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Bovine Schistosomiasis

Tsegaye Mitiku
Alage TVET Collage, Department of Animal Health, P.O. Box 77, Alage, Ethiopia
E-mail: *tsegayemitiku52@gmail.com*

Abstract

Schistosomiasis is caused by different species of parasitic worms, called schistosomes. It is a Neglected Tropical Disease (NTD) of profound medical and veterinary importance. As many as 10 different species of schistosomes have been reported to naturally infect cattle; six have received particular attention mainly because of their recognized veterinary significance. The geographical distribution of schistosoma species infecting cattle are mainly determined by the distribution of their respective intermediate host snails, level of infection and the frequency of water contacts. Epidemiological studies conducted on bovine schistosomiasis are suggestive of the endemicity of the disease in Ethiopia particularly in the area with large permanent water bodies and marsh pasture areas of the country. Most infections in endemic areas occur at a subclinical level. However, it has been established that high level of prevalence of subclinical infections cause significant losses due to long-term effects on animal growth and productivity and increased susceptibility to other diseases. Snail hosts favor intensive transmission of Schistosomiasis and the infection rate of the disease are mainly affected by host related factors, anthropogenic/ human factors like poorly designed irrigation projects, management and seasonal factors. Diagnosis is based primarily on the clinico-pathological picture, parasitological techniques and post mortem findings. The most effective way to control cattle schistosomiasis in endemic areas is to prevent contact between the animals and the parasite. Awareness creation about the disease, destruction of the snail intermediate host population at their breeding sites, either by chemical or biological methods may be considered as a recommendation to prevent the occurrence of bovine schistosomiasis.

Keywords: bovine, Ethiopia, Molluscicide, Schistosomiasis

Introduction

Schistosomosis is an infection due to trematodes of the genus schistosoma. The taxonomic classification of the organism that causes schistosomiasis is presented as platyhalminthes, class trematoda, sub class digenea, super family schistomatidea, Genus schistosoma and species *schistosoma bovis, S.matheei, S.mansoni, S.hematobium, S.nasalis,* and *S.spinalis* (Thrusfied, 2005). Schistosomosis is a chronic debilitating infection affecting both humans and animals by different species of schistosomes and hence the disease of public health importance. Other names give to schistosomosis are blood fluke disease and Bilharziasis (Parja, 2004).

The schistosoma or bilharzia are digenetic, dioecious (sexes are separate) trematodes or flukes with flat bodies (flat worms) (Hanelt *et al*., 2009), which lives in the vascular system of animal. Important predilection sites for this parasite is the mesenteric, portal vein and typically in other organs of the final host. They are the causative agent of schistosomiasis known as blood fluke disease or Bilharziasis, a disease of tropical and subtropical countries (Mersha *et al*, 2012). Schistosomiasis is a chronic debilitating infection affecting both humans and animals by different species of schistosoma and hence the disease is of Public health importance (Belayneh and Tadesse, 2014).

The schistosomes are different from most other members of the digenea in the sexes are separate. The schistosomes or schistosoma means split body and refers to the fact that the male have a ventral groove called gynaecophoric canal (Marquardt and Grieves, 2000). Schistosomes are thin, elongated fluke, up to 2 cm long primarily parasitize in the blood vessels of alimentary tract and bladder responsible to cause schistosomiasis (Urquhart *et al.,* 2003).

Veterinary important species of schistosoma that cause major impact on domestic animals include *Schistosoma bovis* (ruminants in Africa and Asia), *Schistosoma leiperi* (cattle in Africa), *Schistosoma spindale* (ruminants, horse and pigs in Asia), *Schistosoma nasalis* (ruminants and horse in India), *Schistosoma indium* (horse, cattle and goats in India buffalo), *Schistosoma japonicum* (human, Cat, and mammals in Asia) and *Schistosoma margrebowiei* (horses, ruminants and elephants in Africa) (Dwight *et al.,* 2003, Kassaw, 2007).

