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Pathological effect of Schistosomiasis in Human and its Control

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ABSTRACT

Schistosomiasis is a parasitic disease cause by fluke worms belong to genus Schistosoma. There are five species and most of the ailment is cause by *Schistosoma hematobium, S. mansoni and S. japonicum*. It spreads through contaminated water. It has chronic effect on mammals and snail act as intermediate host. More than 200 million people affected in 2011 all over the world and most influenced nation is Africa. Urinary, Gastrointestinal and Hepatosplenic schistosomiasis are its types according to the site where the specific parasite attack. It can be diagnosed by parasitological, immunological and molecular methods and can be treated by Praziquantel chemical (PZQ). No vaccine is available but improved sanitation could reduce or eliminate transmission of this disease and by eliminating the snails that are required to maintain the parasite's life cycle.

INTRODUCTION

Schistosomiasis or bilharzia is a tropical parasitic ailment caused by blood-abiding fluke worms of the Genus *Schistosoma*[1].In Schistosomatidae, 14 genera and 100 species are known (2). Grown-up schistosomes are white or grayish worms of 7 – 20 mm long with a barrel shaped body that highlights two terminal suckers, an unpredictable covering, a visually impaired stomach related tract, and sex organs (1). There are five schistosome species: *S. haematobium* (distinguished in 1852), *S. japonicum* (1904), *S. mansoni* (1907), *S. intercalatum* (1934), and *S. mekongi* (1978) (3).

The lion's share of human ailment is interceded by *Schistosoma hematobium, S. mansoni and S. japonicum* [4]. *S. haematobium* causes urinary schistosomiasis, traditionally showed as irritation and mishappening of the bladder, ureters or kidneys, though *S. mansoni and S. japonicum* are related with intestinal irritation and related hepatosplenic schistosomiasis [5]. The worms that cause schistosomiasis are not found in the United States, individuals are tainted around the world. As far as effect this ailment is second just to jungle fever as the most destroying parasitic sickness. Schistosomiasis is viewed as one of the ignored tropical maladies (6). More than 200 million individuals are evaluated to be tainted with schistosomes, among around 800 million in danger of schistosomiasis (7). In 2011, an expected 243 million individuals in 78 nations were living in zones of high hazard for the illness (3). The symptoms are different depending upon the type of specie which infects the host; mainly caused due to host`s immune system response towards the eggs (8, 17).Schistosomiasis generally influences poor and rustic networks, especially farming and angling populaces (8).

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GEOGRAPHIC DISTRIBUTION

The illness is endemic in 74 nations where 779 million individuals were in danger of schistosomiasis and 207 million people were tainted with Schistosoma worms. As to in danger populace, an expected 660 million were packed in Africa, representing 85% of the worldwide in danger gauge. A disturbing 201.5 million schistosome diseases (for the most part *Schistosoma haematobium*) were evaluated to happen in Africa, representing over 97% of the assessed number of contaminations worldwide (9). Most of the nation's endemic for schistosomiasis are among the slightest built up, whose wellbeing frameworks confront serious strains to give essential consideration at the essential dimension. They can just attempt schistosomiasis control through grants. Based on the evaluated pervasiveness and the measure of the endemic zones, the most extremely influenced nations are: in Africa: Angola, CentralAfrican Republic, Chad, Egypt, Ghana, Madagascar, Malawi, Mozambique, Nigeria, Senegal, Sudan, the United Republic of Tanzania, Zambia; In South America: Brazil; In South-East Asia: Philippines; In South-West Asia: Yemen Arab Republic. Just about 300,000 individuals expire every year from schistosomiasis in Africa alone. Around 10 million ladies in Africa are tainted amid pregnancy. While most enduring nations at present, 29 African nations, Brazil and Yemen which harbor more than one million cases each (9).

