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REVIEW PAPER

FASCIOLIASIS IN CATTLE- A REVIEW

M. A. A. Rana, N. Roohi, and M. A. Khan

Department of Zoology University of Punjab Lahore.
Corresponding Author- rana66pk@yahoo.com

ABSTRACT

Fascioliasis is a common disease of cattle and other ruminants caused by *F. hepatica* and *F. gigantica*. The disease is world wide in distribution and is liable for causing extensive economic losses to the livestock industry encompassing reductions in weight gain, milk yield and fertility. In this study knowledge about prevalence, diagnosis, treatment and control of *Fascioliasis* has been reviewed. This article evaluates more recent work along with previous studies. The fecal egg count, signs / symptoms and specific antibodies in serum were the only diagnostic tools in the past however now for detection of *F. hepatica* specific copro-antigen has been developed and commercialized. An indirect enzyme linked immunosorbent, assay (IEA) allows an early diagnosis. The tracer animals and snail studies have widened the existing knowledge. The treatment has been carried out mainly with *Fasciolicides* (Albendazole, Oxyclozanide and Triclabendazole), however resistance has been developed. Most of the recommended treatments are not feasible. Seasonal deworming is essential. Pasture management by creating bio competent environment with snail predators can be very effective in reducing the rate of incidence and controlling the problem. Vaccine is there but is not frequently used due to incompatible immune response. The studies on reduction in milk yield due to *Fascioliasis* are still lacking and require extensive research/ investigations.

Key words: *Fascioliasis*, *F. hepatica*, *F. gigantica*, Snails, Cirrhosis.

INTRODUCTION

Fasciolosis also known as *Fascioliasis*, Distomatosis and liver Rot is an important disease of cattle caused by trematodes i.e *Fasciola hepatica* and *Fasciola gigantica* (common liver flukes). This condition of internal parasitism is one of the major problems that lowers the livestock productivity throughout the world (Vercruysse and Claerebont, 2001). The significance of helminth infestation has been increased many folds in developing countries. The disease is of paramount importance due to its broad distribution and definite hosts (Rondelaud *et al*., 2001). It causes acute and chronic infections (Sampaio Silva *et al*., 1996). The disease in predominantly caused by *F. hepatica* and / or *F. gigantica* (Soulsby, 1987). The common liver fluke, *F. hepatica* is a trematode and widely distributed throughout the world. It occurs chiefly in cattle, sheep, goats, buffalos and may affect man / other species. The mature flukes live in the bile ducts and immature live in the parenchyma of the liver, very rarely in other organs. They are flat and mostly resemble a laurel leaf in outline. The adult are 18-30 mm long and 4-13 mm broad appearing dirty grey to brownish in colour. Eggs are excreted through feces and require snail as intermediate host that lives mainly in water. The parasites pass through different stages in snail before attaching themselves in the form of cysts to the ground vegetation. Thereon it is taken up by the host during grazing. Cyst wall is dissolved in the gastrointestinal tract of the host and the young fluke emerges. It penetrates and passes through intestines into the liver. Spends 6-8 weeks drifting in the liver and then settles down in the bile duct. In the host the total period of development i.e. from swallowing of the cysts to develop into sexually mature parasite is 2 ½ - 3 months. Most of the above description is also applicable to *F. gigantica*, another species of liver fluke, which is restricted to certain areas, mainly in tropical areas. Under certain circumstances it may cause severe damage to the liver. In adult cattle, the infection usually takes a chronic course, with no obvious clinical signs. Significant production losses occur in the herds having a prevalence of *F. hepatica* infection of 25 % or above (vercruysse and claerebout, 2001). High prevalence of *F. hepatica* infection has been reported in dairy cattle in many countries (Mezo *et al*., 2008). Acute *Fasciolosis* causes huge economic loses as directly or indirectly in terms of anemia due to its ability to suck blood to the extent of 0.2-0.5 ml per day and decrease in the total proteins especially albumin (Soulsby, 1987) while chronic diseases can reduce growth rate, wool production and feed conservation rate. Chronic *Fascioliasis* causes a chronic inflammation of the liver and bile ducts accompanied by loss of condition, digestive disturbances and a general reduction in productivity. Very few studies on their effects on milk production have been carried out and the results have not been consistent.

