Canine Hepatic Calodiosis with Cirrhosis

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Abstract

Parasitic zoonoses from dogs are less frequent although dogs are reservoirs for many zoonotic parasites. The nematode parasite *Calodium hepaticum* (*Capillaria hepatica*) has a global distribution and is commonly reported in rodents (definitive host), dogs, cats and wild animals. Humans especially children are more susceptible to the parasitic infection. This paper documents an incidental finding of hepatic calodiosis with cirrhosis in a stray dog and discusses the zoonotic implications. A nondescript dog was brought for necropsy examination to the Department of Veterinary Pathology, Madras Veterinary College, Tamil Nadu, India. Liver appeared dark brown mottled with multifocal random variably sized, grey white flat firm areas. Histopathologically, liver tissue revealed multiple random encysted large collection of eggs surrounded by mild inflammation with a few lymphocytes, macrophages and fine fibrosis. The eggs had characteristic barrel shape, bipolar ends, bilayered wall, cross striations between the walls, and yolk. Periodic acid Schiff stain demonstrated the glycolic wall of ova. Marked portal to portal fibrosis was demonstrated for collagen by Masson's trichrome and for reticulin by Warthin-Starry stains. The stage of parasitic infection was diagnosed as intermediate to chronic due to fibrosis. A need to study the prevalence of the disease in human and animals and attempts for early diagnosis is emphasized. A caution in general about the zoonotic threat to children/pet parents/ veterinarians/animal handlers caused by *C. hepaticum* infection which is poorly diagnosed and sporadically reported in India and worldwide.

Introduction

Dogs as pets has been studied commonly in human animal interaction research and documented to provide social support, enhanced immunity, reduce stress and anxiety among adults and children in society (Kertes et al., 2018). However, stray and pet dogs pose a substantial risk in transmission of various zoonotic diseases caused by bacterial and viral infectious agents of which more common are rabies and leptospirosis. Parasitic zoonoses due to Echinococcus *granulosus* and *Toxocara canis* are widely reported (Eckert and Deplazes 2004; Chen et al 2018). The nematode parasite *Calodium hepaticum*, earlier known as *Capillaria hepatica*, has a global distribution and is commonly reported in rodents (definitive host) especially wild rats and mice (Fuehrer et al. 2011) and to a lesser extent in dogs, cats, primates, and humans (Fuehrer, 2014). Hepatic capillariosis was reported in non-human primates (Graczyk et al. 1999; Pereira et al. 2016) porcupines (Hamir and Rupprecht, 2000) rabbits (Mowat et al. 2009) horse (Ochi et al. 2017). Canine hepatic capillariosis was reported in India by Patil et al. (2017) and worldwide (Landolfi et al. 2003; Palma, 2009; Ajayi et al. 2010; de Oliveira et al. 2021). Adult humans also suffer from the infection which is manifested as non-specific symptoms such as persistent fever, hepatomegaly, eosinophilia and sometimes leads to death in humans (Fuehrer et al. 2011). Pica among children has been reported as a risk factor for the infection between one to five years old (Aghdam et al. 2015)

Calodium hepaticum has a direct lifecycle and only nematode that parasitizes in adult form in liver. Unembryonated ova present in liver of primary host in genuine infection or intestine in spurious form of

infection may be shed in faeces that contaminates the soil, water or food, it takes four to five weeks for the eggs to embryonate. Rodents or other mammalian hosts ingest the infective embryonated eggs that hatch in the cecum, and the larvae penetrate the intestinal mucosa and enter the portal vein. Larvae reach the liver, where they mature within 3 weeks. The adult worms live for short periods but deposit large numbers of unembryonated eggs in the liver. These eggs do not develop and are not passed in feces but remain viable in the liver until the animal dies. Cannibalism and carcass decomposition may release eggs into the environment (Farhang-Azad, 1977). When the infected animal is eaten by a carnivorous animal, eggs are then discharged and passed out in the feces.

This paper reports an incidental finding of *C. hepaticum* eggs with cirrhosis in liver of a stray dog. Since hepatic calodiosis is less commonly reported in India and as it is of zoonotic importance, this paper emphasizes the need for a detailed clinical investigation in hepatopathology for early diagnosis, the zoonotic implications and precautions to be considered.

Case History

A nondescript stray dog which was found dead on the road, was brought for necropsy examination to the Department of Veterinary Pathology, Madras Veterinary College, Tamil Nadu, India during October 2021. The condition of the carcass was fair with a simple fracture of right femur from the hip joint, dark brown mottled liver that showed multifocal random variably sized, measuring about <1-2 mm diameter, grey white flat firm areas on the surface and extending into the parenchyma (Fig. 1). Lungs appeared dark red due to congestion and haemorrhage. Kidneys were pale with cortical pitting upon removal of capsule. Stomach and intestine had yellow fluid contents. Representative tissue samples were collected in 10% neutral buffered formalin. Formalinized tissues were trimmed and routinely processed for histopathological examination. Paraffin embedded tissues were cut to 4-5 µ thickness and stained with Haematoxylin and eosin, Periodic acid Schiff (PAS), Warthin - Starry and Masson's trichrome methods (Suvarna *et al*., 2019).