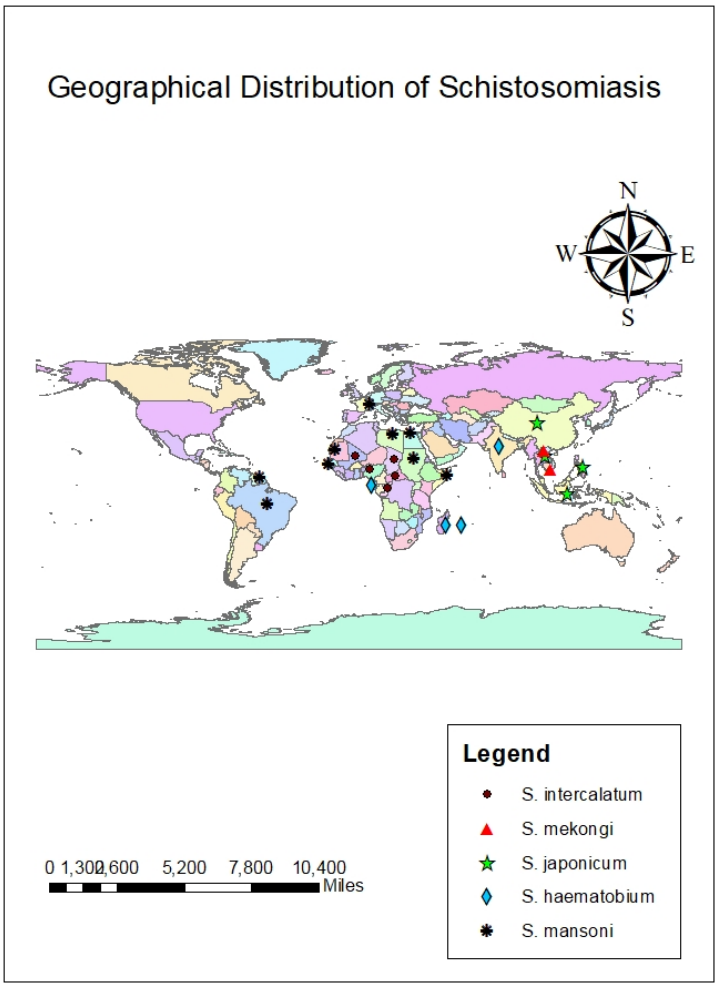

Figure 1. Geographical distribution of Schistosomiasis

S. mansoni is endemic Mauritania, Senegal and Somalia, intestinal schistosomiasis is found in 54 nations, including the Arabian Peninsula, Egypt, Libya, Sudan, sub-Saharan Africa, Brazil, some Caribbean islands, Suriname and Venezuela(10).

S. intercalatum has been accounted for from ten nations in Africa. Transmission of this species in the Central African Republic, Chad, Congo and Nigeria ought to likewise be affirmed(10).

S. japonicum is endemic in China, Indonesia and the Philippines and has been accounted for from Thailand (10).

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*Schistosoma mekongii*is endemic along the Mekong River and certain tributaries in the lower Mekong bowl. Around, 140,000 individuals are in danger for contamination with 80,000 found in Cambodia and a further 60,000 in Laos (9)

*S. haematobium*is endemic in 53 nations in the Middle East and the vast majority of the African mainland including the islands of Madagascar and Mauritius. It might have been wrongly answered to be endemic in Sao Tome and Principe. There is additionally a not well characterized center S. haematobium in India (10).

LIFE CYCLE AND TRANSMISSION OF SCHISTOSOMIASIS

The life cycle of schistosome is regulated in a final mammalian host and in snail as intermediate host [11]. The adult's male and female wormsreside in veins of mammalian host. Here they reproduce and generate fertilized eggs [12].

In developing countries Schistosomiasis occurs almost in all the rural communities where sanitation is poor. Like most trematodes, schistosomes also have an intricate life cycle which involves two stages, a bifurcate cercaria and a ciliated miracidium. Both stages are short lived and lecithotrophic. These parasitic stages are transmitted through percutaneous routes from vertebrate to intermediate snail host and vice versa. Both these stages are just visible with naked eye but when observing through microscope they differ radically both in form and function [13].