In Ethiopia, various epidemiological studies were conducted on cattle schistosomiasis which was indicative of the epidemicity of the disease particularly in large stagnant water bodies and marshy free grazing areas. The prevalence of schistosoma bovis has reported from different regions of the country by fecal examination. For example, 28% in Kemissie, 33.8% in Bahir Dar, 10.17% and 13.7% in fogera was reported by Ameni *et al*. (2001), Solomon (2008) and Mengistu *et al*. and Mersha *et al*. (2012) were evident. Ethiopia is highly endemic for schistosomiasis, since temperature in Ethiopia appears to be the major factor that affects the distribution of both Schistosoma species in Ethiopia (WHO, 2010; Alebie *et al*., 2014).

schistosomiasis is one of the major constraints of animal disease of livestock production as it causes high economic losses due to mortality, low fertility, retard growth, poor productivity (poor conversion rate), low milk yield and increased susceptibility to other disease (Almaz *et al*., 2013). Since schistosomes of veterinary concern have received relatively little attention, detailed information on epidemiological data and various factors, which influence the host parasite relationship, appropriate prevention and control methods of bovine schistosomiasis in Ethiopia as well as in the world, are generally limited. Thus, the present review was carried out with the objective of to review on bovine schistosomiasis with due emphasis on its epidemiology; prevention and control strategies.

Literature Review

Description of the parasite

Schistosoma is primary parasitic disease in the blood vessels of the alimentary tract and bladder of animals and humans. In man, schistosomes are often responsible for sever and debilitating disease and veterinary interest lies in the fact that they can cause a similar disease in animals, some of which may act as reservoirs of infection for man. The schistosomes differ from other flukes in that the sexes are separate, the small adult female lying permanently in a groove, gynaecophoric canal, in the body of the male (Taylor *et al*., 2007).

Morphology

Adult Schistosomosis are obligate parasite of vascular system of vertebrate. Schistosomes are dioecious worms, which is an exception among

the trematodes. The matured female is more slender than the males and normally carried in ventral groove, the gynaecophoric canal which is formed by ventrally flexed lateral out growths of the male body (Bont, 1995). Females are slightly longer and significantly thinner and measures 2.5 cm long and males are wider and shorter (that is 0.1. cm in width and 2.3 cm in length). A total of 19 different species of schistosoma are described worldwide. They can be differentiated through their morphological features, life cycle, host specificity of enzyme and DNA behavioral characteristics. Out of 10 species reported to naturally infected cattle six have received particular attention mainly because of their recognized veterinary significance. Some of the species are S. metheei, S.bovis, S.spinale, S.indicum and S. nasale (Reinecke, 1997).

Eggs of some species are armed with spine when discharged in the feces *(S.mansoni* and *S.japonicum*) and in urine *(S.hematobium*). The eggs of hetrobiliharzia Americana are rather spherical and posses only a slight bump on one side rather than a spine as seen in *S.hematobium* and *S.mansoni* (Bowman *et al*., 2003). Generally the eggs have typical morphological features. Relatively larger, slender (spindle) shaped and have lateral of terminal spine (pointed at both ends) (Urquhart *et al.*, 2003).

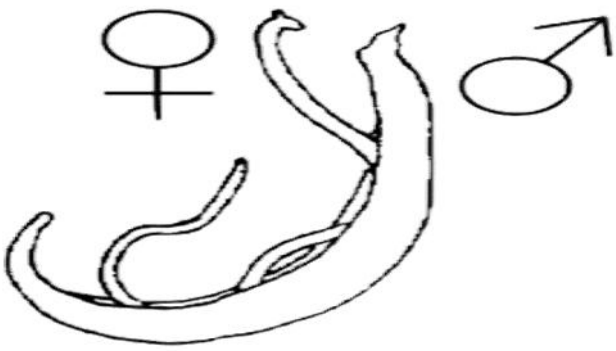

Figure1. Mature schistosome worm: female lying in the gynaecophoric canal of male
Source: (Gobert *et al.*, 2009).

Epidemiology and risk factors

Schistosomiasis is an important cause of disease in many parts of the world, most commonly in places with poor sanitation. It is prevalent in tropical and subtropical regions of Africa, Asia, Middle East and southern Europe; especially in poor communities without access to safe drinking water and adequate sanitation (.Various socio epidemiological factors are responsible for transmission of the disease and level of infection. Among such factors grazing site, migration and emergency of new foci, urbanization, and socio economical status, sanitation, farming intensification, water supply patterns and levels of fecal contamination of water source are important. Due to the nature of transmission schistosomosis is a disease that commonly occurs in the proximity of water sources (WHO, 2010; CDC, 2012).