Prevalence and epidemiology: The cercariae of liver flukes were observed from a pond first time by Otto Muller in 1773 (Andrews, 1999). The snail usually habitat along the edges of stagnant ponds, marshy lands and ditches (Ulmer, 1971; Saladin 1979) which may be a reason of increased prevalence of *Fascioliasis* in the animals bathing in stagnant water. Climatic factors are of supreme importance influencing epidemiology of *Fascioliasis*. (Claxton *et al*. 1997, Rangel-Ruiz *et al*., 1999; Phiri *et al*., 2005 a,b; Ansari-Lari and Moazzeni 2006). Both *F. hepatica* and *F. gigantic* are prevalent in Pakistan (Maqbool *et al*., 1994, 2002; Siddiqui and Shah, 1984; Chaudhry and Niaz, 1984; Masud and Majid, 1984; Sahar 1996). The probable reasons of increased infection rate of *Fascioliasis* may include, (i) development of resistance due to improper use of *Fasciolicides* including frequent use of same drug for a longer time with inappropriate doses (Boray, 1990; Fairweather and Boray, 1999) (ii) Lack of regular evaluation of local available drugs against any parasitic disease or no use of specific drug against any parasitic disease (Jabbar *et al*., 2006). (iii) Socio-economic status of the farmers to treat the nuisance (Jabbar *et al*., 2006). The probable reason for highest prevalence in winter might be the availability of optimal conditions of environment for the transmission, growth and development of parasitic life cycle stages (Rowcliffe and Ollerenshaw, 1960). This includes temperature ranging from 23-26^{o}C for development of eggs (Rowcliffe and Ollerenshaw, 1960; Thomas, 1883 a,b) and maximal growth of snails (Kendall, 1953) and humidity level upto 90 % caused by plenty of water available facilitates embryonation (Andrew, 1999), emergence of miracidium from eggs due to increased activity of cilia (Thomas , 1883 a,b) and liberation of cercariae from snails (Alicata, 1938; Dixon, 1966). However, *Fasciolosis* was recorded throughout the year (Maqbool *et al*., 2002).

Fresh water lymnaeid snails transmit *Fascioliasis* a highly pathogenic liver parasitosis caused by trematode species of genus *Fasciola* that affects human and livestock species almost everywhere (Mas-Coma *et al*., 2009 a). The distribution of *Fascioliasis* both in space (Latitudinal, longitudinal and altitudinal) and time (seasonal and yearly) depends upon the presence and population dynamics of the specific intermediate host species in its turn linked to the presence of the appropriate mater bodies and on adequate climate characteristics enabling fluke development. In flukes temperature has a pronounced and direct effect on a crucial step of their life cycles, such as the production of cercariae in the first (or unique) intermediate molluscan host in both aquatic life cycles (Kendall and McCullough, 1951; Dinnik and Dinnik, 1964; Boray, 1969; Ollerenshaw, 1971; Nice and Wilson, 1974; Tang *et al*., 1979; Rim, 1982; Shostack and Esch, 1990; Lo and Lee, 1996; Umadevi and Madhavi, 1997; Mouritsen, 2002) and terrestrial life cycles (Krull and Mapes, 1952; MasComa *et al*., 1987 c). Cercarial output by snails is a key component of the transmission success of trematods (Erasmus, 1972; Galaktionov and Dorrovolskij, 2003). Development patterns of the cercarigenous larval stages appear crucial in the production of cercariae. In fasciola, more or less long, finite cercarial production appears related to the number of generations of cercariogenous rediae and independent of the different lymnaeid vector species involved (Rondelaud and Barthe, 1987; Rondelaud, 1994; Rondelaud *et al*., 2004). The variations pertaining to the prevalence and seasonal fluctuations of various fluke species in a particular region can be attributed to the presence or absence of the intermediate host species in that area. The biology of the larval stages of flukes, and also of the snail hosts is influenced to a great extent by ecological factors such as temperature, water quality and speed of water currents, etc (Sponhollz and Short, 1976; Bundy *et al*., 1983; Fagbemi, 1984). The occurrence of *Fasciola* infections throughout the year is suggestive of the fact that essential requirements for the completion of the life cycle of the fluke, i.e., high moisture, moderate temperature and availability of the snail intermediate host, are continually present in the region. The epidemiology of *Fasciolosis* has been studied by several authors in different countries (Honer and Vink, 1963; Boray, 1963; Ross, 1967; Boray *et al*., 1971; Ollerenshaw, 1971; Armour, 1973; Shaka and Nansen, 1979; Smith, 1981; Melendez *et al*., 1983). All of these authors agree that climatic factors i.e., rain fall and temperature, play very important role in the epidemiology of *F. hepatica*, since the population dynamics of the snail intermediate host is affected by them.

