



Hepatic *Capillaria hepatica* (Bancroft, 1893) infection in cat (*Felis catus*)—histopathological findings and first report from Iran

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Abstract

Capillaria hepatica (syn. *Calodium hepaticum*) is a globally distributed nematode with a high affinity to the liver of a wide range of mammalian hosts, including humans. Documented reports of the nematode in cats and associated histopathology are rare. Here, we describe a case of *C. hepatica* infection in a 5-year-old male stray cat from Iran. At post-car accident necropsy, all body parts appeared normal except for the liver, in which a few yellowish-white granulomatous nodules were observed through the capsule and in the organ. Histopathological examination of the tissue revealed a large number of clustered parasite eggs in the parenchyma. The barrel-shaped, un-embryonated eggs ($55.19 \times 28.37 \mu\text{m}$), with inconspicuous caps at both ends, were covered with striated shells. The presence of ova in the liver tissue had resulted in the development of hepatic inflammation with hepatocellular necrosis associated with the development of multifocal granulomas. As predators of small rodents, the cats might have a significant role in the epidemiology of *C. hepatica*. Infection of hosts through ingestion of embryonated eggs in contaminated water, food, or soil is of major importance in the epidemiology of *C. hepatica*. Since the rare reports of feline infection have come mainly from accidental detection of the parasite, any hepatic disease presenting difficulties to find an etiological agent may virtually be associated with the infection with this little-known nematode.

Keywords *Capillaria hepatica* · Case report · Feline · Histopathology · Zoonosis

Abbreviations

H&E hematoxylin and eosin

Introduction

The trichurid nematode *Capillaria hepatica* (syn. *Calodium hepaticum*) infects a variety of mammals

including humans worldwide (Fuehrer 2014b). Although more than 180 mammalian species host this parasite, muroid rodents (i.e., Families Murinae, Deomyinae, Arvicolinae, Neotominae, Cricetinae, Sigmodontinae, Gerbillinae, and Cricetomyinae) serve as the main reservoirs for the infection with prevalence rate of >50% in rats and mice in different countries (Fuehrer 2014a).

The first reports of the infection in humans date back to as early as third to fourth century (Mowlavi et al. 2014) and until 2019, almost 200 human cases have been reported worldwide, including one from Iran (Kazemi Aghdam et al. 2015; Wang et al. 2019). Female worms lay eggs in the liver where they readily remain viable for years. Upon death of the host, dispersal through the predation of hosts, or passive elimination in the feces of the predators, the un-embryonated eggs become infective within 10 weeks under appropriate temperature, moisture, and air thence get ready to infect new hosts (Wright 1961). In the present study, we report the diagnosis of hepatic *C. hepatica* infection in a cat on the basis of the histopathological examination.

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Case presentation

A 5-year-old male cat (*Felis catus*) was referred to a veterinary clinic in Yazd, central Iran, in June 2019 after being hit by a car. No evidence of ante-mortem physical abnormalities was detected; however, several bone fractures and hemorrhages associated with the car accident were found at necropsy. Of note, the liver was palish and slightly enlarged with an irregular capsular surface. After having cut the surface of the organ, there were fine granular masses with a reticular appearance enclosed with yellowish lines throughout the liver parenchyma. In the multifocal lesions, there were randomly distributed yellowish-white spots. Tissue samples were collected from the liver and fixed in 10% neutral buffered formalin. The samples were then dehydrated, cleared, embedded, and blocked in paraffin, sectioned at 5- μm thickness by a rotary microtome (Leica RM2145, Germany) and stained with hematoxylin and eosin (H&E). The sections were examined by using a light microscope (Olympus CX41, Japan) and photomicrographed using a digital camera (Olympus DP25, Germany).

Microscopically, a large number of clustered eggs were found in the liver parenchyma with the characteristics of capillariid eggs. The un-embryonated barrel-shaped eggs with striated shells and inconspicuous caps at either end (Fig. 1) had the mean size of $55.19 \pm 1.76 \mu\text{m} \times 28.37 \pm 2.00 \mu\text{m}$, suggestive of *C. hepatica*.

Histopathologically, three types of lesions were observed: (i) some lesions consisted of few multifocal aggregates of *C. hepatica* eggs without a noticeable inflammatory response or accompanied by a mild mononuclear inflammatory infiltrate (i.e., eosinophils and minimal proliferation of fibroblasts) around the eggs; (ii) lesions with frequent clusters of parasitic eggs along with the presence of adult parasite cuts at different planes, some already in the process of degeneration, surrounded by infiltrated mononuclear inflammatory cells; (iii) lesions with the same pattern as the type ii, but with more eggs and fewer eosinophils and fatty degeneration of hepatocytes adjacent to the parasites and eggs. In general, the eggs were surrounded by areas of hepatocellular necrosis, multifocal granulomas, vascular congestion, hemorrhage, inflammation, and increased fibrous connective tissue (Fig. 1).

