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Review Article

Prevalence and Community Awareness of Taenia multiceps Metacestodes in Mianwali Cattle: Implications for Coenurosis Management

[1]Masood Ud Din, [2]Palwasha Haider, [3]Laiqa Haider, [4]Muhammad Shoaib Sarwar and [*4]Kashaf Arshad

[1]Department of Zoology, Minhaj University Lahore, Pakistan
[2]Department of Pharmacology, Government College University Faisalabad, Pakistan
[3]Department of Pharmacy, The University of Faisalabad, Pakistan
[*4]Department of Zoology, University of Agriculture Faisalabad, Pakistan

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Abstract

Taenia multiceps is a cestode parasite predominantly residing in the small intestines of canids, including foxes, coyotes, jackals, and domestic dogs. Recent cases of Taenia multiceps-related illnesses have been reported in cattle in Mianwali, Pakistan. This study aimed to evaluate community awareness, identify susceptibility factors, and determine the prevalence of Taenia multiceps metacestode (Coenurus cerebralis) and other Taenia metacestodes, particularly hydatid cysts, in sheep and goats slaughtered in the Mianwali district. This research represents the first documentation of coenurosis caused by C. cerebralis in slaughtered small ruminants within this region. Among the 338 carcasses examined, hydatid cysts and C. cerebralis infections were identified in 2.95% and 4.43%, respectively; several cases also exhibited concurrent diseases. Contributing factors to the persistence of coenurosis include the prevalent use of dogs for herding, a significant dog population, close interactions between small ruminants and dogs, limited community knowledge regarding coenurosis transmission, unrestricted dog access to carcasses and offal containing viable C. cerebralis cysts, and inadequate veterinary care for dogs, particularly concerning anthelmintic treatment. Understanding the epidemiology of coenurosis is vital for effective management and control measures to safeguard animal health and mitigate disease transmission. It is imperative to develop a comprehensive control strategy or program to address these challenges. Further research is warranted to enhance the regulation of coenurosis, with the findings of this study serving as a foundation for future investigative efforts.

Keywords: *Taenia multiceps, Coenurosis, Cestodes, Sheep, Goats*

1. Introduction

Known by many as sturdy or gid, Taenia multiceps (larval stage Coenurus cerebralis) is a cestode that usually affects livestock's central nervous system (CNS), namely the brain and spinal cord More than 40 species of taenia, a varied group of helminths, have been identified. Taeniasis and/or cysticercosis are caused by taeniasis and/or animal infections [2, 3]. Sheep and goats are frequently used as intermediate hosts, however infection in people and cattle has also been documented [4]. Sheep and goats are common intermediate hosts that contract the infection after consuming vegetation and water tainted with dog eggs [5, 6]. Consequently, the larval stage develops in a variety of tissues, such as the skin, muscles, and brain [7, 8].

Fever, tremors in the muscles, hemorrhagic retinal lesions, ataxia, blindness, nystagmus, dysmetria, and scoliosis are among the acute clinical symptoms [2, 3]. Along with acute symptoms, chronic stages also show paralysis, blindness, lack of coordination, lethargy, and painful sensitivity to pressure over the cystic area [4, 5]. Additionally, cysts can grow in the subcutaneous and intramuscular tissues [6, 7], which can cause pain in the muscles and interfere with normal organ function [8].

Coenurosis is more common in poorer nations [1], with rates of ovine coenurosis ranging from 1 to 40% in Africa, Asia, and the Middle East. According to reports, the frequency in Bangladesh, India, and Jordan is 2.5, 2.88, and 3% [2-4] in Asia and the Middle East, whereas in Iran, the incidence in sheep and goats ranges from 1.7 to 18.7% [5-7]. Countries like Ethiopia, Mozambique, Tanzania, Kenya, and Egypt may have a prevalence of 1.5 to 42.1% [8, 9]. The illness is rare in wealthy nations like the United Kingdom. Nonetheless, research based on slaughterhouses carried out in the 1980s estimated

