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Surgical management and molecular confirmation of *Coenurus gaigeri* cyst in a non-descript goat

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Abstract
A two-year-old non-descript goat was presented to the Veterinary Clinical Complex, Department of Veterinary Surgery and Radiology, VCRI, Orathanadu with a history of fluctuating subcutaneous swellings noticed near the left eyeball and mandible. Fine needle aspiration biopsy revealed the presence of clear watery fluid. Under local anaesthesia, using exploratory surgery, a thin-walled parasitic cyst was successfully removed. Microscopic examination confirmed it as *Coenurus gaigeri* and molecular analysis revealed a ~400 bp PCR product which is specific amplification of *Taenia multiceps* mitochondrial gene. Post-operatively, the goat was treated with antibiotics, anti-inflammatory drugs, and a fenbendazole-praziquantel combination, achieving full recovery by the 14th day without any complications.

Keywords: Cyst, *Coenurus gaigeri*, Goat, Molecular diagnosis, Polymerase chain reaction

Introduction
Coenurosis is a parasitic disease caused by *Coenurus cerebralis*, the larval (metacestode) stage of the tapeworm *Taenia multiceps*, which belongs to the class Cestoda and family Taeniidae (Soulsby, 1982) [13]. This condition, particularly when affecting the central nervous system (CNS), has a global distribution. The adult *Taenia multiceps* resides in the small intestine of definitive hosts such as domestic and wild carnivores. In contrast, its larval form, *Coenurus cerebralis*, primarily localizes in the CNS (brain and spinal cord) of intermediate hosts like sheep and goats, leading to neurological symptoms such as ataxia, head tilting, and blindness. These signs often prove fatal for the affected animals (Avcioglu *et al*., 2011; Varcasia *et al*., 2015) [1, 17]. Although rare, non-cerebral manifestations of coenurosis have been reported, mainly from some Asian countries. In India, the prevalence of non-cerebral coenurosis in goats has been documented to range from 1.1% to 2.41% (Godara *et al*., 2011; Varcasia *et al*., 2012) [3, 16]. When the larval cysts (metacestodes) of *Coenurus* are found in unusual locations such as the neck muscles, eyelids, skin, thigh muscles, abdominal wall, heart, kidneys, and lymph nodes of goats, the condition is referred to as *Coenurus gaigeri* (Oryan *et al*., 2010; Radha Krishna Rao *et al*., 2018) [7, 10]. Molecular and phylogenetic studies have shown that while *Coenurus gaigeri* differs from *Coenurus cerebralis* in location, they are both considered to be the same species (Sharma *et al*., 1998) [14]. This report describes a case of *Coenurus gaigeri* in a non-descript goat, detailing its surgical removal and confirmation through polymerase chain reaction (PCR) analysis.

Materials and Methods
A 2-year-old non-descript goat was brought to the Veterinary Clinical Complex, Department of Veterinary Surgery and Radiology, Veterinary College and Research Institute, Orathanadu, with a history of soft, painless, and fluctuating subcutaneous swellings observed in abnormal locations such as the left eyeball and mandible (Fig. 1). Clinical examination revealed that the goat's vital signs, including rectal temperature, heart rate, and respiratory rate were within normal limits. The animal had not been previously dewormed.

Fine needle aspiration yielded a transparent, clear, watery fluid. Aseptic surgery was performed under local anesthesia using 2% lignocaine. A thin-walled parasitic cyst was carefully excised from the subcutaneous tissue using fine scissors and forceps after making a small incision with a BP blade. Gentle handling allowed the cyst to protrude and be removed manually with light traction (Fig. 2). After removal, the muscles were sutured with 1-0 polyglycolic acid (PGA) in a simple interrupted pattern (Fig. 3), and the skin was closed using 1-0 silk in a cross-mattress suture pattern.

The excised cyst was sent for both morphological and molecular evaluation. Post-operatively, the goat was treated with intramuscular Enrofloxacin at 5 mg/kg and Meloxicam at 0.5 mg/kg for five days. Additionally, a single oral dose of a fenbendazole-praziquantel combination at 7.5 mg/kg was administered. Regular wound dressing and application of topical antiseptic ointment were carried out to prevent infection. The goat recovered uneventfully.

