, special antigen polymerization, and antigen selection by use of monoclonal antibodies (Schmidt & Roberts, 1996).

Treatment of leishmanial infections according to the clinical manifestations, in earlier years trivalent antimonials were the only drugs available, but they were so toxic as to be downright dangerous. But two pentavalent preparations are available: pentostam and glucantime; only pentostam is available in the united states, through the centers for disease control parasite drug service. Furthermore, relapses and post-kala-azar dermal leishmanoid may follow insufficient treatment (Schmidt & Roberts, 1996).

Approaches to treatment involve turning a liability into asset-the liability being the fact that in visceral infections the parasites are located within macrophages (Schmidt & Roberts, 1996).

4.3 Dysentery

Dysentery is an amoebic disease. *Entamoeba histolytica*, the only severely pathogenic amoeba of humans, causes one form of dysentery (Miller & Harley, 1994).

Dysentery is marked by inflammation and ulceration of the lower intestinal tract, accompanied by a debilitating diarrhea that includes blood and mucus (Miller & Harley, 1994).

4.3.1 Symptoms

Debilitating diarrhea that includes blood and mucus (Miller & Harley, 1994).This usually is the case with waterborne epidemics. More commonly the disease develops slowly, with intermittent diarrhea, cramps, vomiting, and general malaise. Infection in the cecal area may mimic the symptoms of appendicitis. The patient might experience pain in the entire abdomen, fulminating diarrhea, dehydration and loss of blood. The onset may be sudden after an incubation period Of 8 to10 days or after a long period as an asymptomatic cyst passer (Schmidt & Roberts, 1996).

Death may occur from peritonitis, resulting from gut perforation, or from cardiac failure and exhaustion (Schmidt & Roberts, 1996).

4.3.2 **Transmission**

Since amoeba is the agent that causes dysentery, amoebas are passed from one host to another in the form of cysts that are transmitted by fecal contamination of food or water. Amoeba leaves the cysts after a host ingests contaminated food or water and takes up existence in the intestinal wall (Miller & Harley, 1994)

4.3.3 Prevention and Controlling

A significant problem in the control of *Entamoeba histolytica* is the fact that an individual can be infected and contagious without experiencing symptoms of the disease (Miller & Harley, 1994).

4.3.4 Treatment

Primarily by clinical and immunological means. X-ray examination and other mean of scanning the liver may be useful in diagnosing abscesses. There is evidence that the surfaces cysteine proteinases elicit an antibody response in the host, and such response may be of diagnostic value (Schmidt & Roberts, 1996).

Several drugs have a high level of efficacy against colonic amebiasis. Most fall into the categories of arsanilic acid and derivatives, iodochlorhydroxyquinolines, and other synthetic and natural chemicals (Schmidt & Roberts, 1996).

Antibiotics, particularly **tetracycline**, are useful as bactericidal adjuvants. These drugs are not as effective in ectopic infections. For which chloroquine phosphate and niridazole show promise of efficacy. Metronidazole has become the preferred drug in treatment of amoebic caused disease (Schmidt & Roberts, 1996).

V. Conclusion

It is an obvious thing that the parasitic matter needs recommendation. Especially for those companies and organizations like WHO must introduce equality among the people in preventing and treating the severe diseases and must be used in the coming future.

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