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the frequency to be between 0.5 and 5.58% [10]. Low prevalence reports have also been made for France and Italy [11]. Even so, the illness is one of the major determinants of advancement in developing countries is small ruminant farming. On the other hand, it is well recognized that parasite infections and other infectious diseases pose a significant threat to cattle productivity. Owners of sheep and goat populations suffer significant financial losses due to parasitic illnesses because of poor growth, sickness, low carcass value, and mortality [1, 2]. About 5% of infected sheep and goats die [3], 25% die in Istanbul, Turkey [4], and 10.2 million rials are lost in Iran [4] as a result of the corpses being condemned, highlighting the financial losses caused by tapeworm metacestodes. Pakistan presents a problem because of its vast and diverse geography, which is home to its own beasts, species, and gene pools. Due to these factors, various regions, species, and ancestors of creatures react differently to various diseases. But how it impacts the animals, and how we must respond to that, in the absence of an early warning system and accurate details of the grievance. Only with a robust, responsive, and efficient surveillance system will we be able to handle international demands and provide our producers with a sustainable product. Veterinary and animal professionals were brought together at the factory. Because there is little information on the prevalence of coenurosis (gid) in this particular region and the nation as a whole, the study was carried out to estimate and validate the extent of the illness. In addition, because it is demand-driven and problem-solving, it will highlight the severity of health issues and their forms.

2. Material and Methods

2.1 Study Area

The Mianwali District is situated in Pakistan's Punjab Province's Sargodha Division. About 385 mm of rain falls there on average. The hottest month is June, when average highs reach 42 °C. The average monthly temperature in December and January during the winter can drop as low as 3 to 4 °C. The 220,010 people living in Mianwali City make up only around 20.82% of the district's total population; the remaining 79.18% are distributed throughout the district in small villages and around a slaughter slab, where sheep, cows, and goats are routinely put to death.

2.2 Research methodology

This investigation was cross-sectional. Meat inspectors visited slaughter slabs and butcher shops between August 2022 and June 2023 to gather the heads of slain sheep and goats. An average of fifty animals (25 sheep and 25 goats) of both sexes were selected at random from slaughter slabs and butcher shops each month. Each animal's brain was removed, and its presence was checked for cystic fibrosis (C. cerebralis).

2.3 Data Types

Primary and secondary data were the two categories of information gathered. The primary data was gathered via biological samples and questionnaire interviews. Secondary data were gathered by browsing the internet and visiting pertinent libraries.

2.4 Gathering, processing, and identifying cysts from the sample

Dog feces and the brains of lambs and goats were among the biological samples. During the investigation, only animals that came from the village and the vicinity where a certain slaughter slab is situated were looked at. The study also included animals that were killed on livestock market days.

The existence of additional hydatid cysts, or tape worm metacestodes, in the same carcass and/or their internal organs were also investigated, with documented results. Prior to slaughter, the history, the place of origin, and the quantity of cysts were noted.

2.4.1 Brain samples – Extraction and examination

Two weekly trips to the slaughterhouse and nearby butcher shops were made during the course of the six-month period. Ten to twenty heads were checked each week. Every cattle's brain was methodically examined using palpation, ocular inspection, and incisions made against Coenuruses cysts. The intestines, tissues, and other important organs were also inspected.

After killing sheep and goats, the heads were removed, the skin was peeled off, and the skulls were carefully cracked open with a machete so as not to injure the brain. A scalpel was used to make an incision in the meninges to reveal brain tissue. Each animal's entire brain was removed, and it was inspected for any discernible **cysts (Coenurus cerebralis).**

2.4.2 Fecal sample collection and processing

In this investigation, feces samples from fifteen household dogs—one sample from each animal—from the same towns where killing slabs are found were gathered. Using gloves, feces samples were taken per rectum and then carefully sealed in labeled plastic containers. Taeniid egg presence was checked in fecal samples. A specific dog's age, sex, and other health details were also noted, along with normal dog husbandry. All phases of sample collection, storage, transportation, and processing were carried out with rigorous adherence to operating procedures for the safety of the researchers, the community, and the environment.

