Review on Ovine Fasciolosis in Ethiopia

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Abstract: Ovine fasciolosis is an economically important parasitic disease of sheep caused by trematode species of the genus Fasciola. It is an important limiting factor for ovine production and causes for several economic losses due to morbidity and mortality in Ethiopia. The two species of the greatest veterinary importance are Fasciola hepatica (F. hepatica) and Fasciola gigantica (F. gigantica) and snails are their intermediate hosts. The snails of the genus Lymnae are mainly involved as an intermediate host in the life cycle of fasciolosis. Ovine fasciolosis in Ethiopia annually losses estimated at 48.4 million Ethiopian birr due to mortality, productivity (weight loss and reproductive wastage) and liver condemnation at slaughter. The objective of this seminar paper is to review the epidemiology, pathogenesis, diagnosis, control and prevention of ovine fasciolosis and its public health and economic impact. Clinical signs of fasciolosis are always closely associated with infectious dose (amount of ingested metacercariae). Diagnosis of fasciolosis is based on clinical sign, grazing history and seasonal occurrence, examination of feces by laboratory tests and post mortem examination. Treatment of infected animals will largely depend on the correct use of appropriate and registered anthelmintics. Ovine fasciolosis may be controlled by reducing the populations of the intermediate snail hosts and by appropriate anthelmintic treatment.

Key words: Ovine · Fasciolosis · Anthelmintic · Snails · F. hepatica · F. gigantica

INTRODUCTION

Ethiopia possesses the largest livestock population in Africa, with an estimated population of 26.1 million sheep [1]. Among the small ruminant in Ethiopia, sheep are the dominant livestock, providing up to 63% of cash income and 23% of the food subsistence value obtained from livestock production productivity [2]. Sheep play a significant role in maintaining household stability by providing meat, milk, skin and wool, generate cash income and play traditional social and religious roles. Even though Ethiopia is known in larger animal populations, the animals’ performance and its contribution to the national economy are relatively low due to viral, bacterial, parasitic diseases, improper health care and other management problems [3].

Fasciolosis is an economically important disease of domestic livestock mainly in sheep and cattle [4]. The disease is caused by trematodes of genus Fasciola, commonly referred as liver flukes [5]. The two species of most commonly implicated, as the etiological agent of fasciolosis are F. hepatica and F. gigantica. F. hepatica has a worldwide distribution but predominant in temperate zones, while F. gigantica is also found in most continents primarily in tropical [6]. The adult flukes are found in the bile ducts and the immature flukes in the liver parenchyma. F. gigantica (giant liver flukes) are similar in shape to F. hepatica but larger with less clearly defined shoulders. It causes economic loss in sheep and cattle of Africa mainly through liver condemnation [7].

The economic significance of fasciolosis in the highlands of Ethiopia has been reported by several workers. An estimate of the economic loss due to ovine fasciolosis in the Ethiopian highlands was made based on available data on mortality, weight loss, reduced reproductive efficiency and liver condemnation at slaughter. The economic effects of fasciolosis were identified and models for estimating the financial loss presented. Ovine fasciolosis in Ethiopia estimated at 48.8 million Ethiopian Birr losses per year of which 46.5%, 48.8% and 4.7% were due to mortality, productivity (weight loss and reproductive wastage) and liver condemnation.
condemnation, respectively [8]. Therefore, the objective of this seminar paper is to review the general characteristics of ovine fasciolosis and its clinical sign, diagnosis, treatment, control options.

Literature Review
Etiology of Fasciolosis: Fasciolosis is caused by the digenean trematode of the genus Fasciola consisting of two species usually implicated in causing the disease namely, F. hepatica and F. gigantica [6].

Morphology of Fasciola Spp: The two species have been traditionally classified based on their morphological features, such as body length and width. Because of variations in size of these two species, the discrepancy of morphological features and the presence of intermediate forms, it might be difficult to distinguish the two species, solely based on these characters [9]. Fasciola gigantica is larger than F. hepatica and can reach 7.5 cm length, more of leaf-like, the conical anterior end is very short and the shoulder characteristic of F. hepatica is barely perceptible. The eggs are larger than those of F. hepatica, measuring 190 × 100 μm [10]. The egg of F. hepatica measures 150 μm by 90 μm in size and also similar in shape to that of F. gigantica. Fasciola eggs should be distinguished from the eggs of other flukes, especially from the large eggs of Paramphistomum. Fasciola eggs have yellowish brown shell with an indistinct operculum and embryonic cells where as Paramphistomum eggs have transparent shell, distinct operculum with embryonic clear cells and possess a small knob at their posterior ends [11]. A characteristic of Fasciola egg is yellow-brown in colour, large and oval in shape. It has an indistinct operculum (lid). It contains an unsegmented ovum surrounded by many yolk cells (Figure 1) [12].

