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Review on Bovine Schstosomiasis: Economic Importance and Status in Ethiopia

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ABSTRACT

Parasitisms are one major problems of livestock production in Ethiopia. Schistosomiasis has an economical important disease in sub Saharan African country including Ethiopia. It is one of zonotic important disease cause illness in humans. Schistosomes are members of the genus Schistosoma, family Schistosomatidae. Schistosomes are dioecious (unisexual) worms, which are an exception among trematodes and have an indirect life cycle Adult worms are obligate parasites of the vascular system of vertebrates Transmissions occur through Schistosoma parasites can penetrate the skin of individuals who come in contact with contaminated water, typically when they are watering, grassing, swimming, or washing. Pathogenesis is due to 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. Clinical signs ranging from acute form (profuse diarrhea and dysentery, dehydration, anorexia, anurea) chronic form i.e formation of inflammatory foci, granuloma, fibrosis, and ultimately the obstruction of portal irrigation. Diagnosis is based on the clinico-pathological picture, parasitological techniques and post mortem findings. Several drugs such as trivalent antimonials lucanthone, hycanthone, nitridazole, trichlorphan, haoxon, amoscanate and praziquantel have been used to treat visceral and nasal schistosomiasis but praziquantel is drug of choice for the treatment of b.schistosomiasis. A combination of control measures included drainage, fencing, and snail control in the long run; regular strategic deworming; grazing management apply to control and prevent the disease. The economic impact of schistosomiasis and the underlying tradeoffs between water resources development and public health concerns have yet to be quantified. In this review the prevalence is ranging from to low 5.7% (in and aroundNekemte, East Wollega zone, Western Ethiopia) to high 26.3% (in and Around Gozamen District, Northwest Ethiopia).

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Introduction

Parasitic diseases remain major bottle neck to livestock development in developing nations [1]. Ethiopia has the largest livestock population in Africa, but productivity is low as a result of parasite, bacterial, viral disease, malnutrition and other management problems. Parasitism is one of the major impacts on livestock development in the tropics. Schistosomiasis is one of the fifteen neglected tropical diseases (NTD) because it is unusual among the helminth diseases for two reasons: much of the pathogenesis is due to the eggs (rather than larvae or adults), and most of the pathology is caused by the host immune system (Delayed-type hypersensitivity and granulomatous reactions) [2]. Schistosomiasis is a parasitic disease caused by microorganisms from the genus Schistosoma. It has a huge negative impact on both economy and health worldwide [3].

Schistosomiasis is one of the most prevalent parasitic diseases and an important public health problem in many developing countries including Ethiopia [4, 5].Schistosomiasis is caused by different species of parasitic worms, called schistosomes. It is a Neglected Tropical Disease 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 and 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 [6]. According to Belayneh and Tadesse, 2014, bovine schistosomiasis is a slug-borne trematode infection of cattle caused by the genus Schistosoma. fSchistosoma bovis is endemic to northern, southwestern, eastern, and central parts of Ethiopia. Schistosoma bovis develops a syndrome characterized by liver damage, rough coat, pale mucosa, severe emaciation and reduced reproductive capacity, leading to a major economic downturn and public health problem [30]. S. bovis has a localized distribution, which is commonly found in northern, eastern, south eastern and central part of Ethiopia. There are some reports which indicate the prevalence of schistosomiasis in different area of Ethiopia [6].

Because signs and history alone are insufficient to distinguish visceral schistosomiasis from other debilitating diseases, diagnosis should be confirmed by the presence and identification of eggs in the feces of the infected animal. At necropsy, macroscopic examination of the mesenteric veins for the presence of adult worms or microscopic examination of scrapings of the intestinal mucosa or of crushed liver tissue (both for eggs) may prove easier (MSD Veterinary manual, 2014).

A confirmatory diagnosis of ongoing schistosomiasis in cattle can only be achieved through the detection of parasite eggs in fecal samples or biopsy specimens from the affected animal (Abera et al., 2020). Several drugs such as trivalent antimonials, hycanthone,

nitridazole, trichlorphan, haoxon, amoscanate and praziquantel have been used to treat visceral and nasal Schistosomiasis with variable efficacy and toxicity [8]. The drug praziquantel is choice for all species of schistosomiasis [9]. The economic impact of schistosomiasis and the underlying tradeoffs between water resources development and its status in concerns have yet to be quantified. Therefore; the objective of this paper is to review bovine shistosomiasis, economic importance and its status in Ethiopia.