For molecular confirmation, DNA was extracted from the scolices of the cysts. The genetic analysis targeted the mitochondrial cytochrome-C oxidase subunit-1 (COX-1) gene. DNA extraction was performed using the QIAamp® DNA Mini Kit (Qiagen, Germany), following the manufacturer's protocol. PCR was conducted using species-specific primers: Forward - 5'-TTTTTTGGGCATCCTGAGGTTTAT-3' and Reverse - 5'-AAAGAAAGAACATAATGAAAATG-3'. The thermocycling conditions included initial denaturation at 98 °C for 1 minute, followed by 30 cycles consisting of denaturation at 98 °C for 30 seconds, annealing at 55 °C for 30 seconds, and extension at 72 °C for 30 seconds, concluding with a final extension at 72 °C for 5 minutes. The PCR-amplified gene was analyzed via 1.5% agarose gel electrophoresis and visualized under UV light using a gel documentation system.

Results and Discussion

Morphological examination revealed that the cysts measured approximately 4 cm in length, featuring a thick, grayish outer wall and a thin, translucent inner wall. The inner layer contained clusters of invaginated scolices attached to the germinal layer. Additionally, four round suckers and a rostellum bearing a double row of taeniid hooks were observed (Fig. 4), confirming the diagnosis of *Coenurus gaigeri*. The cyst's morphology was consistent with the description provided by Soulsby (1982) [13]. Molecular analysis further validated the presence of the mitochondrial COX-1 gene of *Taenia multiceps*. Using specific primers, a PCR product of approximately 400 bp—corresponding to the parasite's COX-1 gene—was amplified (Fig. 5). These findings align with previous reports by Varcasia *et al*. (2022) [18] [16] and Latchumikanthan *et al*. (2024) [6]. Based on the case history, clinical evaluation, and molecular confirmation, the goat was diagnosed with an infestation of *Coenurus gaigeri*.

Coenurosis is a well-documented metacestodosis caused by the larval stage of *Taenia multiceps*. In addition to being a zoonotic threat, the disease is linked to significant tissue destruction, decreased productivity, and reproductive losses in affected hosts. *Taenia multiceps* has a complex life cycle that includes definitive hosts, primarily canids, and intermediate hosts such as sheep and goats. Transmission of metacestodosis in small ruminants mainly occurs through the ingestion of feces from stray dogs.

The larval cysts (*C. cerebralis*) typically develop within the brain or spinal cord, severely impairing the central nervous system (CNS) functions of the infected host, including humans. However, in some cases, the bladder worm stage may localize in atypical anatomical sites such as the neck muscles, eyelids, skin, thigh muscles, abdominal musculature, heart, kidneys, and lymph nodes. Non-cerebral forms are more frequently observed in goats, with numerous documented cases of cysts forming in the musculoskeletal and subcutaneous connective tissues across Asian and African regions. In goats, these non-cerebral coenurus cysts have traditionally been referred to as *Coenurus gaigeri* (Oryan *et al*., 2014; Radha Krishna Rao *et al*., 2018) [8, 10].

Additionally, coenurosis leads to substantial economic losses due to the condemnation of infected organs during slaughter. In severe infestations, it may even result in the death of the host (Radfar *et al*., 2005; Oryan *et al*., 2014; Varcasia *et al*., 2022) [9, 8, 18]. Godara *et al*. (2011) [3] reported that chronic infections are commonly observed in goats between one and two years of age.

In the current case, a 2-year-old goat presented with non-cerebral cysts located in the subcutaneous tissues of the eyelids and mandible, consistent with previous findings (Sharma *et al*., 1998; Oryan *et al*., 2010) [14, 7].

Diagnosis of coenurosis requires consideration of several factors, including the animal's age, clinical symptoms, and findings from neurological exams, ultrasound, and post-mortem evaluations. A combination of clinical symptom interpretation and precise cyst localization using diagnostic imaging is regarded as the most effective diagnostic approach (Oryan *et al*., 2014) [8]. In goats with the non-cerebral form of coenurosis, primary clinical signs include lameness, paresis, paralysis, and the presence of skin swellings due to subcutaneous cysts (Oryan *et al*., 2010; Oryan *et al*., 2014) [7, 8]. However, in the present case, the goat appeared clinically normal and healthy despite the presence of a cyst. The only abnormality noted was a palpable cyst of variable size in the affected regions.