The eggs are released into the surrounding through faeces or urine. They can be residing in host tissues and cause swelling and then die. Eggs in the fresh water environment will then emerge and form a free living ciliated miracidia. This miracidia can pass disease to an appropriate snail host. Eggs then reproduce asexually within the snail and form cercariae after successive stages. Asexual section of life cycle in the snail need 4-6 weeks prior to cercariae are excreted[12]. Cercaria leaves the snails body in the stimulus of light [3].

Disease of mammalian host occurs through the penetration by the cercarial stage into the skin which then changes into schistosomulum stage. It remains in skin for 2-4 days and then schistosomula go into blood vessel [14]. Here they become mature and again produce eggs which are released in the environment and the cycle is again started [12].

The freshwater resources are contaminated by the excreta of suffering people which contains parasitic eggs that hatch in water and starts the process of transmission. People become infected once larval varieties of the parasite free by fresh snails penetrate the skin throughout contact with plagued water.After the infection larvae will now grow into adult schistosomes. Fully mature worms live in blood vessels where female releases eggs. In order to continue the parasite`s life cycle some of the eggs are released either through faeces or urine outside the body. Other eggs remain in the body to cause severe damage to tissues, organs and immune reactions [8].

PATHOLOGY AND MORBIDITY

In schistosomiasis, grown-up worms' dwell in the mesenteric and pelvic venules in different destinations where they lay eggs. These destinations will in general explicit for every specie (e.g. *S. japonicum* lean towards the better mesenteric veins depleting than the small digestive tract, while *S. mansoni* inclines toward the prevalent mesenteric veins of the internal organ). Numerous eggs are conveyed upstream where they get held up in different organs, particularly in the liver, gut, and genitourinary tract (15).

Acute pathology

Intense schistosomiasis (Katayama fever) is a fundamental touchiness response against the relocating schistosomulae, happening four weeks to months after initial infection. The illness begins all of a sudden with fever, weariness, myalgia, discomfort, non-gainful hack, eosinophilia, and inconsistent penetrates on chest radiography. Stomach side effects can grow later, caused by the relocation and situating of the mature worms. Most patients recoup immediately after 2–10 weeks, however some create steady and increasingly genuine ailment with weight reduction, dyspnoea, and looseness of the bowels, and diffuse stomach torment, toxemia, hepatosplenomegaly and broad rash (1).

Chronic pathology

The principle sores in set up and interminable contamination are expected not to the grown-up worms but rather to eggs that are caught in the tissues amid the perivesical movement or after embolization in the liver, spleen, lungs, or cerebrospinal framework. The eggs discharge proteolytic proteins that incite ordinary eosinophilic fiery and granulomatous responses, which are dynamically supplanted by fibrotic storesthe seriousness of the side effects is hence related both to the force of contamination and to singular resistant reactions (1).

Urinary schistosomiasis

Urinary schistosomiasis is caused by the parasitic trematode *Schistosoma haematobium*(16). Parasitic worm stays in the veins, especially those encompassing the human bladder divider. In spite of the fact that not specifically connected with

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high patient mortality, this malady is connected to both momentary dreariness, e.g. unmistakable blood in pee (intense), and long haul sequelae, e.g. urinary tract pathologies (interminable) (16).Poor access to financial open door represents the uneven circulation of contamination in endemic districts. Subsistence cultivating, deficient water supply, poor open sanitation, quick urbanization and dam development are basic inclining factors. In spite of the fact that parasite disease has been accounted for in early earliest stages, top occurrence happens in early youthfulness because of regular showering in polluted pools of water (4). Transient pruritic dermatitis or swimmer's tingle may happen in light of cercarial skin entrance. In any case, recently tainted patients are frequently asymptomatic. Normal side effects are urinary recurrence, earnestness, dysuria and end-stream hematuria. Of these indications, terminal hematuria might be the most doable and is regularly the reason for epidemiologic conclusion (4).

