Incidence and pathological study of *Explanatum explanatum* (Creplin, 1847) Fukui, 1929 in goats in Andhra Pradesh, India

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Abstract Amphistomiasis, caused by species of Paramphistomatidae is an economically important disease in ruminants. *Explanatum explanatum* is a very common amphistome in bile ducts and gall bladder of cattle and buffaloes worldwide where as in goats, it is exclusively found in Asian countries. Screening of livers from 100 sheep and 154 goats during slaughter at local slaughter houses from October, 2014 to April, 2015 in Andhra Pradesh (India) revealed presence of amphistomes in main bile ducts and gall bladder in three goats (1.9%) and were not observed in livers of sheep. Grossly, the affected livers were congested and the bile ducts were firm, thickened and occluded with amphistomes along with light yellowish foul smelling fluid. There were no apparent changes in gall bladder. Amphistomes were identified as *E. explanatum* by the standard staining technique using borax carmine. Microscopically, sections of liver revealed areas of haemorrhage, necrosis and infiltration of mononuclear cells in the parenchyma and surrounding the bile ducts. The wall of bile ducts revealed connective tissue proliferation with a characteristic mucosal plug of bile duct drawn into the acetabulum. There was hyperplasia of bile duct epithelium along with marked proliferation of mucosal glands and mononuclear cell infiltration. This paper appears to be the

first report of *E. explanatum* in goats from Andhra Pradesh, India.

Keywords *Explanatum explanatum* · Bile ducts · Pathology · Goats

Introduction

In India, small ruminants play a major role as a source of animal protein and in improving the rural economy. Goat population in India is 154.0 million contributing to 16.7% of world's population (Basic Animal Husbandry Statistics 2012). Amphistomiasis, caused by species of the family Paramphistomatidae is an important trematode parasitic disease in goats that causes considerable economic losses due to condemnation of infected organs and also mortality by immature amphistomes (Gall 1981; Iqbal et al. 1986). The normal location of species of Paramphistomatidae in goats is rumen and reticulum except for *Explanatum explanatum* that migrates to and matures in the bile ducts and gall bladder. *E. explanatum* is the common parasite in bile ducts and gall bladder of cattle and buffaloes worldwide where as in goats, it is exclusively found in Asian countries (Smith and Sherman 1994). The parasite has been reported from different parts of Asian countries viz., India (Jithendran 1996), Pakistan (Ashraf 1977) and Iran (Rajabloo et al. 2014). In India, prevalence of different amphistomes in goats has been reported from Andhra Pradesh (Hafeez and Rao 1977), Assam (Talukdar 1996), Karnataka (Muraleedharan 2005), Bihar (Suchita et al. 2010) and Jammu (Mir et al. 2012; Godara et al. 2014), but there was no report of *E. explanatum* from these states. Moreover there is no detailed pathological study on *E. explanatum* in small ruminants. Hence the present paper reports the occurrence and

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pathological study of *E. explanatum* in naturally infected goats in Andhra Pradesh, India.

Materials and methods

In the present study, livers from 100 sheep and 154 goats were screened during slaughter for *Fasciola* sp. at local slaughter houses in Krishna District, Andhra Pradesh, India from October, 2014 to April, 2015. Animals slaughtered in these slaughter houses were not only from the Krishna district but also from adjacent districts of Andhra Pradesh state. The suspected livers were brought to the laboratory and gall bladder and bile ducts were opened to determine the presence of flukes. Amphistomes were noticed in three livers of goats that were collected, rapidly killed in 70% alcohol, flattened and stained by the standard technique using borax carmine (Soulsby 1982) for species specific identification. For histological examination, tissue samples of the liver, bile duct and gall bladder of goat were collected and fixed in 10% neutral buffered formalin. The samples were processed by routine paraffin embedding method and the sections were stained with hematoxylin and eosin.

