

Pathological and parasitological evidences of non-cerebral *Coenurus gaigeri* infection in goats

B. Kamdi^{*}, R. Ingole¹, V. Anandgaonkar¹ and D. Kale¹

¹Department of Veterinary Pathology, Post Graduate Institute of Veterinary and Animal Sciences, Maharashtra Animal and Fishery Sciences University, Nagpur- 440 007, Maharashtra, India

Abstract

The *Coenurus gaigeri* is a larval stage of *Taenia multiceps* and causes non-cerebral coenurosis, particularly in goats and sheep. The present report is a review of three cases affected by non-cerebral coenurosis in native goats. In this communication, we described pathological and parasitological characteristics of non-cerebral coenurosis in goats. Three goats aged 15, 18 and 25 months were referred to the Department of Veterinary Pathology, Post Graduate Institute of Veterinary and Animal Sciences, Akola, Maharashtra, for necropsy. At necropsy, multiple fluid-filled superficial cysts with white clusters of scolices having 2-4 cm diameter were noticed on the heart, liver, subcutaneous tissue and musculature. Multiple cysts having single bladderworm were recovered in the affected animal. Cysts had a volume of approximately 5–8 mL and an average number of scolices ranging from 69-76. Cysts were surrounded by the fibrous, semi-opaque and pale white color membranes. There were no cysts in the brain or spinal cord of infected goats. Histopathological examination of affected organs revealed multiple scolices growing on the internal layer of the cyst, parenchymatous pressure atrophy in the affected organs, and chronic granulomatous reaction surrounding the cystic layer. Based on parasitological and histopathological examination, coenuri were confirmed as *Coenurus gaigeri*.

Keywords: *Coenurus gaigeri*, Goat, Non-cerebral coenurosis, Scolices, *Taenia multiceps*

Highlights

- Occurrence of *Coenurus gaigeri* in goats was detected.
- Multiple fluid-filled superficial cysts with white clusters of scolices were located in the musculature and other tissues.
- Scolices had 4 suckers and 2 circles of rostellar hooks.
- Histopathology revealed granulomatous reaction in the affected tissue.

Coenurus cerebralis, the larval stage of *Taenia multiceps*, causes coenurosis (gid or sturdy) in various livestock species worldwide. The term non-cerebral coenurosis, also known as muscular coenurosis, refers to the occurrence of coenurus cysts in locations other than brain and spinal cord (Christodouloupoulos *et al.*, 2013). Dogs act as definitive hosts for this parasite and as a continuous source of infection by releasing eggs in the faeces (Soulsby, 1982). Intermediate hosts like herbivores receive infection through ingestion of contaminated food and water having eggs with hexacanth larvae (Tanowitz *et al.*, 2001). *Coenurus cerebralis* is frequently found in the nervous system, including brain and spinal cord of many herbivores, like goats. Cerebral coenurosis often manifests neurological symptoms such as drowsiness, ataxia, hind leg paralysis, head pressing, circling, coma and usually results in the death of an infected animal (Gharagozlou *et al.*, 2003). However, the cystic stage of *Taenia multiceps*, known as *coenurus gaigeri*,

commonly localizes in subcutaneous tissues or skeletal muscles (Ghosh *et al.*, 2005; Sami *et al.*, 2014). It has been reported that its massive occurrence in subcutaneous tissues and musculature has been noticed in goats, leading to a progressive failure of locomotion that leads to recumbency (Sharma and Chauhan, 2006). Cases of non-cerebral coenurosis constitute a food hygiene problem due to their intramuscular location. Carcasses with such parasites are rejected during meat inspection, which ultimately causes economic losses (Oryan *et al.*, 2010). Although coenurosis is an endemic disease in some parts of India, information on the occurrence and pathology of non-cerebral coenurosis in goats is scanty. Hence, the present communication reports pathological and parasitological observations of non-cerebral coenurosis in goats.