Molecular characterization using mitochondrial genes such as cytochrome c oxidase subunit 1 (COX-1) and nicotinamide adenine dinucleotide dehydrogenase subunit 1 (NAD-1) is particularly effective for identifying *T. gaigeri*. In this study, the COX-1 gene proved useful for identifying *C. gaigeri*, the causative agent of non-cerebral coenurosis in the goat. Nevertheless, these are now regarded as genetic variants of *T. multiceps* (Varcasia *et al*., 2022) [18]. Various diagnostic tools, including radiography and ultrasonography, have been used to localize cysts, which is crucial for planning surgical removal (Varcasia *et al*., 2012) [16]. Although Varcasia *et al*. (2022) [18] noted difficulties in interpreting radiographs for cyst localization, in the present case, the cysts were identified through gross examination and aspiration of cyst fluid.

Therapeutic management involving albendazole or a combination of anthelmintics such as fenbendazole and praziquantel (Ghazaei, 2005) [4], along with proper post-operative care using antibiotics and anti-inflammatory drugs (Rashmi *et al*., 2018) [11], followed by six days of regular wound dressing and application of antiseptic ointments, has proven effective against *C. gaigeri* infections. In this case, the goat was treated with Enrofloxacin at 5 mg/kg intramuscularly, Meloxicam at 0.5 mg/kg intramuscularly for five days, and a single oral dose of a fenbendazole-praziquantel combination at 7.5 mg/kg. The animal began showing clinical improvement by the third day post-surgery. By the time the sutures were removed, the goat had recovered well enough to walk normally and exhibited notable

improvement, with no signs of vision impairment.

Fig 1: Different locations of *Coenurus gaigeri* in a non- descript goat

Fig 2: *Coenurus gaigeri* cyst coming from the incision on cyst at mandibular region

Fig 3: Following cyst removal, muscles were sutured with 1-0 polyglycolic acid (PGA) in a simple interrupted pattern

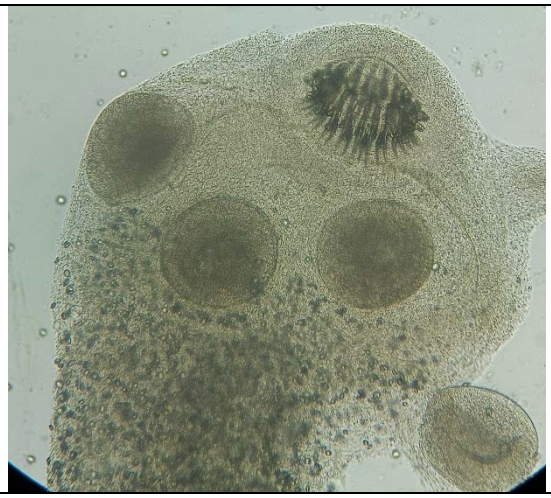

Fig 4: Microscopical examination of single *Coenurus gaigeri* scolex showing 4 round suckers and a rostellum with a double crown of hooks

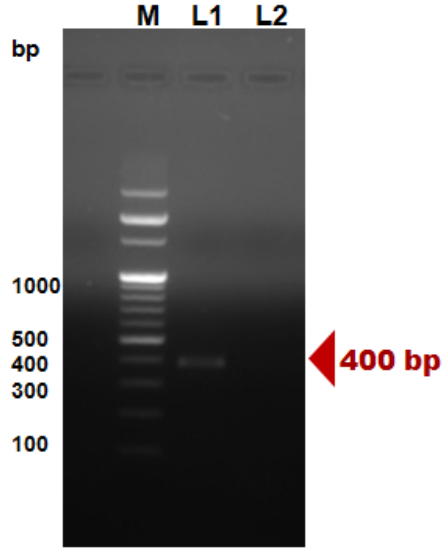

Fig 5: Agarose gel electrophoresis showing ~400 bp amplicon of Cox-I gene of *T. multiceps Coenurus* cyst in PCR. (Lane M - 100 bp DNA ladder, Lane L1 - ~400 bp PCR product, L2 - Non-template control)

Conclusion

The present study documents a case of non-cerebral coenurus cyst in a goat caused by *Coenurus gaigeri*, confirmed through molecular techniques and successfully treated through surgical intervention. As goats serve as intermediate hosts and typically acquire the infection from canine feces, it is essential to regularly deworm dogs in and around farm areas to control the spread of tapeworms. Given the zoonotic significance of

the disease, preventive measures such as routine deworming, proper disposal of feces, thorough carcass inspection, and adequate cooking of meat are crucial in reducing the risk of transmission to humans.

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

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