2.5 Interviews – Questionnaire Survey

A systematic questionnaire was utilized to gauge community awareness and knowledge of the epidemiology and risk factors for coenurosis. The two main areas of knowledge—the origin of coenurosis and its mode of transmission—were evaluated. Interviews

were conducted in twenty villages, which included the butcher shops and the slaughter slab. An interviewee's selection criteria included having a dog(s) or being convenient. Individual interviews with one hundred farmers and livestock keepers were conducted. The information on community awareness and knowledge on the epidemiology and predisposing factors of coenurosis, as well as sample collection, storage, transportation, and processing, was anticipated to come from the results.

3. Results

3.1 As a Whole Prevalence

Upon physical examination of the skulls of 338 sheep, goats, cows, and buffaloes, it was discovered that 80 (4.43%) of the heads had *Coenurus cerebralis* cysts in the brain. Slab-slaughtered sheep, goats, cows, and buffaloes had an overall coenurosis prevalence of 4.43%; individual species prevalences include 10.66% in sheep, 3.96% in goats, and 1.46 % in cows and buffaloes. Sheeps (10.66%) had the highest species prevalence at Mianwali's slaughter slab..

3.2 Season-wise prevalence of coenurosis

Seasons also affect coenurosis, with spring and fall being the seasons with the highest infection rates. Acute infection rates peaked in the spring, from March to May. After a few more months, in September through October, the coenurus reaches maturity and turns deadly in late fall, which is when the majority of the disease's chronic cases were noted, as Table 1 illustrates.

Table 1 Seasonal prevalence of *C. cerebralis* in cattle from August 2022 to June 2023 in District Mianwali.

Season	Examined	Positive %
Spring (March – May)	57 (4)	7.01
Summer (June- August)	59 (4)	6.77
Autumn (September-November)	150 (5)	3.33
Winter (December- February)	70 (2)	2.85

3.3 Clinical signs

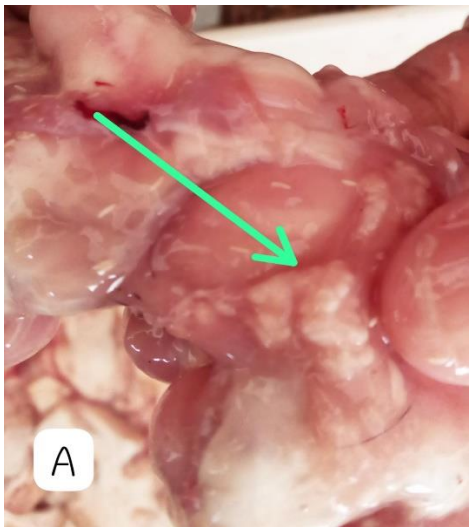
All farmers reported the presence of coenurosis-related clinical symptoms, describing the disease by locally recognized names and illnesses, in 20 of the flocks included in the study. Various clinical symptoms were observed in animals who were affected. Table 2 indicates that blindness was a prominent indicator.

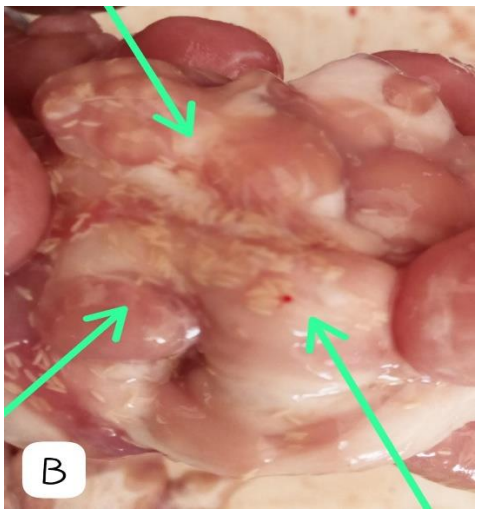
Table 2: Total cases = 29; number and percentage of cases exhibiting the various clinical symptoms typical of coenurosis