Three female goat carcasses with the age of 15, 18 and 25 months were presented for a necropsy to the Department of Veterinary Pathology, Post Graduate

^{*}Corresponding Author, E-mail: bhupeshkamdi@gmail.com

Institute of Veterinary and Animal Sciences, Akola, Maharashtra were studied. A detailed post-mortem examination of all animals was conducted, and gross lesions in various visceral organs were recorded. Cysts located in different organs were collected for further investigation. Organs (liver, heart and muscle) and cysts were collected and fixed in the 10% neutral buffered formalin. In the next step, histopathology was conducted for the tissue samples (Kamdi *et al.*, 2018). In brief, the fixed tissues were washed for 5 hours in running tap water, further dehydrated in graded alcohol and subsequently embedded in paraffin. Then, tissues were cut into 5 µm thin sections and stained with hematoxylin and eosin. Properly stained slides were observed under a microscope for the identification of various lesions. Various cysts from different locations were carefully examined to confirm identity. Bladder worms were laid on a flat surface to measure the number of scolices and notice their arrangement. Further identification of cysts was carried out as per the descriptions of Oryan *et al.* (2010). Briefly, a cluster of scolices and a drop of normal saline were placed on a clean glass slide. Subsequently, cover slip was pressed tightly on the glass slide to provoke the evagination of the scolices and the scolices of the cluster were examined under a light microscope. The identification of the coenurus larvae was based on the recognition of the rostellar hooks and the four surrounding suckers in the evaginated scolices (Soulsby, 1982).

Clinical examination revealed weak and emaciated goat carcasses with rough body coats. They had a history of fever, mucopurulent nasal discharge, congested conjunctival mucous membrane and excess lachrymation. At necropsy, 10 cysts were recorded in different organs of these animals. Multiple fluid-filled and superficial cysts with white clusters of scolices having 2-4 cm diameter were located in the subcutaneous tissue, heart (Fig. 1), liver and abdominal muscle (Fig. 2). As cysts had a bladder filled with watery fluid and thin and transparent wall with numerous scolices attached to its inner surface, these were initially identified as a coenurus cyst. Cysts had a volume of approximately 5-8 mL and an average number of scolices ranging from 69 -76. Cysts were surrounded by fibrous, semi-opaque and pale white color membranes. Scolices had 4 suckers and 2 circles of rostellar hooks. Large and small rostellar hooks were recorded in two circles, and large hooks had blunt handles. The number of rostellar hooks of protoscolices ranged from 28-32 (Fig. 3). There were no cysts in the brain or spinal cord of infected goats. In further investigation during necropsy, other significant

lesions recorded were marked cranio-ventral consolidation of lungs with the presence of pale yellowish fibrinous layer over the cranio-ventral portion of the right lung lobe, and congestion and emphysema of diaphragmatic lobes, catarrhal enteritis and focal necrosis of liver. On histopathological examination, each coenuri was enclosed in a fibrous connective tissue capsule with infiltration of inflammatory cells followed by an inner thin hyaline layer. Multiple scolices with rostellar hooks, suckers and bladder wall were noted in the lumen of each coenurus (Fig. 4 and Fig. 5). Microscopic examination of heart, subcutaneous tissue, liver and muscle revealed the presence of multiple scolices growing on the internal layer of the cyst, parenchymatous pressure atrophy in the affected organs along with chronic granulomatous reaction surrounding the cystic layer characterized by mononuclear cells infiltration and fibrous tissue proliferation (Fig. 6).

In the present study, typical pathological and parasitological changes were observed from the cases of non-cerebral coenurosis in goats and bladder worm, confirmed as *Coeneurus gaigeri*. It is a metacestode stage of parasite previously known as *Multiceps gaigeri* (Hall, 1916). However, molecular studies targeting two mitochondrial genes (cox1 and nad1) indicated very little difference between *Multiceps gaigeri* and *Taenia multiceps*; both parasites are considered the same species as *Taenia multiceps* (Oryan *et al.*, 2010). In the case of non-cerebral coenurosis, most animals remain normal without showing any clinical signs and the condition is generally diagnosed only after death. In the present study, animals showed varied clinical signs, including fever, dyspnea and oculo-nasal discharge; it was because of severe acute fibrinous bronchopneumonia as evidenced during post-mortem examination. Ten cysts were located in these animals from different locations including subcutaneous tissue, heart, liver and abdominal muscles. Similarly, Christodouloupoulos *et al.* (2015) recorded coenuri cysts from different locations, while there was no evidence of cysts in the brain and spinal cord. The presence of numbers of clusters and scolices as well as the averages of the number of large and small hooks were in agreement with previous study by Schuster *et al.* (2010). This similarity indicates the cyst recorded in the present study is *Coenurus gaigeri* because there are differences in the morphological characteristics of cysts causing non-cerebral coenurosis and cerebral coenurosis (Christodouloupoulos *et al.*, 2016). Further, it is supported by the absence of cysts in the brain and