Results

Out of 100 sheep and 154 goat livers examined, mature amphistomes were present in only three goats' livers (1.9%) and were not observed in sheep livers. In goats, one infected liver revealed presence of amphistomes exclusively in the gall bladder and co-infection with *Fasciola* sp. was noticed within small bile ducts. Among other two infected livers, amphistomes were present as single species in one liver and as a co-infection with *Fasciola* sp. in another. Amphistomes were found to be in the main bile ducts but not in intrahepatic ductules when co-infected with species of *Fasciola*.

Grossly, the affected livers were congested with thickening and enlargement of bile ducts. The lumen of bile ducts was filled with light yellowish foul smelling fluid and large number of deeply embedded *E. explanatum* (Fig. 1). Microscopic examination of fluid revealed presence of characteristic amphistome egg (Fig. 2). There were no apparent changes in gall bladder except the presence of amphistomes. The amphistomes from all the three livers were identified as *E. explanatum* based on the presence of large deep sub-terminal ventral sucker, obliquely tandem testes and position of ovary posterior to testes. Microscopically, sections of liver revealed areas of haemorrhage, necrosis and infiltration of mononuclear cells in the parenchyma and surrounding bile ducts. A few lymphoid aggregates were also noticed in the liver parenchyma. The

Fig. 1 Goat liver: note thickened bile ducts with attached *E. explanatum*

Fig. 2 Egg of *E. explanatum* ×100

wall of bile duct was thickened by connective tissue proliferation and in some bile ducts the cut section of fluke was noticed with a characteristic mucosal plug of the bile duct into the acetabulum (Fig. 3). There was hyperplasia of bile duct epithelium along with marked proliferation of mucosal glands and mononuclear cell infiltration (Fig. 4).

Discussion

Studies on prevalence and pathogenicity of *E. explanatum* from slaughtered goats in India are scanty and seldom reported though *E. explanatum* causes pathological

Fig. 3 Goat liver: note section showing a plug of bile duct mucosa drawn into the acetabulum of *E. explanatum* H&E $\times 40$

Fig. 4 Goat liver: note section showing hyperplasia and mononuclear cell infiltration of bile duct epithelium H&E $\times 100$

changes in bile ducts and gall bladder leading to liver condemnation (Smith and Sherman 1994). However occurrence of *E. explanatum* in goats, sheep, buffaloes and cattle have been reported from different parts of Asian countries (Jithendran 1996; Ashraf 1977; Ahmed et al. 2005; Haque and Mohan 2011; Ichikawa et al. 2013). The present study revealed the presence of *E. explanatum* either in the gall bladder and or in the bile ducts in 3 livers (1.9%) out of 154 goats' liver examined. Jithendran (1996) found *E. explanatum* in 5 livers out of 437 goats livers examined in hilly region of Himachal Pradesh. In accordance with the present observation, a survey carried on helminth parasites of goats in Peshawar, Pakistan revealed presence of *E. explanatum* from gall bladder of a goat that also carried *F. hepatica* (Ashraf 1977). Later Ahmed et al. (2005) conducted a study to investigate the diversity and prevalence of helminth parasites of livers of sheep and goats in the district of Quetta, Pakistan and found *E. explanatum* in

sheep but not in goats which contradicts the present observation of *E. explanatum* exclusively in the liver of goats. Presence of *E. explanatum* exclusively in liver of goats in Andhra Pradesh and in liver of sheep and or in goats of different areas of Asian countries could be a new recognition of a previously unrecognized infection, which suggests that *E. explanatum* is an old parasite but new emergence as was also opined recently by other authors (Rajabloo et al. 2014). The amphistomes were not in close association with *Fasciola* sp. as it was also observed in the liver of buffalo (Mazahery et al. 1994). Gross pathological changes observed in bile ducts and gall bladders of goats were similar as reported by Jithendran (1996) and Ahmed et al. (2005). Literature pertaining to pathology of *E. explanatum* in small ruminants is meager and thus literature in cattle and buffaloes is discussed here. Gross and histopathological changes observed in bile ducts were in accordance with the findings of Haque and Mohan (2011) and Chauhan et al. (2015) who reported *E. explanatum* in buffaloes. This appears to be the first record in this host from Andhra Pradesh, India. Further research is necessary to enlighten the epidemiology and economic importance of *E. explanatum* in goats in India.

