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Original Article

Cysticercus fasciolaris (*Taenia taeniaeformis* Larval Stage) in Urban Rats with Illustration of Histopathological Changes in the Liver

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Introduction: *Cysticercus fasciolaris* is the larval stage of the cestode *Taenia taeniaeformis*, whose definitive hosts are cats. Rodents and very rarely humans act as intermediate hosts. Here, we investigated the rate of infection among urban rats in the north of Khuzestan province, southwest of Iran, and described the histopathological changes in the liver of infected animals. **Methods:** One hundred eight rats were collected from the cities Dezful, Sush, and Andimeshk in the north of Khuzestan province during 2014-2015. The rats were sacrificed, dissected, and their livers were removed and examined macroscopically for the presence of the cyst, which were then cut open and inspected for larvae. The cysts of infected livers were examined for the histopathological changes and the recovered larvae were identified based on morphometric features. **Results:** Out of 108 rats examined, 8 (7.4%) had small to moderate size cysts. Each cyst had two layers and contained one larva of *C. fasciolaris*. The scolex of the larvae had four suckers and a rostellum armed with two rows of hooks. The infected livers had multiple cysts and liver parenchyma necrosis or neoplastic evidence were not seen in the tissue sections. **Conclusion:** The small size cysts indicated actue infection, which may explain the absence of sarcoma as well. *J Med Microbiol Infect Dis, 2017, 5 (3-4): 43-46. DOI: 10.29252/JoMMID.5.3.4.43*

Keywords: *Cysticercus fasciolaris,* Rats, Histopathological changes.

INTRODUCTION

Cysticercus fasciolaris is the larval stage of *Taenia taeniaeformis,* a cestode parasite of the small intestine of carnivores, mainly cats [1]. This stage of the helminth is not frequent in humans and was detected just in a post-mortem survey once in India in 1975 [2]. *Cysticercus fasciolaris* infection has been reported in wild rats worldwide [3-6]. These animals serve as intermediate hosts and acquire infection through the ingestion of contaminated food with *Taenia* eggs expelled with cat feces [7]. Once ingested, the embryonated eggs hatch in the small intestine and the larvae migrate through the portal blood into the liver, where they form cysts. In rodents, the larvae rarely migrate to other organs such as spleen and lung [8], but cause liver structural changes accompanied by liver cells dysfunction [9]. Also, fibroplasia and progressive inflammation were observed in the liver parenchyma that may progress to fibrosarcoma [3]. Though, the cysts may be seen in different species of rodents, however, due to the host specificity of the parasite at this stage, the development of the larvae of the parasite in rats is more successful [10]. In Iran, a prevalence of 4.34% was reported in rodents of Kermanshah [11], 0.5% in *Ratus norvegicus* rats of Mazandaran province [12], 3.3% and 1.3% in the *Apodemus sylvaticus and Mus musculus* of Hamadan province, respectively [13], and 18.2% in wild rats of Tehran [14]. Regarding the significant prevalence of *C. fasciolaris* among the rats and the possible accidental transmission to humans, we investigated the rate of infection among rats in the cities of Dezful, Sush, and Andimeshk in the north of Khuzestan province, southwest of Iran during 2014-2015. We also described the histopathological changes in the liver of infected rats.

MATERIAL AND METHODS

Study area. The study was conducted in urban areas of the north of Khuzestan province, southwest of Iran during 2014-2015. The rats were entrapped in cities of Dezful, Sush, and Andimeshk (Fig.1). The area is semi-arid with hot summers and mild winters with average rainfall and humidity of 384.4 mm and 46.5% in year.

Entrapping animals. Live traps baited with bread, cheese, or cucumber were installed in public places, *e.g.*, food and grocery stores at around 8-9 PM and were collected the next day early morning at 6 to 7 AM. The entrapment of the rodents was performed during 2014-2015.

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Fig.1. The areas from which the rats were collected in the north of Khuzestan province, Andimeshk, Dezful, and, Sush

Examination of the animals. The rats were sacrificed by chloroform, dissected and their livers were checked macroscopically for cysts. The location, number and size of the cysts in the liver were recorded.

Identification of larvae. The cysts wall were cut open and inspected for larvae. The recovered larvae were stained with lactophenol as described elsewhere [15], and were identified based on morphological and morphometric characters of the hooks as described by others [15]. The small and large hooks were measured, and drawings were made using a microscope equipped with a camera lucida.

Histopathology. The infected tissues with gross lesions were fixed in 10% neutral buffered formalin and dehydrated in an increasing degree of alcohol, *i.e.*, 70%, 85%, 96%, and 100% followed by immersion in xylene, each step for one hour. The tissues were embedded in paraffin, and 5 µm sections were prepared. The sections were mounted on microscope slides, stained with hematoxylin and eosin and examined under a light microscope with a magnification of 40X [16].