Non-cerebral coenurosis in goats



Fig. 1. Heart showing single superficial cystic structure



Fig. 2. Opened intra muscular coenurus cyst showing multiple scolices in 08 clusters fixed to the inner surface of the cyst



Fig. 3. Isolated protoscolex of an intra-muscular coenurus with 28 rostellar small and large hooks arranged in two circles

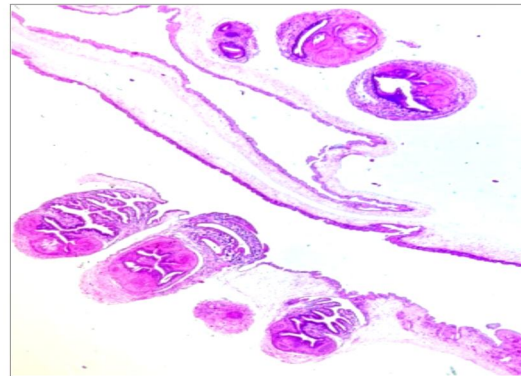


Fig. 4. Microphotograph of a scolex of a metacestode of *C. gaigeri* stained with hematoxylin and eosin showing bladder wall, suckers, and hooks (bar=200µm)

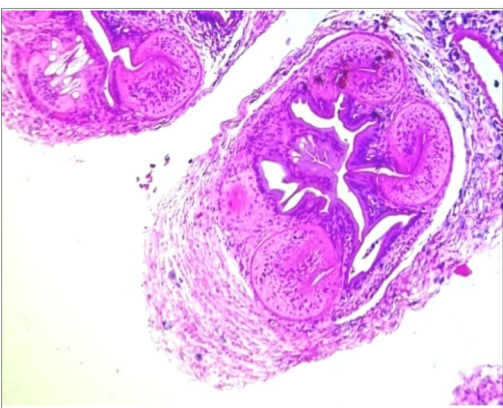


Fig. 5. Microphotograph of scolex stained with hematoxylin and eosin showing multiple suckers and rostellar hooks (bar=200µm)

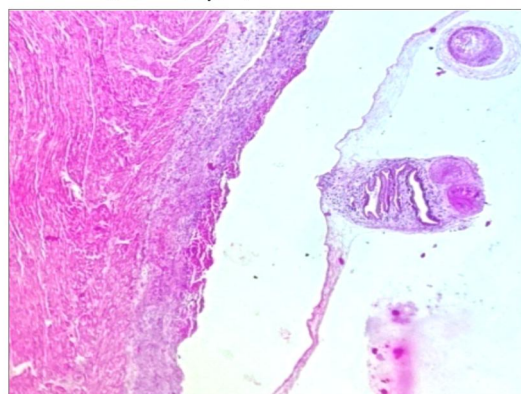


Fig. 6. Microphotograph of a heart stained with hematoxylin and eosin showing coenurus and surrounding tissue with scolices, mononuclear infiltration in the fibrous connective tissue cystic wall and atrophic myocardial fibers having degenerating changes (bar=300µm)

spinal cord of the animals included in the present study. The presence of coenuri in the muscle and visceral organs like heart caused damage at gross and microscopic levels. This included traumatic destruction/pressure atrophy of the affected tissues associated with degenerative and necrotic changes, together with infiltration of polymorphonuclear leucocytes and mononuclear cells throughout the lesion. The lesions often persist throughout the life span of the host (Sharma and Chauhan, 2006). Although intramuscular localization of cysts does not cause health risk to the host, the presence of parasite in visceral organs like heart may be detrimental (Madhu *et al.*, 2014). Notably, the presence of parasite cyst in sheep and goats causes carcass condemnation and ultimately fetches economic losses to the farmers (Sharma and Chauhan, 2006).