Gastrointestinal Schistosomiasis

Gastrointestinal schistosomiasis because of *S. mansoni, S. japonicum* and *S. mekongi* can cause gut sores, for example, ulceration, pseudopolyps, and microabcesses. The semanifest clinically as stomach torment, adjusted inside propensities, and blood in stools. Liver development and periportal fibrosis are normal in cutting edge cases, and is commonly connected with ascites and entry hypertension. Clinical signs including: shallow stomach vein dilatation, spleen , and dying inclined esophageal varices have been all around reported (15).

Hepatosplenic Schistosomiasis

Hepatosplenic schistosomiasis alludes to the significant intricacy of endless disease with *Schistosoma mansoni, S. japonicum* and *S. mekongi*, schistosomal entry hypertension. Hepatosplenic schistosomiasis is usually, but not perpetually, related with augmentation of the liver and spleen, and reversible hepatosplenomegaly may happen in early diseases not confounded by the improvement of entrance hypertension (19).

The liver might be amplified, of ordinary size or even somewhat contracted; its external surface is once in a while nodular. Hepatic fibrosis advances from an exorbitant amassing of collagen in the liver. In many patients with hepatosplenic schistosomiasis, the spleen is expanded in size. Splenomegaly results from unending uninvolved clog and hyperplasia of the reticuloendothelial framework. The minute appearance is undefined from that seen in sclero-congestive splenomegalies. The entrance blood flow is expanded in monstrous splenomegaly in light of the fact that an augmented spleen requires a more noteworthy blood supply, which thus builds gateway hypertension due to a presinusoidal square (20).

Extra manifestations and signs saw in hepatosplenic schistosomiasis are hematemesis, melena, ascites, whiteness, and lower leg edema and security periumbilical varices. Manifestations proposing extreme hepatic insufficiency, for example, jaundice, bug angiomas, palmar erythema, gynecomastia and adjusted hair circulation are once in a while detailed. Demise from hepatic disappointment in *S. mansoni* diseases is uncommon, except for those cases confused by hepatitis B or C contaminations, liquor misuse or rehashed esophagogastric dying(20). These occasions may prompt decompensated hepatosplenic ailment or liver disappointment. For a long time, the analysis of hepatosplenic schistosomiasis and liver fibrosis was confirmed by stomach palpation and the identification of liver or potentially spleen development. In any case, there is no accord with respect to the clinical parameters of the liver and spleen to be considered in this physical assessment (20).

DIAGNOSIS

Different types of diagnostic methods for schistosomiasis include parasitological, immunological and molecular methods. The widely used test is stool examination for eggs using Kato-Katz faecal smear (21). The Kato-Katz (KK) technique is mostly used because it is cheap, quantitative and easy to perform(22). Despite of these advantages it has some drawbacks, high intensity infections (KK) has high sensitivity because there is a large worm load in host but in areas with low prevalence and where eggs are clumped together in the stool samples it shows significantly low egg counts. The test`s sensitivity can be improved by using more than one stool sample for many days but this is confidential (11).

Immunological Diagnosis

Considering the drawbacks of (KK) smear and other faecal tests the more sensitive diagnostic tests were developed which work on the base of detection of antibodies in serum reactive with schistosome antigens (21). Our immune system responds differently at different stages of Schistosome infection. In the initial stage of infection our immune system responds by releasing a T helper 1 (Th-1) indicating the migration of immature parasites. In the next stage when the schistosome matures another strong (Th-2) response predominates due to egg antigens and (Th-1) response decreases. The (Th-2) response also decreases when granulomas formed around the eggs. Immunological tests are particularly useful where the light infections are more and parasitological tests shows negative results (11). Antibody-based tests have a limitation that parasite specific antibodies remain in the circulation for years after infection has been cleared (21).