Schistosomiasis

Epidemiology

History of Schistosomiasis Bovine schistosomiasis, a disease caused by parasitic worms (schistosomes), has a history that spans centuries, with the first documented cases in humans dating back to ancient times. While initially studied in humans, research in the late 19th century revealed that schistosomes also infect cattle, leading to a greater understanding of the disease's epidemiology and its impact on livestock. Human Schistosomiasis The first human schistosome, Schistosoma haematobium, was discovered in 1851 by Theodor Bilharz in Egypt. Bovine Schistosomiasis In 1859, T.S. Cobbold demonstrated that schistosomes were not limited to humans by identifying Bilharzia magna (later known as Schistosoma species) in a West African monkey, and later in other animals, including cattle (Https//:www. history of bovine shistisomiasis, 2025). Schistosoma is primary parasitic disease in the blood vessels of the alimentary tract and bladder of animals and humans. In man, schistosomes areoften 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, gynaecophoriccanal, in the body of the male [10].

Etiology

Schistosomiasis is a parasiticdisease caused by microorganism from the genus Schistosoma. The major species that cause animal schistosomiasisinclude: Schistosomabovis, S. indicum, S. japonicum, S. matthei, S. intercalatum, S. nasale and S.rodhoni [11]. S. bovis, S. matthei and S.intercalatum are the most important species that can cause schistosomiasis in ruminants. The adult worms inhabit the mesenteric vessels of the definitive host and the intermediate forms develop into snails from the genus biomphalaria, bulinus and monocephala [12].

Characteristics of Schistosoma

Schistosomes are members of the genus Schistosoma, family Schistosomatidae. Adult worms are obligate parasites of the vascular system of vertebrates. Schistosomes are dioecious. The mature female is more slender than the male and normally is carried in a ventral groove, the gynecophoric canal, i.e formed by ventrally flexed lateral out growths of the male body (Somu Yogesh priya, 2024). 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 [19]. 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 [13]. 2.1.3. Host

Various animals such as cattle, dogs, cats, rodents, pigs, horses, and goats, serve as reservoirs for S. japonicum, and dogs for S. mekongi. S. mansoni is also frequently recovered from wild primates in endemic areas but is considered primarily a human parasite and not a zoonosis. Intermediate hosts are snails of the genera Biomphalaria, (S. mansoni), Oncomelania (S. japonicum), Bulinus (S. haematobium, S. intercalatum, S. guineensis). The only known intermediate host for S. mekongi is Neotricula aperta [20].

Distribution

Schistosoma mansoni is found primarily across sub-Saharan Africa and some South American countries (Brazil, Venezuela, and Suriname) and the Caribbean, with sporadic reports in the Arabian Peninsula.S. haematobium is found in Africa and pockets of the Middle East.S. japonicum is found in China, the Philippines, and Sulawesi. Despite its name, it has long been eliminated from Japan.The other, less common human-infecting species have relatively restricted geographic ranges. S. mekongi occurs focally in parts of Cambodia and Laos. S. intercalatum has only been found in the Democratic Republic of the Congo; S. guineensis is found in West Africa. Instances of infections with hybrid/introgressed Schistosoma (S. haematobium x S. bovis, x S. curassoni, x S. mattheei) have occurred in Corsica, France, and some West African countries [20]. Schistosoma bovis is widely spread in Ethiopia's Northern, Eastern, Southwestern, and Central regions. It is an economically significant cattle disease with global health implications [14].

Source of infection and Transmission

People and animals become infected when larval forms of the parasite – released by freshwater snails – penetrate the skin during contact with infested water. Transmission occurs when people suffering from schistosomiasis contaminate freshwater sources with faeces or urine containing parasite eggs, which hatch in water. In the body, the larvae develop into adult schistosomes. Adult worms live in the blood vessels where the females release eggs. Some of the eggs are passed out of the body in the faeces or urine to continue the parasite's lifecycle. Others become trapped in body tissues, causing immune reactions and progressive damage to organs [15].

Risk Factors

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, farm in intensification, water supply patterns and levels of fecal contamination of water source are important. Due to the nature of transmission schistosomosisis a disease that commonly occurs in the proximity of water sources [16, 21].

Life Cycle

Eggs hatch immediately after deposition if they contact water. The miracidium enters an intermediate host, Lymnaea cubensis or Pseudosuccinea columnella. The mature cercaria is produced in about 25 days. It penetrates the skin of the mammalian host, finds its way to the lung, then to the liver and the mesenteric veins. The pre patent period appears to be about 84 days [17]. 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. 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 [18]. Visceral schistosoma mature in the hepatic portal veins, mate and migrate to the mesenteric veins where egg production starts [19]. 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 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 [27]. The schistosome life cycle occurs in 2 hosts: snails and mam- mals. Either asexual or sexual reproduction occurs, depending on the type of host. Asexual reproduction occurs in fresh- water snails. In the snail, this begins with the development of miracidia into a sporocyst. Sporocysts multiply and grow into cer- cariae. In the mammalian hosts, parasites grow to become ma- ture, mate, and produce eggs. Mammalian hosts include humans, mice, and dogs [22].

