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Research Article

MORPHOLOGICAL AND HISTOPATHOLOGICAL STUDY ON *STROBILOCERCUS* OF *TAENIA TAENIAEFORMIS* INFECTION IN THE LIVER OF WISTAR RATS

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ABSTRACT

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. In the present study we report the detailed morphological and histopathological study of *Strobilocercus fasciolaris* infection, the metacestodal stage of *Taenia taeniaeformis*, in the liver of laboratory Wistar rats. During necropsy of rats in one toxicopathological study, two rats out of 32 were found to be infected with tape worms wherein liver revealed transparent, white to creamish, thick walled 4-7 cystic structures containing strobilocercus of *Taenia taeniaeformis* on the hepatic lobe. Cysts were small to moderate size about 4 mm to 16 mm in diameter. Histopathological examination revealed the presence of cross-section of larva surrounded by a thick fibrous capsule and moderate infiltrations of lymphocytes, plasma cells and a few eosinophils. Fatty degeneration of hepatocytes, gastric mucosal hyperplasia, distended gastric glands and marked increase in them mucosal epithelial cells and goblet cells in the duodenum were also observed. Contamination of feed and bedding materials seems to be the probable source in these naturally infected rats.

Keywords: Histopathology, Rat, Strobilocercus, *Taenia taeniaeformis*

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The larval stage of the cestode *Taenia taeniaeformis*, also known as *Strobilocercus fasciolaris* or *Cysticercus fasciolaris*, mostly uses cats as its definitive host. This larval stage uses a wide range of small rodents as intermediate hosts, with sporadic usage of human being and birds as well. When the rodent consumes the infectious eggs, the larvae pass through its intestinal wall and grow into cysticerci or cysts, which are found in the peritoneum or liver of the rodent (McInnes *et al.*, 2014). The metacestodes, which are frequently seen in the livers of voles, black rats, cotton rats, mice, and other wild rodents, have the potential to be zoonotic and will likely have an impact on the findings of the (McInnes *et al.*, 2014).

Various other terms for this metacestode have been utilized in the literature, such as bladder worm, *Hydatigena fasciolaris*, *Strobilocercus fasciolaris* and *Taenia crassicolis* (Kass *et al.*, 1993). To manage parasitic control, it is recommended to depopulate the infected rat colonies, as the infection is generally considered asymptomatic with minimal complications (Karim, 2010). Rats belonging to the Sprague-Dawely, Wistar and wild species were shown to have hepatic fibrosarcoma linked to Taenia species (Mahesh *et al.*, 2006). In addition to being linked to fibrosarcomas, the metacestode stage causes severe liver damage and gastroenteropathy in intermediate hosts (Moudgil *et al.*, 2016). The purpose of the present study was to evaluate a detailed morphological and histopathological alterations induced by strobilocercus of *Taenia taeniaeformis* infection in the liver of inbred laboratory wistar rats and to access the possibility of induction of hepatic fibrosarcoma by these parasitic larvae in liver.

MATERIALS AND METHODS

In accordance with the guidelines established by the Institutional Animal Ethics Committee (IAEC/24/1/28) vide letter no 145/IAEC/24 dated 05-03-2024 and the Committee for Control and Supervision of Experiments on Animals (CPCSEA), thirty-two, three-month-old Wistar rats were sacrificed for post-graduate research in toxopathological studies. The study was conducted in the Department of Veterinary Pathology at UP Pandit Deen Dayal Upadhyaya Pashu Chikitsa Vigyan Vishwavidyalaya Evam Go Anusandhan Sansthan (DUVASU), Mathura, Uttar Pradesh, India. Two rats had multiple cysts on liver without any other distinct morbid lesions. All of the rats' body organs were carefully inspected to check for cysts or other abnormalities. Liver specimens were preserved in 10% neutral buffered formalin for histopathological assessment.

The gross morphological examination involved

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assessing the overall appearance, number, and size of the cysts. This initial step provides a broad understanding of the cyst characteristics. Following this, a more detailed dissection was carried out to investigate whether larval stages were present within the cysts or if they were absent. This meticulous dissection was done to determine the developmental stage and potential infectivity or pathology associated with the cysts.

Taenia fasciolaris cyst-containing liver tissue samples were collected and preserved in 10% neutral buffered formalin (NBF). Following the standard paraffin embedding procedure, 5 µm thick tissue slices were produced. For general histological examinations, these tissue sections were stained with hematoxylin and eosin (Luna, 1968). The metacestode was extracted from the cyst wall by gently dissecting it. It was then placed between two slides and preserved in 10% neutral buffered formalin. Following an overnight washing, the specimen was stained with borax carmine, moved to cedar wood oil, a cleaning agent and then mounted in DPX. The entire arrangement of the rostellar hooks and suckers, together with the creation of scolices were investigated.