Host Range

Definitive Host

The definitive hosts of schistosoma species are mammals. Mainly important is cattle as well as sheep, including human beings. Species of schistosoma that humans as definitive host are schistosoma mansoni and schistosoma intrcalatum cause intestinal schistosomiasis; schistosoma mekongi causes Asian intestinal schistosomiasis Species of schistosoma that animals as definitive host: *S. bovis* normally infects cattle, sheep and goats in Africa, parts of Southern Europe and Middle East, S.matheei normally infects cattle, sheep and goats in central and Southern Africa (Fraser *et al.*, 1991).

Intermediate host

The main intermediate host of S.mansoni is biomphalaria boissyi in Egypt, B.Pfeiferich in Africa (most parts). In Ethiopia, different Bulinus species (Bulinus truncates B.africanus and B.abyssinicus) serve as the intermediate hosts are reported from different region like Gondar and Gojjam (Alemseged, 2010).

A s intermediate hosts of both *schistosoma haematobium* (human urinary schistosomosis) and *S.bovis* (bovine schistosomosis) freshwater snail belonging to the *Bulinus africanus* group play a major economic role in south African rural communities in the endemic areas of South Africa. Generally, the intermediate hosts are widely distributed, then schistosomiasis that are pathogenic to domestic animals are also widely distributed throughout Africa, the middle East, Asia and some countries bordering Mediterranean (Fraser *et al.*, 1991). The ideal suitable conditions for snails are the presence of stagnant water bodies, marshy area, and irrigation canals and then these are suitable condition for the distribution of schistosomiasis (Dunn, 1998).

Life cycle

Schistosomes are dioecious (unisexual) worms, which are an exception among trematodes and have an indirect life cycle, while water snail act as an intermediate host belong to the genera Bullinus and planorbis (Brown, 1980). Embryonated eggs of schistosomes are excreted through faeces, urine and nasal discharge from definitive host, depending on the localization of the species. When the egg comes into contact with water, they hatch and liberate miracidium which is a pyriform in shape and is an active swimmer. It has a few hours to find and to penetrate the appropriate susceptible snail and it transformed to a mother sporocyst close to the site of penetration. Several hundred daughter sporocysts are formed within the mother sporocysts. The daughter sporocysts break out through the tegument of the mother sporocysts and migrate to the digestive glands and reproductive tract of the mollusk, in which they proliferate internally to produce cercariae with a bifid forked tail (furcocercaria) which is the infective stage for the disease, after they leave the snail invade the final host through the skin or mucus membranes penetration (Aiello, 2000).

Visceral schistosoma mature in the hepatic portal veins, mate and migrate to the mesenteric veins where egg production starts (Bont, 1995). The female in the mesenteric vein insert her tail into the venule and then the eggs penetrate the venule endothelium aided by their spines and by proteolytic enzymes secreted by the unhatched miracidia (Urguhart *et.al*. 2003) that migrate to the intestinal lumen, urinary tract or the nasal cavity (s.nasalis) and are eliminated with faeces, urine and nasal discharge or disseminated while urinating, drinking or sneezing (Soulsby, 1999).

Pathogenesis

Infection occurs when skin comes in contact with contaminated water in which certain types of snails that carry the parasite are living. Freshwater becomes contaminated by *Schistosoma* eggs when infected individuals urinate or defecate in the water. The eggs hatch, and if the appropriate species of snails are present in the water, the parasites infect, develop and multiply inside the snails. The parasite leaves the snail and enters the water where it can survive for about 48 hours. *Schistosoma* parasites can penetrate the skin of individuals who come in contact with contaminated water, typically when they are watering, grassing, swimming, or washing. The penetration of the cercariae through the skin causes dermatitis, which is evident about 24 hrs after infection. Passage through the lungs may also causes pneumonia in gross infection and abdominal organs such as the liver may become congested during the early stage of the disease due to the arrival of immature worms in the intra-hepatic portal blood vessels. The most serious damage is caused by the adult schistosoma in the egg laying stage due to the irritation caused by the eggs lodged in the tissues, which are forced to find their way through small venules to the epithelium and lumen of the gut (Taylor, 2007). Over several weeks, the parasites migrate through host tissue and develop into adult worms inside the blood vessels of the body. Once mature, the worms mate and females produce eggs. Some of these eggs travel to the bladder or intestine and are passed into the urine or stool (CDC, 2012).