RESULTS

Animals collection. A total of 108 rats, including 84 *R. norvegicus* and 24 *Rattus rattus*, were collected using live traps from urban areas of the north of Khuzestan province, southwest of Iran.

Gross pathology findings. Out of 108 rats examined, 8 (7.4%) including seven *R. norvegicus* and one *R. rattus* were infected with larvae. The infected livers had multiple cysts with the size of 1-1.5 mm; most of them were in the right lateral lobe of the liver with the color ranging from white to cream.

Microanatomy findings. The larvae were 4-15 cm in length with a scolex bearing four large suckers and a rostellum containing two rows of large and small hooks attached to a long neck. There were 34-42 small and large hooks on the rostellum with average size of 224±12 µ and 381±18 µ for small and large hooks, respectively. These morphological features matched those of *C. fasciolaris* (Fig. 2).

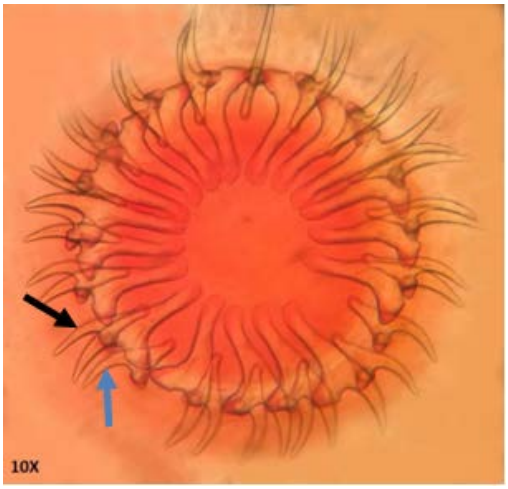

Fig. 2. The *C. fasciolaris* rostellum.

The small and large hooks are indicated by blue and black arrows, respectively.

Histopathology findings. Microscopically, the cysts of *C. fasciolaris* were partially or wholly embedded in the liver parenchyma or had replaced the tissue (Fig. 3 A). The proteinous fluid of each cyst contained one well-developed larva of *C. fasciolaris*. The scolex of the larva had four suckers, and the outer surface of the parasite was profoundly and evenly pleated (Fig. 3 B). The cyst wall composed of two layers, an inner layer made of loose connective tissue with fibrocytes, active fibroblasts, and cellular matrix delicate connective tissue fibers (Fig. 3 C). In the internal portion of the inner layer, there were modified connective tissue cells with a single nucleus and a large cytoplasm. These modified cells seem to be the secretory cells of the inner layer of the cyst wall (Fig. 3 D). The outer layer was composed of an aggregation of lymphocytes, plasmocytes and a very few eosinophil (Fig. 3 E). In two microscopic slides, moderate infiltration of lymphocytes within port spaces of liver parenchyma was evident. Other pathological changes including liver parenchyma necrosis or neoplastic evidence of the liver were not seen in the tissue sections.