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Parasitological Methods

The earliest known methods for diagnosis are parasitological tests that include detection of eggs in stool sample (11). The sensitivity of parasitological tests is very high in areas with higher prevalence and intensity of infection but in areas where prevalence is low and infection intensity is also low its sensitivity diminishes which makes it less appropriate. These tests also fail to diagnose the infections where worms have not started to produce eggs. A modern approach named as Helmintex is developed in Brazil which detects the infection on the basis of physical properties of eggs. The only drawback of this technique is that it takes long time to process each sample(21). In order to improve the standard of microscopic examinations other parasitological methods are also developed which includes formol ether sedimentation, interaction of magnetic microspheres with eggs and salt flotation (11).

Molecular approaches

There are many molecular approaches for diagnosing Schistosomiasis, one of them is PCR. To detect DNA sample of Schistosomiasis in host`s stool, tissue or organ many PCR techniques can been used. A very specific method is conventional PCR that amplifies a specific target segment of DNA and is a very useful method for direct detection of schistosomiasis(11). For low intensity infections conventional PCR is used. Conventional PCR can be combined with other techniques to detect schistosomiasis such as restriction fragment length polymorphism (PCR-RFLP) analysis and PCR-ELISA. While being more sensitive it also has some disadvantages. The PCR can be inhibited by the compounds of faecal sample but it`s accuracy can be increased by enhanced by combining it with different parasitological or serological techniques. Another major drawback for the developing countries is that high cost reagent, trained staff and need of expensive equipment (11).

TREATMENT

The treatment of schistosomiasis largely depends upon the population access to safe water, sanitation conditions, snail control and drug treatment. WHO focuses to reduce this parasitic disease periodically through drugs such as praziquantel (PZQ) (8). Praziquantel was available to people in 1970s for the treatment of schistosomiasis and other trematode diseases. Its use become popular because the one can be taken orally and have very few side effects. Regardless of its widespread use, no evidence exists that shows schistosomiasis has develop resistance against PZQ (23).

Toxicity and side effects of PZQ

In animals PZQ demonstrated at very low toxicity and there are no genotoxic evidences exists of its mutagenicity or carcinogenicity. There are massive evidences that suggest PZQ is a safe drug. PZQ is a tolerateable and effective drug among patients of all ages. With existing proofs that PZQ is a safe drug ad hoccommittee of WHO recommended that it can be offered to both pregnant and lactating females(23).

Side effects after treatment are usually mild and transient effecting as many as 30- 60% of patients. The frequency of side effects after normal treatment is mainly depends upon the number of eggs excreted before treatment. The most severe side effects are of bloody diarrhea or endematous urticaria. These are observed in those areas where the intensity of infection is high (23).

PREVENTION AND CONTROL

Preventive measures should be taken to avoid schistosomsis sicknesses. Individuals should utilize seas for swimming and swimming pools that are chlorinated (6). Drink safe water, although schistosomiasis is not transmitted by swallowing contaminated water, if your mouth or lips come in contact with water containing the parasites, you could become infected,because water coming back directly from canals, lakes, rivers, streams, or springs may be contaminated with a variety of infectious organisms, you should either bring your water to a rolling boilfor one minute or filter water before drinking it.Bring your water to a rolling boil for a minimum of one minute can kill any harmful parasites, bacteria, or viruses present.Iodine treatment alone won't guarantee that water is safe and freed from all parasites.Vigorous towel drying once Associate in nursing accidental, very brief water exposure may help to prevent parasites from penetrating the skin. However, do not rely on vigorous towel drying alone to prevent schistosomiasis(6).

Another way is that, stockpiling tank load up with water and kept it for 1-2 days and then can be used for bathing(24). DEET (N,N-Diethyl-meta-toluamide) are Insect repellants, connected to keep cercariae hatchling from entering into the skin (3).

Contact with contaminated water cannot generally be stayed away from, particularly by individuals in endemic regions whose occupation (e.g., fishing, rice cultivating) or everyday movement opens them to these waters.In territories where the predominance of disease is in any event 10%, preventive treatment ought to likewise be given to the individuals who are at high danger of contamination due to their occupation (3).