The main infection site of the final host is through skin penetration, infection by mouth is theoretically possible, provided the ingested furcocercaria has time to penetrate the oral mucosa, since it is destroyed in the stomach if

swallowed or if ruminants drink large quantities of water, diluting the final fluid, they can be infected via rumen. Gross anatomical features and a complex set of vascular changes characterize schistosomal hepatopathy as a peculiar form of chronic liver disease, clinically known as "hepatho-splenic schistosomiasis". Intrahepatic portal vein obstruction and compensatory arterial hypertrophy render the hepatic Parenchyma vulnerable to ischemic insult. This may lead to focal necrosis, which may give place to focal post necrotic scars. These events are of paramount importance for the clinic-pathological evolutions of schistosoma hepatopathy. Damage to muscular walls of the portal vein may be followed by dissociation of smooth muscle cells and their transition towards myofibroblast, which appear only as transient cells in schistosomal portal fibrosis. A process of chronic hepatitis is a common accompaniment of portal fibrosis in schistosomiasis (Andrade, 2004).

Clinical signs

Even though Schistosomiasis can be quite common in animals, it is considered to be a much more serious and important infection in sheep than in larger ruminants, and even where a high prevalence of the parasite is detected in slaughtered cattle, clinical sign of the disease are seen only rarely. In sheep anemia and hypoalbuminaemia have been shown to be prominent during the clinical phase apparently as a result of mucosal haemorrhage, dyshaemopoesis and an expansion in the plasma volume. The significance of low level infection is not known, but it has been suggested that this may have a considered effect on productivity (Taylor, 2007). The species which are most pathogenic to domestic ruminants are *S. bovis* and *S. japonicum* where as *S. matthei* and *S. spindale* are less pathogenic. Schistosomiasis in cattle has an acute phase when recently matured parasites release large quantity of egg in the intestinal mucosa, and chronic phase during which the damage is caused by the reaction produced by eggs trapped in inside tissues (Acha and Szyfres, 2003).

In acute phase, it causes severe hemorrhagic lesions in the intestinal mucosa with infiltration of eosinophils, lymphocytes, macrophages, and plasmocytes along with profuse diarrhea and dysentery which is called intestinal syndrome and dehydration, anorexia, anurea, hypoalbuminaemia, weight loss and retarded development. The duration of the disease depends on the parasitic burden and recovery is spontaneous (Taylor *et al*., 2007). But in chronic phase it causes the formation of inflammatory foci, granuloma , fibrosis, and ultimately the obstruction of portal irrigation due to cell mediated immune response to antigen from the trapped eggs which is called hepatic syndrome. The principal manifestations are emaciation, anemia, eosinophilia and hypoalbuminaemia (Khan and Line, 2005).

Unlike human, animals do not appear to be susceptible to spleenomegally or eosophageal varicose, but the presence of dead parasites can cause to develop enlarged follicles or lymph nodes as well as venous thrombosis, with infarct of the organ. Cattle have also been reported to have obstructive phlebitis caused by the presence of adult parasites in the vein (Acha and Szyfres, 2003).

Diagnosis

The diagnosis of schistosomosis is not always easy to diagnose based on symptoms because the symptoms of visceral schistosomosis are not pathognomonic. However, the symptoms of haemorrhegic diarrhea, weakness, emaciation, and anemia, coupled with the history of access to water course infected with snails, may create a suspection of schistosomosis, but in regions where nasal schistosomosis is endemic, the presence of nasal polyps and respiratory symptoms, accompanied by pronounced snoring, are characteristic of the disease caused by schistosoma nasale (s. nasale) (Acha and Szyfres, 2003). It also diagnose based on the demonstration of characteristic egg of the parasite. Its definitive diagnosis is carried out by the detection of eggs from the infected animal

feces and/ or urine nevertheless, the parasitological methods of diagnosis have low sensitivities, especially with patients with the acute phase of illness or with low intensity infection (Khan and Line, 2005).