RESULTS AND DISCUSSION

Upon necropsy, two Wistar rats (02/32) displayed thick-walled cysts with transparent, white, or cream walls. The cysts, which ranged from 4 to 7 in number, were embedded in raised areas and varied in size from 4 to 16 mm across one or more of the hepatic lobes (Fig. 1). The hepatic parenchyma was the primary tissue affected. The thick, grayish-white, fibrous capsule that surrounded the cysts, which ranged in diameter from 4 to 16 mm, was clearly defined. Inside, the cysts contained coiled, mostly living, creamy-colored segmented *Taenia* larvae (Fig. 2), which ranged in length from 8 to 24 cm and held a small amount of fluid. Both rats were covered in coarse fur and exhibited pale mucous membranes. Cysts larger than 6 mm in size contained developed scolices, while most cysts smaller than this showed no mature scolices. The fully developed adult scolices had four lateral suckers. The rostellum was armed with two distinct rows of hook-shaped structures, resembling pen knives. Upon examination, the larvae were found to possess a large scolex, an elongated neck measuring 3-4 cm, pseudo-segmentation along the length of the body and a swollen terminal segment. The larva possessed a two-rowed rostellum that was armed (Fig. 3). The segmented strobila did not have any genital organs (Fig. 4). Based on the morphology and their anatomical site of predilection in rats, the larva was identified as strobilocercus of *Taenia taeniaeformis*.

Histopathological examination of the cystic liver revealed pronounced degenerative changes in the hepatic tissue surrounding the cystic wall. The cystic structure was distinctly demarcated from the adjacent liver parenchyma, allowing for clear differentiation between normal and affected tissue (Fig. 5). The cyst was identified as a fluid-filled sac composed of dense fibrous connective tissue, serving as a habitat for *Taenia fasciolaris*, a cestode parasite characterized by its distinct hooks, which were observed in close proximity to the hepatic capsule (Fig. 6). The presence of the parasite appeared to exacerbate hepatic damage, particularly in regions adjacent to the cyst, where pronounced fatty infiltration was evident, suggesting an advanced stage of hepatic steatosis.

The portal triad region of the hepatic tissue exhibited significant pathological alterations, including hepatocellular degeneration, fatty vacuolization, and the proliferation of fibrous connective tissue. Additionally, a robust inflammatory response was observed, characterized by dense infiltration of immune cells, including lymphocytes, macrophages and eosinophils, indicative of a chronic inflammatory process (Fig. 7). This immune response likely represents a host reaction to both the parasitic infection and the associated tissue damage.

Further examination of the hepatic sinusoids revealed varying degrees of congestion, suggesting impaired blood flow and possible disturbances in hepatic microcirculation (Fig. 8). The accumulation of inflammatory cells, coupled with fibrotic changes, likely contributed to increased vascular resistance and localized hypoxic conditions. These pathological findings underscore the complex interaction between *Taenia fasciolaris* infection, immune-mediated tissue responses, and hepatic structural remodeling, highlighting the multifactorial impact of parasitic infections on liver pathology.

The incidence of *C. fasciolaris* infection in Wistar rats was reported to be 6.25% (2/32). The study's rats were all the same age, although there were differences in their infection levels. An infection that occurs periodically could be the cause of this alteration. The source of infection might have been the breeder's colony because the rats were kept in completely hygienic circumstances. The cestode *Taenia taeniaeformis* hatches as fluid-filled larvae in a variety of organs. As the final host, carnivores' small intestines are the starting point for adult tapeworms, which subsequently disseminate to rodents as intermediate hosts. It is prevalent worldwide, but especially in Mexico (Rodríguez *et al.*, 2011), Japan (Okamoto *et al.*, 2007) and India (Singla *et al.*, 2008).

Although *Taenia taeniaeformis* parasitic larva infection is generally considered asymptomatic with few

Morphological study

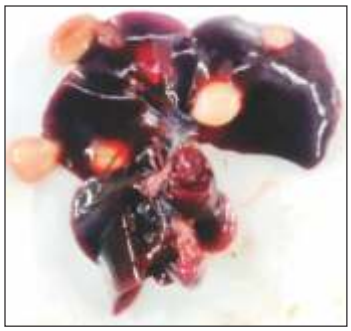

Fig. 1. Multifocal hepatic cysts involving all the lobes.

Fig. 2. Metacystodal stage of taenea

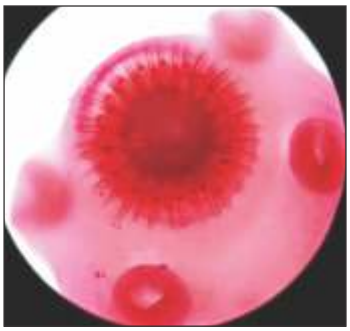

Fig. 3. Mature scolex of metacestode with two distinct rows of large and small hooks with the presence of lateral suckers

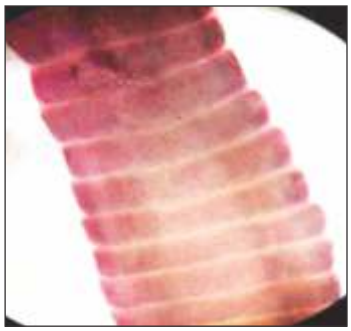

Fig. 4. Segmented body of the meta -cestode contains numerous proglottids

Histopathological study:

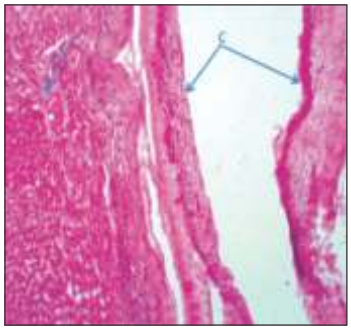

Fig. 5. Rat liver section showing liver tissue (L) and cyst (C) (H&E, X 100)

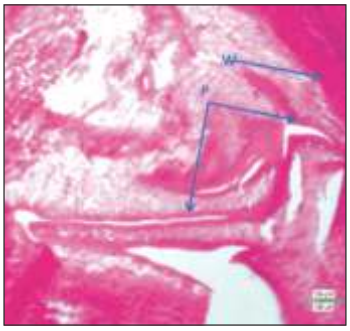

Fig. 6. Rat liver section showing parasite (P) and in cystic wall (W) (H&E, X 100)

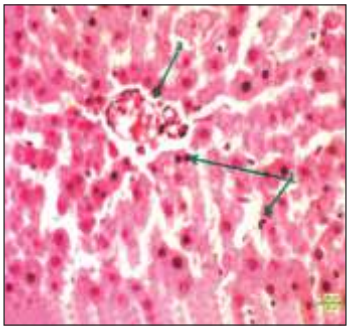

Fig. 7. Rat liver section showing degenerative changes in portal triad area (a) and lymphocytic infiltration (L) (H&E, X 400)

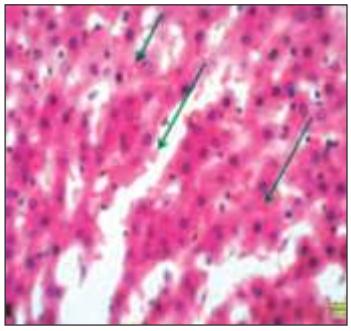

Fig. 8. Rat liver section showing congestion in live sinusoids (arrow) (H&E, X 400)

rare complications, it can significantly affect investigational results (Jithendran *et al.*, 1998). Here, we report a severe and high *Taenia taeniaeformis* strobilocercus infections in Indian Wistar rats. In gross morphological investigations, the number of cysts and their relative sizes varied among the rats; this variation may have been connected to the duration of the rats' infection exposure. In infections under a month old, only a small number of immature cysts without the development of scolex could develop targeting a small number of hepatic lobes, while in infections over a month old, a variable number of cysts, ranging from more than six, could be easily detected throughout the liver parenchyma, including all of the lobes. A similar finding has been reported previously (Moudgil *et al.*, 2016).

The current research revealed that the two rows of pen knife-shaped hooks on the rostellum of the scolex contained an equal proportion of large and small hooks, consistent with the findings of Al-Jashamy *et al.* (2007). However, Al-Najjar (2009) suggested that the rostellum of a metacestode generally has 30 to 40 hooks. Microscopic analysis of the cystic liver revealed degenerative changes near the cystic wall, with a clear distinction between liver tissue and the cystic structure. The cysts consisted of a fibrous tissue sac filled with fluid and containing *Taenia fasciolaris*, a parasite also found near the liver capsule. The liver showed more damage around the parasite, with a more pronounced fatty liver. Degenerative changes were observed in the portal triad area, including altered fat content, growth of fibrous connective tissue and infiltration by lymphocytes, macrophages and eosinophils. Additionally, varying degrees of congestion were present in the liver sinusoids. Similar observations were noted by other researchers (Armando *et al.*, 2007).

Although they were not present in our study, the incidence of parasite cysts and hepatic fibro sarcomas has been well described in some prior research (Armando *et al.*, 2001). This is due to the possibility of false positive results, particularly when liver function is examined, when asymptomatic rats carrying *C. fasciolaris* are used in animal investigations (Sengupta *et al.*, 2011). This parasite has been reported to cause neoplastic transformation. However no such finding were observed in our study and lesions observed confined to chronic inflammatory fibrosis around the parasites. The lesions around the cysts also revealed the infiltration of mononuclear cells including lymphocytes with few eosinophils. It could be

concluded that the parasitic infestation in the liver has led to formation of parasitic granuloma. T-cell-driven changes in enteropathy could have been caused by parasite migration in the gastrointestinal tract (Moudgil *et al.*, 2016).

CONCLUSION

Our findings indicate that *Taenia taeniaeformis* infections can occur naturally in laboratory rats, which may introduce unintended variables in biomedical research. Such infections have the potential to alter physiological responses, leading to skewed data interpretation and compromised experimental validity. This study underscores the dual significance of these infections, not only as a zoonotic concern but also as a factor that could inadvertently influence research outcomes. Ensuring strict health monitoring and biosecurity measures in laboratory settings are essential to maintaining the integrity and reproducibility of scientific investigations.

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