Results And Discussion

The case was a stray dog found dead with fracture of hip, presumably due to hit by a vehicle. When the dog was necropsied, liver revealed multifocal random small grey white firm foci. Histopathological examination of the foci (855.62µm to 940.60 µm diameter) revealed multiple random large collection of numerous eggs surrounded by mild inflammatory reaction consisting of a few lymphocytes, macrophages and fine fibrosis (Fig. 2). The eggs were numerous and of various sizes, approximately measuring 59.39 x 30.46 µm with characteristic barrel shape, bipolar ends, bilayered wall, cross striations between the walls, condensed or disintegrated yolk. The glycolic wall of the oocysts was distinct pink with PAS (Fig. 3) and brown black with Warthin-Starry stain. Our morphological findings were consistent with earlier reports (Patil et al. 2017; Demirer et al. 2018; de Oliveira et al. 2021). However, no granulomatous or calcified lesions, as reported (Yadav et al. 2016; Ochi et al. 2017; Demirer et al. 2018) was observed. Marked portal to portal fibrosis was demonstrated for collagen by Masson's trichrome

(Fig. 4) and for reticulin by Warthin-Starry stains. Li et al. (2010) had discussed that the inflammatory reaction persist until the worm eggs become encysted or calcified followed by septal fibrosis due to activation of Kupffer cells. Septal fibrosis was evident in intermediate stage of infection and persisted through chronic stage in an experimental infection of *C. hepatica* in rats (Andrade and Andrade 2004). No adult worm was observed in serial sections in the liver of dog studied. In the life cycle of *C. hepaticum*, sexually mature female adult worms live for about 40-60 days, lays eggs in liver portal space and then degenerate. Once reproductive function is fulfilled the adult parasite dies and gradually degenerate (Demirer et al. 2018). Hence, the stage of parasitic infection was diagnosed as intermediate to chronic as there was absence of adult worm, encysted ova, minimal inflammation and marked portal fibrosis. The dog could have been infective only on decomposition or predation, as eggs are not passed in feces from liver.

This parasitic infection goes undiagnosed due to nonspecific clinical manifestations in humans and animals. Hepatic biopsy and incidental histopathological findings in liver after death were the commonly reported diagnostic methods although other clinical investigations like ultrasound, serological methods are helpful and mostly followed in humans (Ochi et al., 2017). This parasitic infection must be considered as a disease to be ruled out whenever symptoms or lesions of hepatic abnormalities are encountered.

A seasonal occurrence of hepatic calodiosis in a puppy was reported in spring in Turkey (Demirer et al.,2018). In the present case, the infected stray dog died in October which was a period of monsoon in Tamil Nadu, with rain water stagnation, dead rodent carcasses, lowered temperature, an environmental condition favorable for the embryonation of eggs of *C. hepaticum.* The stray dog could have contracted the infection up on eating rodent carcass or through contaminated soil or feed with eggs of *C. hepaticum* and could have become infective if it was just lying on the road without being found, and upon decomposition the dissemination of eggs in soil or by predation could have occurred. *C. hepaticum* parasitic infection in dogs may pose an increased risk to human health, contribute to the dissemination of eggs if in spurious form of infection from intestine through excrements on streets and serve as a source of infection for other animals (Quadros et al. 2016; Demirer et al. 2018).

Sporadic cases of hepatic capillariasis were reported in humans in India and the reports were mostly among children between 1-5 years with serious liver abnormalities (Nabi et al. 2007; Yadav et al. 2016) due to soil-hand-mouth habit (Misra et al. 2008). Epidemiological studies on prevalence of this parasitic infection is scarce among human and animals. Humans are intercalary or accidental host similar to dogs, hence adequate personal protection while handling of animals/dead or decomposed carcass, safe disposal, avoiding contact with contaminated soil or feces, uncooked meat and proper disinfection of hands of person/fomites/premises is to be adopted.

This paper documents an incidental finding of hepatic calodiosis with cirrhosis in a stray dog. A need to study the prevalence of the disease in human and animals and attempts for early diagnosis is emphasized. A caution in general about the zoonotic threat to children/pet parents/ veterinarians/animal

handlers caused by *Calodium hepaticum* infection which is poorly diagnosed and sporadically reported in India and worldwide.

Declarations

Ethical approval

The manuscript describes an incidental finding of a parasite in a necropsied dog that does not require ethical approval.

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Authors conflict of Interest

The authors declare no conflict of interest with regard to manuscript.

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Figures

Figure 1

Dog - Liver showing multifocal random grey white firm areas

Figure 2

Large collection of eggs surrounded by fine fibrosis (H&E x400)

Figure 3

Calodium hepaticum - Ova - barrel shape, bipolar ends, glycolic wall stained pink (PAS x1000)

Figure 4

Liver showing marked portal fibrosis (Masson’s trichrome, x100)