In animals clinical history and signs are insufficient; the characteristic, terminal spined eggs must be identified in the feces, rectal scrapings, or nasal mucus for confirmation. Eggs of *S. bovis* (202 × 58 µm) are spindle-shaped; those of *S. spindale* (382 × 70 µm) are more elongated and flattened on one side, and those of *S. nasale* (456 × 66 µm) are boomerang-shaped. The oval eggs of *S. japonicum* are relatively small (81 × 63 µm), with a rudimentary spine. In chronic cases, it may not be possible to find eggs in the feces or nasal mucus, and the diagnosis must be confirmed at necropsy by finding adult flukes in the blood vessels (Khan and Line, 2005).

The egg of schistosome parasite differ in size and shape: oval in s. japanicum and spindle shape in s.bovis and s.mattheei containing a single spine protruding from the shell. The position of the spine of the egg shell is a distinguishing feature; a rudimentary lateral spine in ova of s. japonicum and the terminal spines in others (Soulsby, 1999).

Treatment

Several drugs such as trivalent antimonials lucanthone, hycanthone, nitridazole, trichlorphan, haoxon, amoscanate and praziquantel have been used to treat visceral and nasal schistosomiasis with variable efficacy and toxicity but according to world health organization (WHO, 2004), three new drugs have revolutionized for treatments of schistosomiasis which are praziquantel, oxamniquine, and mentritonate. The drug of choice for all species of schistosomiasis is praziquantel (Gryseels and Polman, 2006), but rapid re infection is the problem, although schistosomiasis is not eradicable, the disease can be prevented and transmission controlled with a single annual dose of praziquantel. Oxamniquine active against *S. mansoni* and metrifonate against *S. haematobium* are also orally given (Krauss, 2003). In case of animals Praziquantel (25 mg/kg) is highly effective, although 2 treatments 3–5 weeks apart may be required. However, for practical and economic reasons, schistosomiasis in domestic stock is rarely treated. The drugs still widely used for animals are the antimicrobial preparations, although these are superseded by niridazole and trichlorphon, all of which have to be given over a period of days at a high dosage rates (Urquhart *et al*., 1996).

Control and prevention

Control measures are based on interrupting the epidemiological cycle by removing of adult parasites by chemotherapy, elimination the intermediate host by molluscides and habitat modification and preventing access of definitive hosts to natural water course contaminated with cercariae. Simple measures such as creating a barrier to prevent animals from gaining access to water contaminated by the snail vectors are very effective (Farida and Shombe, 2012). Understanding the life cycle of a parasite and the epidemiology of the disease caused by the parasite are fundamental to control disease s. There are four broad interventions that can be made to disrupt the life cycle of the parasite and hence its transmission (Chimbari, 2012).

The first is treatment of infected individuals to reduce, and remove morbidity, reduce mortality and reduce contamination of the environment with schistosoma parasite eggs (Chimbari, 2012). Chemotherapy of infected individuals is not only curative but also preventive in that it halts the production of eggs that contaminate the environment. In communities that has a high prevalence of infection but limited economic resource; treatment can be restricted to the groups in the highest parasite burdens or individuals at risk in endemic areas (Acha and Szyfres, 2003).

Second, providing communities with adequate, appropriate sanitation to reduce environmental contamination and hence minimize the chances of miracidia finding and penetrating the intermediate host snails. Environmental sanitation refers especially the provision of potable water and sanitary waste elimination in rural areas.

Provision of adequate and accessible safe water is vital to reduce the chances of people and animal getting in contact with water that may be infested with cercariae and hence limits the chances of cercaria locating the human and animal host and infect them in its limited life span (Chimbari, 2012).

The third is snail control to minimize the chances of miracidia finding an appropriate intermediate host and therefore significantly reducing the number of cercariae available for infecting people and animals at water contact sites. Controlling intermediate hosts can be achieved in a number of ways: by draining swampy land, removing vegetation from water bodies, improving irrigation system, and through the use of molluscides, though expensive , is a rapid and effective means of reducing transmission if it is combined with other measures especially chemotherapy (Acha and Szyfres, 2003).