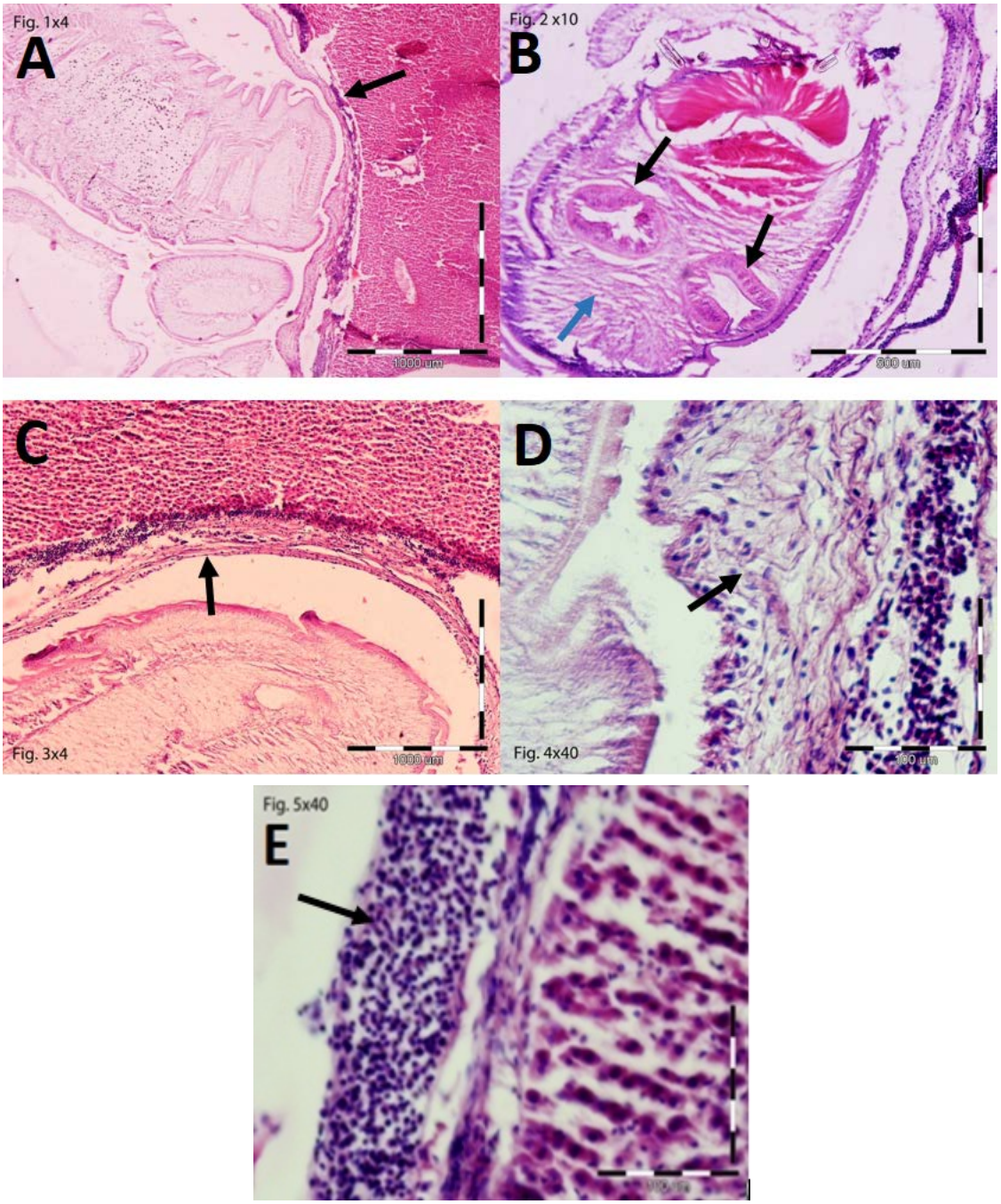

Fig. 3. The liver sections of *C. fasciolaris*-infected rats. (A) the cyst of *C. fasciolaris* (black arrow) in the liver parenchyma; (B) the rostellum (blue arrow) and suckers (black arrows) of the larva; (C) the inner layer (black arrow) of the cyst; (D) the internal portion of the inner layer of the cyst (black arrow); (E) the outer layer of the cyst (black arrow)**.**

DISCUSSION

In this study, we described *C. fasciolaris* infection in the urban rats from the north of Khuzestan province and demonstrated the histopathological changes of the liver. The infection rate of *C. fasciolaris* in the urban rats was 7.4%. In gross morphological studies, the size of cysts was small to moderate among different rats, which could be attributed to recent infections. Previous studies showed that the size of cysts was related to the duration of the infection [15], and the development stage of the cyst [17]. Moreover, the infected livers had multiple cysts, which may reflect the number of ingested eggs [18]. Other studies have shown the variation in the size of the cysts that might be due to infection at different time intervals [15]. In this study, histopathology of the liver demonstrated a two layer cyst around the *C. fasciolaris* larva, which might be a defense mechanism to limit the growth of the larva [19]. Similar studies have shown two layers of connective tissue around the larva [19]. Also, aggregation of lymphocytes, plasmocytes, and eosinophils in the outer layer of cyst shows the acute nature of infection [15]. Previously, infiltration of mononuclear cells including lymphocytes,

macrophages, and eosinophils was seen in tissue sections of the liver [15, 19]. There are reports of hepatic cell necrosis due to the migration of larvae through liver [20]. Some studies have shown the association between implantation of larvae and the development of neoplasia in the liver [10]. The liver sections showed spindle pleomorphic neoplastic cells invading liver parenchyma [9]. *Cysticercus fasciolaris* act as a foreign body causing chronic irritation and a high degree of inflammatory reactions with neoplasia [9]. Also, hepatic sarcoma has been observed in rats 12-15 months post infection [10]. These findings are in contrast with the result of the present study in which there was no evidence of neoplasia, necrosis, and hepatic sarcoma. Sarcoma occurs in chronic infections which may disseminate in abdominal cavity and pleural [15]. Furthermore, sarcoma is induced by larvae-derived oncogenic substances, microbial infection, and chronic inflammation reactions of the capsule [10]. The tumor development depends on the host species, and laboratory and wild rats are more vulnerable than other rodents [10]. The absence of sarcoma in the present study might be an indication of actue infection since an increase in the post-infection period would increase the chance of hepatic sarcoma.

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CONFLICT OF INTEREST

The authors declare that there are no conflicts of interest associated with this manuscript.

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