Epidemiology: The risk of hepatic fasciolosis is determined by the number of infected Lymnae snails in the grazing area. The disease has a predictable seasonal pattern in regions where snails are active for only part of the year. Some Lymnae snails have more aquatic habit than others but most are restricted to damp [14]. Water
land and blocked drainage are hazardous for grazing stock [15].

The geographical distribution of *F. hepatica* and *F. gigantica* is determined mainly by the distribution patterns of the snails that have a role as intermediate hosts [16]. In Ethiopia, both species coexist at different altitudes and transmitted by the snail called *Lymnaea truncutula* and *Lymnaea natalensis*, respectively. In Ethiopia both *F. hepatica* and *F. gigantica* have the greatest risk occurred in areas of extended high annual rainfall associated with high soil moisture and surplus water, with risk diminishing in areas of shorter wet season and or lower temperatures. Average annual mean temperature s of 23°C or above were found to correspond to areas below the 1200 m elevation limit of *Fasciola hepatica* in Ethiopia [12].

The main factors determining the timing and severity of fasciolosis depend on the ecology of the snail. Particularly, temperature and rainfall affect both the spatial and temporal abundance of snail hosts and the rates of development of fluke eggs and larvae. The three most important factors that influence the occurrence of fasciolosis are availability of suitable snail habitat, temperature and moisture [17].

Intermediate host of fasciolosis is determined by the number of infected lymnaeid snails in the grazing area. The disease is seasonal pattern in regions where snails are active for only part of the year. Some lymnaeid snails have more aquatic habitat than others but most are restricted to damp or wet environments. In general non acidic low lying swampy areas with slow moving water and irrigated areas are highly suitable for infection to take place. Snails burrow in to the soil to survive dry periods and release cercaria when free water is present [15].

The snails of the genus *Lymnae* are the intermediate hosts for the genus *Fasciola*. The epidemiology of fasciolosis depends on the ecology of the snail. *Lymnae* species most important in the transmission of fasciolosis [28]. The most important intermediate hosts of *F. gigantica* are *L. natalensis* and *L. auricularis* [18].

Hosts of *F. hepatica* are most mammals including man, sheep and cattle which is found in highland area. Cattle being most important, due to their deep grazing habit close to the marsh area, while sheep are selective feeder compare with cattle. *F. gigantica* affects a wide range of domestic animals and is found in low land areas replacing *F. hepatica*. Because intermediate host of *L. natalensis* is found in the tropics while *L. truncutula* is in temperate area. Adult sheep and cattle may remain carriers for many years because of the longevity of the adult flukes due to their adaptation [18].

**Transmission:** By ingestion of contaminated grass or hay and drinking from the snail infesting watering places [18].

**Life Cycle:** Infection with fasciolosis is usually associated with grazing wet land and drinking from the snail infesting watering places [15]. Adult flukes in the bile duct shed eggs into the bile, which enter to the intestine. Eggs reach the outside by passing down the common bile duct and being voided with feces. The eggs of flukes passed in the feces of mammalian host develop and hatch releasing motile, ciliated miracidium. This takes 9 days at optimum temperature of 22°C - 26°C and little development occurs below 10°C. The liberated miracidium has a short life span and must locate a suitable snail within 3 hours if successful penetration of the tissue of snail occurs. In infected snails, development proceeds through the sporocyst and rediae stage to the final stage in the intermediate host, the cercaria; these are shed from the snail as motile forms which attach themselves to frame surface, such as grass blades and insisted there to form the infective metacercariae. It takes a minimum of 6 - 7 weeks for completion of the development from miracidium to metacercariae. Infection of snail with one miracidium can produce over 600 metacercariae. Metacercaria infests the final host and encysted in the small intestine, migrate through the gut wall, cross the peritoneum and penetrate the liver capsule. The young flukes tunnel through the liver parenchyma for 6 - 8 weeks and then enter to the bile duct where they migrate to the large ducts and occasionally the gall bladder. The prepatent period is 10 - 12 weeks [9, 12, 19].

Adult flukes can survive for many years in the livers of infected hosts and lay between 20,000 and 50,000 eggs/day. Animals grazing in wet marshy areas, favored the intermediate host, are more likely to become infected. Typically, long and wet seasons are associated with a higher rate of infection. However, sheep are more likely to ingest large numbers of cysts during dry periods following a wet season. This is due to a reduction in available pasture, forcing the animals to graze in swampy areas or in areas where the water has receded, thus exposing them to vegetation heavily infected with metacercaria [20].
**Pathogenesis:** The development of fasciolosis infection in definitive host is divided into two phases: the parenchymal (migratory) phase and the biliary phase. The parenchymal phase occurs during migration of flukes in the liver parenchyma and is associated with liver damage and hemorrhage. During the parenchymal stage of the infection, liver damage caused by the migrating flukes compromise liver function, which in sheep is reflected in a decline in plasma albumin concentrations, attributed partly to reduced rate of synthesis and partly to an expansion of the plasma volume [21].