The other measures available for control and prevention of schistosomiasis are: education of people in endemic areas on the mode of transmission in order to make them aware of the dangers of watering their animals at sites where snail vectors are abundant and to inform them of how potential disease transmission can be reduced in this way and changing the environment. Health education consists essentially in teaching people to avoid contact with contaminated water and not to contaminate water with their own excreta. Changing the environment entails an improved standard of living for the population, more education, and healthier surrounding the measure described above are useful, when they are incorporated realistically within the frame work of a control program (Tohon *et al*., 2008).

Economic importance

Schistosomiasis causes major economic loss in sheep and cattle. It has an economic impact like production losses due to *S. bovis* result from mortality, delayed growth, partial liver condemnation, poor future reproduction performance and sub clinical infections cause significant losses due to long term effects on animal growth and productive capacity or milk yield, draft power and increase susceptibility to other parasitic or bacterial disease (). In human's economic losses in terms of working hours has been shown and even though the diseases has got negative impacts, it is only within recent years and wide spread deaths of cattle and sheep that no any recognition has been given to the veterinary importance of these parasites (Pitchford and Visser, 1998).

The public health importance

Schistosomiasis is one of the most prevalent parasitic diseases and an important public health problem in many developing countries including Ethiopia (Akande and Odetola, 2013).The economic and health effects of schistosomiasis are considerable. Compared with many other tropical infections, schistosomiasis is characterized by low mortality rates and very inconclusive morbidity estimates. It has been asserted that schistosomiasis follows malaria as the most important tropical disease in terms of endemicity and public health importance on a global level. A report by the WHO expert Committee states that socioeconomic impact of schistosomiasis is second only to malaria. These observations are based on epidemiological figures on prevalence, but extrapolating impact of infection on complex measures such as health, disability and productivity from prevalence data is complicated (Prescott, 1979).

The symptoms to which people generally referred included weakness, laziness, tiredness, alterations in the skin, loss of appetite, loss of weight, swollen stomach, diarrhoea, vomiting, headache, pain in the legs and bad temper. Weakness, lack of energy and tiredness are considered to be the most characteristic symptom of schistosomiasis. This group of signs (pain in the legs, weakness, loss of weight, vomiting, bloody diarrhoea and swollen stomach) seems to be linked to the idea of loss (of strength, appetite, weight and blood), that evokes the progressive destruction of the body (since schistosomes attacks the liver, spleen and blood it had serious con-notations). Most people regarded schistosomiasis as a very serious

disease, capable of killing, but only in the absence of early treatment. It was considered that the disease would only progress and death result if schistosomiasis was not treated, thus access to treatment was essential to interrupt the course of the disease (Elizabeth *et al*., 2000).

In children, schistosomiasis can cause anemia, stunting and a reduced ability to learn, although the effects are usually reversible with treatment. Chronic schistosomiasis may affect people's ability to work and in some cases can result in death. In sub-Saharan Africa, more than 200 000 deaths per year are due to schistosomiasis. Hygiene and play habits among male children especially make them vulnerable to schistosomiasis and STH infections. It is estimated that 400 million school-age children who are infected are often physically and intellectually compromised by anemia, leading to attention deficits, earning disabilities, school absenteeism and higher dropout rates (Rajini and Gurdip, 2010).

The disease burdens and reduces the quality of life of those people infected. Deaths occur, mainly through bladder cancer and renal failure driven by urinary schistosomiasis and liver fibrosis due to intestinal schistosomiasis (Tallo *et al*., 2008).

Schistosomiasis can substantially reduced labor productivity. In Egypt, for example, labor output dropped as much as 35% among infected groups whereas, in Nigeria, the disease reduced worker productivity, cash income, rates of land clearing and farm size (Umeh *et al*., 2004). Similarly, studies on sugar plantations in Tanzania and Sudan showed that infected workers produced 10 to 15% less than non-infected workers (Guy, 1991).