Pathogenesis

Pathogenesis of schistosomasis during larval migration may cause mechanical damage and lesions. Moreover Schistosoma eggs trapped in the tissue elicit granulomatous reaction that is mounted to destruct the eggs. These granulomas consist of several cell types, mainly eosinophils, macrophages and lymphocytes. In the chronic stages of the disease the pathology is associated with collagen deposition and fibrosis, resulting in organ damage and dysfunction [23]. 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 intrahepatic 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 [10]. 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 [21].

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 [24]. 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 [10]. The species which are most pathogenic to domestic ruminants are S. bovis and S. japonicum whereas 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 [25].

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 [10]. 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 [26].

Diagnosis

Diagnosis is based primarily on the clinico-pathological picture, parasitological techniques and post mortem findings [7]. 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) [25]. 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 [26]. 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 [27].

Treatment

Schistosomiasis eradication attempts commonly concentrate on controlling the infection through preventive chemotherapy. Praziquantel is cost-effective for treating schistosomiasis. The World Health Organization recommends a single dose of 40 mg/kg for all species and ages [28]. 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 [16]. 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 [29]. 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

Prevention and Control

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 [7]. 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 [31].

Economic Importance

The economic impact of schistosomiasis and the underlying tradeoffs between water resources development and public health concerns have yet to be quantified. Schistosomiasis exerts large health, social and financial burdens on infected individuals and households. While irrigation schemes are one of the most important policy responses designed to reduce poverty, particularly in sub-Saharan Africa, they facilitate the propagation of schistosomiasis and other diseases [32]. 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 [24]. Ruminants are usually infected with cercariae by active penetration of the unbroken skin. It is an economically important disease caused by several Schistosoma species and results in economic losses through mortality and morbidity [33]. Bovine schistosomiasis, caused by parasitic worms, has several significant economic impacts on the livestock industry. These include reduced livestock production, increased susceptibility to other diseases, costs associated with treatment and control, lower carcass weight, and a decline in milk production [34].

Status of Bovine Schistosomiasis in Ethiopia

In Ethiopia bovine schistosomiasis is reported to exist in many different areas of the country. The prevalence of bovine schistosomiasis was found to range from 22 to 45.7% [14]. The Prevalence of bovine schistosomiasis reported by researchers(Kerie and Seyoum,2016;Molla et al., 2022;Mesifn et al., 2024; Mesifn et al., 2024 [34]. Yihunie et al., 2019; Mekuriaw et al., 2020; Yezina Mengist and Nigussie Yilak 2019; Bezaneh et al., 2024; Gedifew et al., 2024; Mengistu et al., 2011; Abriham et al., 2018 [35].

Table 1: Prevalnce of Bovine Schistosomiasis in Different Areas of Ethiopia

Study area	Prevalence (%)	Reference
In selected areas of south Achefer district, North West Ethiopia	24.6	(Kerie and syoum.2016)
In some selected areas of South Wollo and Oromia zones of Amhara region, North East Ethiopia	16.7	(Molla et al., 2022)
In and around Haramaya, Oromia region, East Ethiopia coprological examination	21.28	(Mesfin et al.,2022)
In and around Haramaya, Oromia region, East Ethiopia post mortem examination	18.23	(Mesfin et al.,2024)
In South Achefer district, North West Ethiopia	22.2	(Abebe et al., 2019) [1].
In and around Bahir Dar town, North West Ethiopia	21.6	(Mekuriaw et al., 2020)
In and around Gozamen district, North West Ethiopia	26.3	(Yezina And Nigusie, 2019)
In Dembecha district, North West Ethiopia	16.4	(Bezaneh et al., 2024)
In Bahir Dar town, North West Ethiopia	21.1	(Gedifew et al., 2024)
Fogera district South Gonder Zone, Amhara National regional state, North West Ethiopia	10.17	(Mengistu et al., 2011)
In and around Nekemtie, East Wollega Zone, Western Ethopia	5.7	(Abirham et al., 2018)
In and around Debret Tbour town, North West Ethiopia	7.6	(Mihret and Samuel 2015

Conculsion and Recommendations

Schistosomiasis should be taken in to consideration as one of the major limiting factor of livestock production. The occurrence ofschistosomiasis is closely linked with environmental factors suitable for thedevelopment, breeding and multiplication of intermediate host (snail) and the parasiteitself.

- There should be initiation and awareness creation on the prevention and control of snails.
- Further epidemiological investigations should be conducted to assess the Schistoma infection and its economic loss.
- A combination of control measures included drainage, fencing, and snail control in the long run.
- There should be regular strategic deworming and veterinary service in the endemic area.
- Grazing management should be involved to avoid grazing and watering around marshy area in which snail population is high [36-55].

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