Early infection, during fluke migration, there is hyper proteinemia, hyper globulinemia and hypo-albuminemia. The hypo-albuminemia is associated with plasma volume expansion caused by liver damage and reduced albumin synthesis. When excysted juvenile flukes penetrate the intestinal wall then flukes migrate within the abdominal cavity and penetrate the liver or other organs. *Fasciola hepatica* has a strong predilection for the tissues of the liver [21]. The biliary phase occurs when the parasite is in the bile ducts and results from the hematophagic activity of the adult flukes and from the damage to the mucosa, by their cuticles spines and in biliary ducts, flukes mature, feed on blood and produce eggs. Hypertrophy of biliary ducts associated with obstruction of the lumen occurs as a result of tissue damage [1].

**Clinical Signs:** Clinical signs of fasciolosis are always closely associated with infectious dose (amount of ingested metacercariae). In sheep, as the most common definitive host, clinical presentation is divided into 4 types [22].

Acute Type I fasciolosis: infectious dose is more than 5000 ingested metacercariae. Sheep suddenly die without any previous clinical signs. Acute Type II fasciolosis: infectious dose is 1000-5,000 ingested metacercariae. As above, sheep die but briefly show pallor, loss of condition and ascites. Sub acute fasciolosis: infectious dose is 800-1000 ingested metacercariae. Sheep are lethargic, anemic and may die. Weight loss is dominant feature. Chronic fasciolosis: infectious dose is 200-800 ingested metacercariae. Asymptomatic or gradual development of bottle jaw and ascites (ventral edema), emaciation, weight loss.

**Diagnosis:** Fasciolosis can be diagnosed based on clinical sign, grazing history and seasonal occurrence, examination of feces by laboratory tests and post mortem examination [23].

Diagnosis of fasciolosis may consist of tentative and confirmatory procedures. A tentative diagnosis of fasciolosis may be established based on prior knowledge of the epidemiology of the disease in a given environment; observations of clinical signs, information on grazing history, seasonal occurrence and examinations.
of snails must be considered. Confirmatory diagnosis, however, is based on demonstration of Fasciola eggs through standard examination of feces in the laboratory. Postmortem examination of infected animals may demonstrate of immature and mature flukes in the liver [24].

The oval percolated golden eggs of *F. hepatica* appear in the feces ten weeks after infection, while *F. gigantica* eggs only appear 15 weeks after infection. Excretion of fluke eggs shows considerable day to day and within day variation and distribution of eggs in feces are irregular thus single fecal egg count assay may lead to incorrect conclusion [24].

The detection of adult flukes in the liver at necropsy is the most reliable method to confirm fasciolosis. Prevalence studies should be based on abattoir survey other than coproscopic investigation. Acute fasciolosis which is common in sheep is manifested by severe anemia and sudden death. Confirmation is by post mortem examination when small fluke can be expressed from the liver parenchyma. Whereas chronic fasciolosis is confirmatory diagnosis could easily carried out by coproscopic examination employing sedimentation technique. Number of eggs in fecal sample is not an accurate indication of the number of the parasites neither in the liver nor of the amount of damage being done to the host [25].

Diagnosis of bovine fasciolosis can sometimes prove difficult. In this context, routine hematological tests and examination of faeces for fluke eggs are useful and may be supplemented by two other laboratory tests. The first is the estimation of plasma levels of enzymes released by damaged liver cells. Two enzymes are usually measured. Glutamate dehydrogenase (GLDH) is released when parenchymal cells are damaged and levels become elevated within the first few weeks of infection. The other, gamma glutaniyl transpeptidase (GGT) indicates damage to the epithelial cells lining the bile ducts; elevation of this enzyme takes place mainly after the flukes reach the bile ducts and raised levels are maintained for a longer period. The second is the detection of antibodies against components of flukes, the ELISA and the passive haemagglutination test being the most reliable [26].

**Treatment:** All compounds are not equally effective against all stages of development of *F. hepatica* and *F. gigantica* in the body. For the treatment of acute fasciolosis, it is essential to choose a product highly effective against the juveniles that damage the liver parenchyma. Triclabendazole (Fasinex) is considered as the most common drug due to its high efficacy against adult as well juvenile flukes. It is effective against adult *F. hepatica* at a dose rate of 7.5 mg/kg in sheep. It is Ovicidal and well kills any *F. hepatica* eggs present in the bile duct or the alimentary tract at the time of treatment. Nitroxynil is given subcutaneously at 10 mg/kg and has good efficacy against the adult fluke but the dose has to be increase by up to 50% to obtain adequate control of acute disease [26].