Clinical signs	Number	Percentage
Blindness	17	58.6
Head Deviation	11	37.9
Paralysis	13	44.8
Hypermetria	9	31.0
Ataxia	5	17.4
Teeth grinding	8	27.5
poor appetite	13	44.8

3.4 Number of *Coenurus cerebralis* cyst

Fifteen (n=15) Coenurus cerebralis cysts were found in total. There were one to three cysts per skull or brain that was evaluated (1 – 3).Clear or translucent cyst fluid was found inside the thin-walled recovered cysts (Fig. 1C). A mature coenurus was recovered from sheep; the brain's surface was covered in many protoscolices (Fig. 1B) and clusters of protoscoleces (Fig. 1A). There have been instances of a sophisticated kind of meningial cyst that was superficially placed and adhered to the prosterior side of the brain (Fig. 1D).





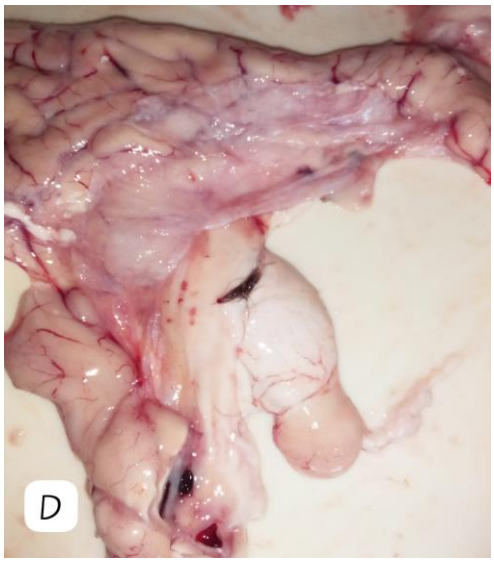


Figure 1 (A) shows a mature coenurus isolated from sheep, along with clusters of protoscoleces; (B) shows protoscoleces dispersed throughout the brain of a goat; (C) shows coenurus cerebralis cysts isolated from the brain of a sheep; and (D) shows a complex kind of meningial cyst attached to the back of the brain.

4. Discussion

To far, there isn't a single report detailing the coenurosis occurrence in Mianwali. Thus, the findings of this study document for the first time the prevalence and incidence of coenurosis in sheep and goats that have been killed as a result of *Taenia multiceps* metacestode *(Coenurus cerebralis)* in the Mianwali district. There are few reports on the frequency of coenurosis in Pakistan, particularly in slaughter slabs where the majority of the animals used for slaughter are local residents. The overall prevalence of *C. cerebralis* was found to be 4.43% in sheep, 3.96% in goats, and 1.46 % in cows and buffaloes, as indicated by the data.According to this study, the coenurosis prevalence in the Mianwali district is 4.43%. 5% prevalence figures published by other sources in.

The actual state of the flocks in the Mianwali district is reflected in the high prevalence of coenurosis in animals that have been slaughtered, such as goats and sheep. Given the widespread practice of raising sheep and/or goats, it is possible that the conditions seen and documented in this study are similar to those in other regions of the nation, where such cases are disappearing without being officially reported. Therefore, moving sheep and/or goats from these areas to other regions where the disease is either unknown or less common could greatly increase the risk of introducing coenurosis into new areas. If appropriate and strategic control measures are not implemented, the disease will probably continue to spread as a major pathogen in other regions of the nation. While farmers might choose to sell sick animals known as "ormilo" to the livestock market and/or butcher in order to prevent losing an animal, during the field survey, it was noted that meat inspectors had placed a restriction on the slaughter of coenurosis-affected animals at the slaughter slab. i.e., during the antemortem examination, the sheep and goats that showed clear clinical symptoms of coenurosis were discarded. Livestock keepers regularly bring animals for slaughter to these killing slabs. Animals killed on livestock market days were not included in the study in order to reduce the amount of slaughtered animals from beyond the study area. It is possible, therefore, that some of the animals included in this study were purchased on a market day and held for a few days prior to being killed. It is believed that the low prevalence reported at the slaughter slab originated from animals that did not exhibit overt clinical symptoms (nonclinical positive), allowing them to elude rejection during antemortem examination.