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References

- Ahmed S, Nawaz M, Gul R, Zakir M, Razzaq A (2005) A diversity and prevalence of trematodes in livers of sheep and goat in Quetta, Pakistan. *Pak J Zool* 37(3):205–210
- Ashraf M (1977) Helminthiasis in goats of Peshawar. M.Sc. thesis, University of Peshawar, Peshawar
- Basic Animal Husbandry Statistics (2012) Ministry of agriculture, Government of India, p 131
- Chauhan VD, Pandey S, Pandya SS, Prajapati AS, Khyalia MK, Patel PV, Hasnani JJ (2015) Histopathology of the liver naturally infected with *Gigantocotyle explanatum* in Buffaloes. *Int J Adv Multi Res* 2(2):19–21
- Gall C (1981) Goat production. Academic Press, London
- Godara R, Katoch R, Yadav Anish, Rastogi Ankur (2014) Epidemiology of paramphistomosis in sheep and goats in Jammu, India. *J Parasit Dis* 38(4):423–428. doi:10.1007/s12639-013-0264-y
- Hafeez MD, Rao BV (1977) Studies on amphistomes and amphistomiasis of sheep and goat in Andhra Pradesh. *J Res APAU* 1(4):1–5
- Haque MC, Mohan Ahmad I (2011) Natural trematode infection in liver of water buffalo (*Bubalis bubalis*): histopathological investigation. *J Parasit Dis* 35(1):50–53. doi:10.1007/s12639-011-0022-y
- Ichikawa M, Kondoh D, Bawn S, Maw NN, Htun LL, Thein M, Gyi A, Sunn K, Katakura K, Itagaki T (2013) Morphological and molecular characterization of *Explanatum Explanatum* from cattle and buffaloes in Myanmar. *J Vet Med Sci* 75(3):309–314
- Iqbal Z, Hayat CS, Hayat B (1986) Natural infection of helminthes in livers and lungs of sheep and goats. *Pak J Agric Sci* 23:136–140

- Jithendran KP (1996) Occurrence of hydatidosis and various liver fluke infections in sheep and goats in Kangra valley: an abattoir study. *J Vet Parasitol* 10(1):63–67
- Mazahery Y, Razmyar J, Hoghooghi-Rad N (1994) *Explanatum explanatum* (Creplin, 1847) Fukui, 1929, in buffaloes in the Ahwaz area, southwest Iran. *Vet Parasitol* 55(1–2):149–153. doi: [10.1016/0304-4017\(94\)90066-3](https://doi.org/10.1016/0304-4017(94)90066-3)
- Mir Muzaffar Rasool, Chishti MZ, Dar SA, Rashid Majidah (2012) Bionomics of Helminth Parasites in Goats of Subtropical Jammu Area of Jammu & Kashmir, India. *Agric Biol J N Am* 4(3):316–319
- Muraleedharan K (2005) Prevalence of gastrointestinal parasites of livestock in a central dry zone of Karnataka. *J Vet Parasitol* 19(1):31–33
- Rajabloo M, Namazi F, Shayegh H, Alavi AM (2014) *Explanatum explanatum*: an emerging liver fluke in cattle and sheep. *Online J Vet Res* 18(8):675–679
- Smith MC, Sherman DC (1994) *Goat medicine*. Lea & Febiger. Waverly Company, Philadelphia, pp 336–337
- Soulsby EJJ (1982) *Helminths, arthropods and protozoa of domesticated animals*, animals, 7th edn. Bailliere Tindal and Cassell Ltd, London
- Suchita Kumari, Sinha SRP, Sucheta Sinha, Hoda MZ, Mandal KG, Sharma SK (2010) Incidence of gastrointestinal helminthosis in sheep and goats in Patna (Bihar). *J Vet Parasitol* 24(1):94–97
- Talukdar SK (1996) Prevalence of helminthic infections of goats in Assam. *J Vet Parasitol* 10(1):83–86