Basically, fascioliasis control in ruminants depends on the administration of anthelmintics. However, various authors have reported the development of parasite populations resistant to triclabendazole [27-29].

**Control and Prevention:** Program charts for fasciolosis control can be produced based on average rainfall and temperature records of any geographic regions [30].

Reduction of snail population before any scheme of snail control is under taken as a survey of the snail habitat should be made to determine whether they are localized or
wide spread. When the snail habitat is limited simple method of control is to fence off these areas or treat annually with a molluscicides. Currently cupper sulphate is most widely used and more efficient molluscicides such as N-trityl morphine [23].

Control of snail by chemical such as niclosamide, sodium pentachlorophenate, copper sulphate focally and seasonally possible, however, usually not practical due to labor, high cost, environmental consideration and rapid colonization of snail habitat [23]. Seasonal strategic application of effective anthelmintics which is specific for trematode as well as timely prophylactic and curative treatment play an important role in the control of liver fluke infection [31].

The prophylactic used of anthelmintics aiming to reduce pasture contamination by fluke eggs at times most suitable for development of fluke, April to august and removing fluke population at times of heavy burdens or at periods nutritional stress to animal. Prophylactic treatment in sheep is therefore directed at reducing the fluke burdens in the winter at a time when the nutritional status of the animal is at its lowest level [23].

Other control methods include environmental sanitation and manipulation (draining swamps, building sewage system and providing clean water supplies), rotational grazing and also avoiding mixed grazing of animals of different age groups (young animals are generally susceptible to helminthes infection [32]).

Molluscicide is the most frequently used public health intervention is the application of molluscicides to decrease the population of Lymnaea snails, the intermediate hosts of Fasciola hepatica. Molluscicides have been particularly popular because they also decrease transmission of many other Trematode of importance, such as the various Schistosoma and Fasciola species [33].

Two methods for control of snail, they are biological and chemical methods. Biological control agents of snails have been studied and tested against the snail host, naturally Free-ranging birds, which feed on snails, have also been proposed as a possible means for control of F. gigantica and F. hepatica. But now biological control of snail is not applicable in Ethiopia rather than prophylactic treatment. Because, lack of awareness to the farmers about the transmission and control methods of fasciolosis [34].

**Importance of Ovine Fasciolosis**

**Public Health Importance:** Human fasciolosis has been reported from countries in Europe, America, Asia, Africa and Oceania. The incidence of human case has been increasing in the 51 countries of 5 continents. A person must ingest the metacercariae to become infected [11]. Human acquire infection through ingestion of metacercariae that are attached to certain aquatic plant and vegetable. In addition experimental studies suggested that human consuming raw liver dish from liver infected with juvenile flukes could become infected. The distribution of the disease is predominantly rural being associated with cattle and sheep breeding [27].

**Economic Importance:** Fasciolosis causes major economic loss in sheep, goat, buffalo and cattle [35]. The disease causes considerable impact on the economy of the livestock industry. The economic losses consist of costs of anthelmintics, drenches, labor, liver condemnation at meat inspection; and losses in production due to mortality, reduction in meat, milk and wool production; and reduction in growth rate, fertility and decreased feed intake, conversion and lower resistance to other disease [15].

The prevalence of fasciolosis in many parts of Africa has been determined mainly at slaughter. However estimation of economic loss due to fasciolosis at national or regional level is limited by lack of accurate estimation of the prevalence of disease [3]. The presence of fasciolosis due to F. hepatica and F. gigantica in Ethiopia has long been known and its prevalence and economic significance has been reported by several workers [36].

**CONCLUSION**

Fasciolosis is an important limiting factor for ovine production and causes several economic losses due to morbidity and mortality and also due to liver condemnation there by contributing to loss hide and wool productivity of sheep industry in Ethiopia. The two species of the greatest veterinary importance are F. hepatica and F. gigantica and snails are their intermediate host with the recommendations of education of farmers, control rather than treatment, reduction in the number of snail by drainage, fencing and use of molluscides. Strategic anthelmintics treatment with appropriate fluckicide drug should be practiced twice a year; before and after rainy seasons to eliminate fluke burden of the host of animal and minimize pasture contamination by fecal egg shedding thus interrupting the life cycle and cook water-grown vegetables thoroughly before eating. Disease of livestock have many additional direct and indirect impacts on human nutrition, community...
development and socio-cultural and also reduction in farm income, contributing to food insecurity and poor nutrition.

Based on the above conclusion, the following recommendations are forwarded:

- Improving of the veterinary service and infrastructure in prevalence area with provision of modern anthelmintic and treatment.
- Regular deworming of animals before and after the rainy season.
- Drainage of swampy area or fencing and applications of molluscicide drugs are important in the control of the intermediate hosts.

REFERENCES