The role of animals for human schistosomiasis

It was found that baboons played some role in the transmission of *S. mansoni* and the discovery of schistosomes in rodent's suggested that they might also be involved as reservoir hosts but soon it become obvious that other species of schistosomes were prevalent in livestock and wild animals and that man was constantly exposed to cercariae of this zoonotic species (Soulsby, 1999). Now a day it is clearly known that animals play an important epidemiological role because they contaminate the water enabling human to become infected (Acha and Szyfres, 2003).

Apart from the so called human schistosomes, *S. mansoni*, *S. haematobium*, and *S. intercalatum* there are a variety of other species in domestic and wild animals. For example, *S. bovis, S. mallwei, S. leiperi,* and *S. margerbowie* in cattle and sheep and wild ungulates, *S. rodhaini* in rodents and carnivores and *S. hippopotami* and *S. edwardensie* in the hippopotamus. These parasites are often transmitted by the same snail host as the human parasites so that in parts of Africa man is inevitably exposed to a variety of hetrologous infections (Soulsby, 1999).

In Africa, Schistosoma spp. belong either to the *S. mansoni* group, characterized by eggs with lateral spines, or the *S. haemattobium* group, identified by terminal spines on the eggs. The eponymous species of these two groups are most commonly found in humans and bring a huge public health burden on many communities and regions. There are, however, other species within these groups that primarily affect non-human animals; this section will outline these other species that are found in Africa, most of which are primarily known as infections in rodents and ungulates, but some of which have been reported from non-human primates too. The rest of the review will focus on accounts of 'human' schistosome species, namely *S. haematobium, S. intercalatum/guineensis* and *S. mansoni*, as found in non-human primates (Standley *et al*., 2012).

Other species that make up the *Schistosoma haematobium* group are *S. intercalatum, S. guineensis, S. bovis, S. mattheei, S. margrebowiei, S. leiperi, S. curassoni* and the recently described *S. kisumuensis* (Webster *et al*., 2006; Hanelt *et al*.,2009). *S. intercalatum* and *S. Guineens* primarily infect humans. The remaining species, with the exception of *S. kisumuensis*, usually parasitize artiodactylid ruminants, with some most commonly found in domestic ungulates

whereas others are more frequently observed in wild bovids. There are occasional reports in the literature of *S. bovis* and *S. Mattheei* from humans and baboons, although usually alongside a mixed infection with either *S. mansoni* or *S. haematobium* (Standley *et al.,* 2012).

A reservoir host is defined as 'an animal which maintains under natural conditions an infection transmissible to man'. To be an important source of Schistosoma infection in man it must be readily susceptible, must occur in sufficiently large numbers, so that a high level of transmission is maintained, and must frequent water sufficiently so that substantial amounts of excreta containing large numbers of schistosome ova are deposited in or near water. Pitchford (1977) lists the following animals as susceptible to *S. mansoni*: chimpanzee, various species of baboon, grivet monkey, sheep, dog, waterbuck, various species of rodent and two species of shrew, of which the chimpanzees, baboons and perhaps the monkeys are of potential practical significance as hosts. The following records of natural infection are listed for *S. haematobium* two species of baboon, chimpanzee, vervet monkey, pig, sheep and the Cape buffalo (Guy, 1991).

Conclusion and Recommendation

Schistosomiasis is a chronic debilitating infection of humans and animals caused by different species of schistosomes. *S. bovis*, the agent of schistosomiasis in cattle is one of the major veterinary problems in many Mediterranean and African countries. Occurrence of bovine schistosomiasis is dependent on environmental factors such as moisture, rain fall, temperature, water bodies (stagnant, swampy and marshy) and snail intermediate hosts. Few epidemiological studies conducted on bovine schistosomiasis in Ethiopia indicate, the endemicity of the disease in the country. Although few or no overt clinical signs may be recognized in case of bovine schistosomiasis in the short term, high prevalence of chronic schistosome infections cause significant losses on a herd basis. Although the economic significance of the disease is mainly attributed to morbidity, mortality, liver condemnation, reduced productivity and poor subsequent reproductive performance, still there a limitation on detailed information of epidemiology; and various factors, which influence the host parasite relationship. Therefore, further study on the epidemiology of the disease like malacological and parasitological survey, and mapping high risk areas, destruction of the snail intermediate host population at their breeding sites, either by chemical or biological methods should be carried out for sound prevention and control of schistosomiasis.

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