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World Health Organization (WHO) prescribed a treatment called chemotherapy to control schistosomiasis it decreases the nearness, prevalence, and seriousness of the disease. In any case, chemotherapy not shield from re-contamination this just reduces the development and improvement of eggs creation, which thus keeps from illnesses that is caused because of the aggregation of eggs in the tissues of people. School matured youngsters have high possibility/danger of disease so preventive chemotherapy is better for them (8). The principle goal of chemotherapy is to reestablish the patient's prosperity and lessen transmission of the infection (25). Mass chemotherapy was utilized for the general population from endemic regions with a high predominance (26). Wiping out the snails that are required to keep up the parasite's life cycle (6),Chemicals used to eliminate snails in freshwater sources may harm other species of animals in the water and, if treatment is not sustained, the snails may return to those sites afterwards, for certain species of the parasite, such as , animals like cows or old World buffalo can even be infected.Runoff from pastures (if livestock are infected) can contaminate freshwater sources(6).

Early endeavors to control schistosomiasis amid 1930–1985 depended on concoction molluscicides for snail control, and generally inadequate and less very much endured medications (27).

Cell reinforcement pathways are known to assume and essential job in the survival of schistosomes in the oxidative condition of the circulatory system where they dwell (28). The control of schistosomiasis is principally reliant on the utilization of praziquantel (PZQ) the main promptly monetarily accessible medication (27).

CONCLUSION

Schistosomiasis also known as bilharzia spread due to fluke worms belong to Genus Schistosoma, it is a parasitic disease. It is also known as snail fever because snail acts as an intermediate host and finally cause ailment in the mammals. There are five schistosome species: *S. haematobium, S. japonicum, S. mansoni, S. intercalatum*, and *S. mekongi*;huge amount of ailment is cause due to the former three species. Schistosomiasis is the most overwhelming disease after malaria. The type of disease depends on particular type of schistosome species act on host's body. 800 million people are under danger of this parasitic disease and Africa is most effected country where 300,000 deaths were occurred in one year. Schistosomiasis is divided into three types on the basis of their location where particular species act: Urinary schistosomiasis is caused by the parasitic trematode *Schistosoma haematobium*and effect human bladder but do not lead to death of the individual, *S. mansoni, S. japonicum* and *S. mekongi* can cause gut sorescalled Gastrointestinal schistosomiasis and *S. mansoni, S. japonicum* and *S. mekongi*, schistosomal cause hypertension and endless disease Hepatosplenic schistosomiasis. The worms reside in the vein of mammals where they lay eggs and cause disease. Life cyclesinclude two stages: bifurcate cercaria and a ciliated miracidium. The larval stages of worms are released by the snail in freshwater and then pass it to the final host; cause disease, the host excrete it in faeces and urine and life cycle goes on. The Kato-Kartz technique is uses to diagnose schistosomiasis it is cheap but do not give accurate results where prevalence is low. Parasitological, immunological and molecular methods are also available for diagnosis by testing stool sample. Praziquantel drug is taken orally to cure schistosomiasis; it has low toxicity and do not have any evidence of causing mutagenicity or carcinogenicity, side effects include bloody diarrhea or endematous urticaria. This disease mostly occur due to drinking contaminated water, by taking bath in polluted pools, and in territories where the predominance of disease is 10%, preventive treatment ought to likewise be given to the individuals who are at high danger of contamination due to their occupation, for example, anglers, agriculturists, and water system laborers, and in addition ladies who might be presented to tainted waters when playing out their residential errands.So, swimming in chlorinated water, using boiled water for drinking and using stockpiling tank for bathing is safe. The one can also control it by reducing the population of snail. Chemicals used to eliminate snails in freshwater sources. Chemotherapy is use to decreases the nearness, prevalence, and seriousness of the disease. So, one should try to live in clean environment and keep them away from contaminated water.

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