Diagnosis: The diagnosis of *Fasciolosis* is based on the detection of eggs in feces or *F. hepatica* specific antibodies in serum. Recently, a method based on detection of *F. hepatica* specific copro-antigen has been developed and commercialized (Mezo *et al*., 2004). The sensitivity (Se) and specificity (Sp) of these tests have been determined after experimental infection (Cornelissen *et al*., 2001) or by using two distinct populations, a positive population selected from an enzootic area and a negative population from a fluke free area. (Ibarra *et al*., 1998; Mezo *et al*., 2004; Salimi-Bejestani *et al*., 2005). The current diagnostic tests for *Fasciolosis* in cattle are qualitative only, yet the level of infection is considered an important factor in determining production losses. (Dargie, 1987; Vercruysse and Claerebout, 2001).

The current trend in the diagnosis of more common bovine diseases, including *Fascioliasis* is to use the same samples of milk that are collected on farm for routine monitoring of animals productivity and quality of milk (Hill *et al*., 2010; Mars *et al*., 2010), reducing the associated costs and disturbance to animals as a result of handling sampling. The MM3-SERO ELISA is a sensitive and highly specific test for the sero-diagnosis of cattle *Fasciolosis* and can be reliable to use with milk samples. It is an excellent method of estimating within-herd prevalence of infection when used with bulk samples (Mezo *et al*., 2009, 2010). The immuno enzymatic techniques as indirect ELISA have been found very suitable for the diagnosis of *Fasciolosis* due to their high sensitivity and the possibility of many sera samples (Arriaga de Morilla *et al*., 1989). These techniques based on detection of antibodies have been successfully utilized to detect early infection (Oldham, 1985; Hillyer and Soler de Galanes, 1991; Poitou *et al*., 1993; Paz *et al*., 1998). During migratory phase of infection, *F. hepatica* antigens are available to the immune system, and it is possible to detect them by serologic probes as sandwich-enzyme-linked immunosorbent assay SEA (Langley and Hillyer, 1989). When the parasite is established in the bile ducts less antigen is there available to the immune system, and its detection must be directed to fecal or bile samples. It has been demonstrated that most of pathological damage takes place when flukes are migrating through peritoneal cavity and liver parenchyma before their establishment in the bile ducts. It is very important to use early diagnostic techniques to reduce the great losses in cattle. An indirect-enzyme immune-linked immunosorbent assay IEA allows an early diagnosis of *Fasciolosis*. *F. hepatica* antibodies can first be detected by indirect-ELISA between 3 and 6 weeks after infection during the liver migratory phase of immature worms (Marin, 1992). Long persistence of high levels of immunoglobulin, even though animals have been successfully treated, makes interpretation more difficult (Ibarra *et al*., 1998), (Langley and Hillyer, 1989) in detected antigenemia as early as 2 weeks after infection in cows. It is concluded that it is very important and useful to combine two enzymatic assays, indirect and direct ELISA, to achieve a more reliable knowledge of the real infection status of the host. Results of iELISA using different antigens of *F.gegantica* for detecting antibodies against *Fasciola* in sera may be used in cattle. The diagnostic sensitivity, specificity and accuracy of the assay can be calculated according to Timmreck, 1994 and Smith, 1995**.**