The present study, based on pathological and parasitological observation, confirms the occurrence of *Coenurus gaigeri*. Non-cerebral coenurosis is a challenge to diagnose as it rarely manifests any clinical signs; therefore, to avoid economic losses by carcass condemnation, preventive measures should be strictly followed. Goats usually acquire infection from dog's

excreta; hence the treatment of dogs in and around the farms for tapeworms should be followed.

Conflict of interest: Authors declare no conflict of interest in this study.

Author's contributions: BK: Sample collection, necropsy, diagnosis, analysis of samples and final draft preparation; RI: Supervision of work, analysis of samples and manuscript draft preparation; VA: Histopathology and parasitological investigation and preliminary draft preparation; DK: Necropsy and histopathology and parasitological investigation.

Data availability statement: All the data supporting the research findings have been presented in this paper. The corresponding author is willing to provide the raw data upon reasonable request.

ACKNOWLEDGEMENT

The authors are obliging the Associate Dean, Post Graduate Institute of Veterinary and Animal Sciences, Akola for providing the necessary research facilities and support for this study.

REFERENCES

- Christodouloupoulos G, Dinkel A, Romig T, Ebi D, Mackenstedt U *et al.*, 2016. Cerebral and non-cerebral coenurosis: on the genotypic and phenotypic diversity of *Taenia multiceps*. *Parasitol Res*, 115(12): 4543-4558, doi: 10.1007/s00436-016-5246-4
- Christodouloupoulos G, Kassab A and Theodoropoulos G, 2013. Occurrence of non-cerebral coenurosis in sheep. *J Helminthol*, 87(1): 125-127, doi: 10.1017/S0022149X1100085X
- Christodouloupoulos G, Kassab A and Theodoropoulos G, 2015. Characteristics of non-cerebral coenurosis in tropical goats. *Vet Parasitol*, 211(3-4): 216-222, doi: 10.1016/j.vetpar.2015.05.020
- Gharagozlou MJ, Mobedi I and Akhavan P, 2003. A pathological and parasitological study of *Coenurus gaigeri* infestation of Goats from Iran. *Indian J Vet Pathol*, 27(1): 95-97
- Ghosh RC, Dubey S, Mandal SC and Sharma N, 2005. Occurrence of *Coenurus gaigeri* cyst in a goat. *Indian Vet J*, 82(1): 90-91
- Hall MC, 1916. A new and economically important tapeworm, *Multiceps gaigeri* from the dog. *J Am Vet Med Assoc*, 50: 214-223
- Kamdi BP, Singh S, Kumar P, Singh V and Singh R, 2018. Pulmonary hydatidosis in buffalo calves. *Indian J Vet Pathol*, 42(4): 296-298
- Madhu DN, Mahan T, Sudhakar NR, Maurya PS, Banerjee PS *et al.*, 2014. *Coenurus gaigeri* cyst in the thigh of a goat and its successful management. *J Parasit Dis*, 38(3): 286-288, doi: 10.1007/s12639-013-0242-4
- Oryan A, Nazifi S, Sharifiyazdi H and Ahmadnia, S, 2010. Pathological, molecular, and biochemical characterization of *Coenurus gaigeri* in Iranian native goats. *J Parasitol*, 96(5): 961-967, doi: 10.1645/GE-2399.1
- Sami M, Mirzaei M and Kheirandish, R, 2014. Intramuscular and subcutaneous coenurosis in goats and sheep in south-east Iran. *Comp Clin Path*, 23(1): 141-144, doi: 10.1007/s00580-012-1585-4
- Schuster RK, Sivakumar S and Wieckowsky T, 2010. Non-cerebral coenurosis in goats. *Parasitol Res*, 107(3): 721-726, doi: 10.1007/s00436-010-1919-6
- Sharma DK and Chauhan PPS, 2006. Coenurosis status in Afro-Asian region: A review. *Small Rumin Res*, 64(3): 197-202, doi: 10.1016/j.smallrumres.2005.05.021
- Soulsby EJJ, 1982. *Helminths, Arthropods and Protozoa of Domesticated Animals*. pp 809
- Tanowitz HB, Weiss LM and Wittner M, 2001. Tapeworms. *Curr Infect Dis Rep*, 3(1): 77-84, doi: 10.1007/s11908-001-0062-z