Discussion and conclusions

The gross and microscopic features of hepatic *C. hepatica* infection in an accidentally roadkilled stray cat are herein described. There are very rare documented reports of hepatic infection in domestic cat (*Felis catus*), jungle cat (*Felis chaus*), and cougar (*Puma concolor*) (Fuehrer 2014b; Karawita et al. 2016; Quadros et al. 2009) with little, if any, information on the epizootology of this parasitic infection in

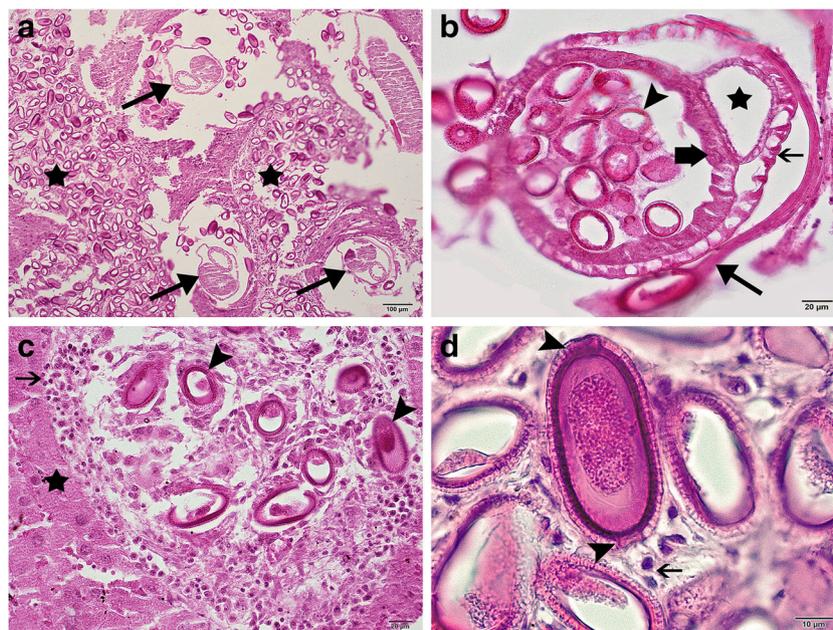


Fig. 1 *Capillaria hepatica* infection in the liver of a domestic cat. **a** Severe hepatic infection with multiplanar cuts of adult worm (large arrows) and clustered ova of the parasite (asterisks). **b** Cross section of an adult female *C. hepatica* in the hepatic parenchyma showing smooth cuticle (large arrow), bacillary bands (small arrow), centrally located prominent uterus with thick, glandular wall (thick arrow) containing ova (arrowhead), and a thin-walled intestine (asterisk in the lumen). **c**

The ova (arrowheads) are enclosed by areas of hepatocellular necrosis (asterisk), and infiltrated leukocytes (small arrow) in the liver parenchyma. **d** A magnified embryonated barrel-shaped *C. hepatica* ovum with a bilamellar striated shell and bipolar opercula (arrowheads) surrounded by infiltration of mononuclear inflammatory cells (small arrow). Scale bars: **a** = 100 μm ; **b**, **c** = 20 μm ; and **d** = 10 μm . Hematoxylin & Eosin

these animals. In the only study from Brazil, 1.38% of 435 necropsied cats were found infected with a rate of infection higher than that recorded in the same area in dogs, i.e., 0.23% (Ilha and Barros 2000). Cats may become infected by exposure to embryonated eggs in the environment or via feeding on dead rodents containing embryonated eggs in their carcasses. In the study above, only one out of six infected cats showed clinical signs of liver disease including abdominal pain, jaundice, salivation, apathy, and permanent decubitus followed by death (Ilha and Barros 2000), suggestive of the asymptomatic nature of the infection in some cases.

At the necropsy of the cat herein examined, the foci of granulomatous reaction were observed through the capsule and in the parenchyma of the liver as multifocal yellowish streaks and patches. Microscopically, there were foci of granulomatous hepatitis together with hepatocellular necrosis and vascular congestion, in consistence with previously described cases of hepatic capillariosis (Ilha and Barros 2000; Miller et al. 2020; Quadros et al. 2009).

Since the diagnosis of *C. hepatica* infection in cats and dogs has solely been carried out through necropsy and histopathological examination of the liver, the available reports are based mostly on accidental findings. This explains the limited information about the distribution of the parasite in nature. A thorough re-assessment of material stored in the archives of veterinary pathology laboratories might help to elucidate the role of cats in the epidemiology/epizootiology of *C. hepatica*. In addition, data herein presented suggest that some feline hepatic diseases in which the etiological agent is difficult to be diagnosed could be associated with *C. hepatica* infection.

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Data availability All data generated or analyzed during this study are included in this published article and its additional files.

Declarations

Ethics approval and consent to participate Not applicable.

Consent for publication Not applicable.

Competing interests The authors declare no competing interests.

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