Treatment and control: The treatment is essential for controlling spread of *Fascioliasis* as infected animals pass eggs through feces. Range of anthelmintics (Boray, 1986) effective in killing of different developmental stages of parasites are available. Indiscriminate use of anthelmentics has caused resistance (Boray, 1990), so the disease has not been eradicated. Combinations of some older drugs have a high efficacy against the mature and immature flukes (Boray, 1994). In developed countries it is supported by analyzing on costs and benefits, but in developing countries there are more priorities for utilization of limited reserves of cash and treatment of animal. Grazing on mutual lands is inefficient till a high proportion of livestock owners treat. Treating with an anthelmentic 4 times a year is effective against young parasites, but there are few marked places where it will be feasible. The most frequently used drug in *F. hepatica* infected dairy herds is Albendazole (Mezo *et al*., 2008), a broad spectrum anthelmintic that is also active against nematodes in gastro intestinal tract which can have a negative effect on milk production (Charlier *et al*., 2007). Oxyclozanide is the only effective drug against mature flukes over 14 weeks old (Boray, 1986; Richards *et al*., 1990) and greater improvement in milk yield would be expected with drugs such as Triclabendazole, which is effective against all stages of parasite. Triclabendazole (TCBZ) is the current drug of choice used for the treatment of *F. hepatica* infections, because of its high activity against both Juvenile and adult flukes (Boray *et al*., 1983; Fairweather, 2005). The constant use of TCBZ is being compromised by the emergence of populations of *F. hepatica* that are resistant to it (Fairweather, 2005, 2009). One potential strategy to deal with resistance is by manipulating the pharmacokinetics of the drug, thereby enhancing its bioavailability active lifespan, with the goal of increasing its efficacy. The metabolism of benzimidazble-type drugs, as TCBZ, can be affected by co-treatment with inhibitors that target the flarin mono-oxygenase (FMO) and Cytochrome P450 (CyP450) enzyme pathways. This may lead to an enhancement of the bioavailability of the active metabolisms (Lanusse and Prichard, 1991, 1992 a,b; Lanusse *et al*., 1992, 1995; Mckellar *et al*., 2002; Sanchz *et al*., 2002; Merino *et al*., 2003; Virkel *et al*., 2009). In turn, the enhanced bioavailability has been shown to improve the efficacy of the drug (Benchaoui and Mckellar, 1996; Lopez-Garcia *et al*., 1998; Sanchez-Bruni *et al*., 2005). Rediae of *F. hepatica* (Boray, 1964; Hodasi, 1972) and *F. gigantica* (Wilson and Dennison, 1980) can reduce or sterilize the fecundity of lymnaeid snails by damaging the gonads. *F. hepatica* in *L.truncatula* (Kendall, 1950) and *F.gigantica* in *L.natalensis* (Madsen and Monrad, 1981), impair the growth of snails in the early stage of infection. But in the later stage growth rate may be stimulated by *F. hepatica* (Gold, 1980; Wilson and Dennison, 1980). When there are heavy infections with *F. hepatica* it kills the snails (Boray, 1964; Kendal, 1965; Murkhe Jee, 1966). Trematode rediae of one Species can consume the sporocysts of another species (Lie, Basch and Umathery, 1966). Rediae of E. audyi eliminate *F. gigantica* from snails (Hoa, Lie and Young, 1970). E. revolutum eliminates existing *F.gigantica* infections and precludes super infection (Estuningsih, 1991). In some situations there have been substantial successes for biological control of schistosomiasis in the field, particularly with competitor snails and trematode antagonisms (revived by Combes, 1982; Madsen, 1990), but on the whole there has been little impact on the disease. Cattle acquire resistance against the discrete infections with *F. hepatica* and some or all of the resistance may be a consequence of fibrosis of the liver parenchyma, and fibrosis and calcification in the bile duct (Boray, 1967 a; Ross, 1967; Doyle, 1973; Kendall *et al*., 1978). Although anthelmintic treatment is effective against *Fasciolosis*, this is an expensive and non-sustainable measure, and drug resistant strains have been reported (Brennan *et al*., 2007; Overend and Bowen, 1995). The alternative to anthelmintics is the development of a vaccine. In developed countries vaccines would have to be as cost effective as *Fasciolicides*. Vaccines in developing countries would have to be affordable, but would have the advantage that their efficacy would be independent of the levels of infection in other animals in the community. Lymnaeid Snails with thin shells and no operculum are vulnerable to predators such as, crustaceans, amphibians, birds, rodents and reptiles.

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