It has been discovered that coenurosis is maintained by intimate interactions between the definitive hosts, dogs, and intermediate hosts, sheep and goats. Understanding the cause and the route of transmission is crucial to the control of the illness. The extremely low level of community awareness and understanding of the etiology and spread of coenurosis facilitates this. It's crucial to remember that during at-home animal slaughters, brain tissues and other trimmings deemed unfit for human food are just thrown into the bush and fed to surrounding canines only when there are none left. If not, these tissues are typically tossed uncooked to dogs, a practice that increases the risk of infection in sheep or goats and so exacerbates the illness problem when the tissues contain infectious materials. However, as revealed by the questionnaire survey results, feeding dogs with brains that may contain *Taenia multiceps* cysts (C. cerebralis) as well as improperly disposing of infective material, such as raw brains thrown into the bush or feeding dogs raw offal directly, were identified as major contributing factors to the spread of viable cysts. If the material comes from an infected animal or animals, these cysts eventually mature into adult tapeworms after being consumed by the ultimate host. In addition, the majority of dogs are always outdoors, and some of them are shepherd dogs, a behavior that raises the possibility of dog feces contaminating pastures.

The study also revealed that 95% of respondents had encountered coenurosis, often known as "ormilo," which is a well-known health issue among livestock keepers of sheep and goats. They are ignorant about the origin and mode of transmission, nevertheless. It goes without saying that livestock keepers, or pastoralists, are aware of the diseases that typically afflict their herds and flocks given the decades-long tradition of animal husbandry and keeping in the area. This suggests that coenurosis is a novel health issue for sheep and goats in the research area, as evidenced by the fact that the majority of respondents (50%) saw the condition for the first time in less than ten years. The recorded prevalence of hydatid cysts was 2.95% overall. The organs most frequently impacted by hydatid cysts in sheep and goats were the lungs and liver, as seen in

other earlier research conducted in Central Oromia, Saudi Arabia, by [1]. In Ethiopian abattoirs, the incidence of concurrent organ infections was found to be 11.78% in sheep and 4.9% in goats. The corresponding concurrent organ infections were 0.89 in the lungs, 1.93 in the kidney, 4.5% in the peritoneum region, and 3.9% linked with the intestines [2]. This study's hydatid cyst prevalence was lower than that of Ngorongoro District studies, which found 34.7% in goats and 63.8% in sheep [3]. The discrepancies could be explained by variations in the number of animals investigated or by the correctness of the retrospective recordings. Even while the prevalence was not as high as Ernest's findings, it still raises the idea that hydatidosis is a significant public health concern in this study area and that some of the taeniid eggs found in dog feces may actually be the eggs of an Echinococcus species.

Conclusions

This study established the presence of *C. cerebralis* in the Mianwali district for the first time, revealing a significant incidence in slab-slaughtered sheep and goats and highlighting its role in the mortality of young ruminants. Furthermore, the zoonotic potential of *T. multiceps* posed a considerable public health risk, akin to other metacestodoses, which could lead to substantial economic losses in small ruminant breeding. Consequently, further research into effective chemical prophylactic measures, including drugs and vaccines for coenurosis, as well as comprehensive control strategies such as infection prevention in definitive hosts was warranted. Enhancing the value of sheep and goat products could also have supported efforts against this metacestodosis. Additionally, current research on *T. multiceps* had primarily focused on a limited number of isolates from final and intermediate hosts, particularly cattle. Future studies should have aimed to analyze NAD1 and COX1 gene sequences from *T. multiceps* isolates in diverse countries to determine potential variations in genotype morphology, development, or pathology. Finally, a critical factor contributing to the persistence of this disease was the lack of awareness among the human population regarding the disease and its preventive measures. Addressing this knowledge gap was essential for effective disease management and control.

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