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PREVALENCE OF *COENURUS CEREBRALIS* IN SHEEP IN KARS PROVINCE, TURKEY

YUNUS GICIK, MURAT KARA, AND MUKREMIN O. ARSLAN

Department of Parasitology, Faculty of Veterinary Medicine,
University of Kafkas, 36040, Kars, Turkey
yunusgicik@gmail.com

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Abstract

The prevalence of *Coenurus cerebralis* was investigated for 12 months in 387 slaughtered sheep in the Kars province. During the study, the breed, age, sex of animals, the location of cysts, numbers, diameters of the cysts, the amount of the fluid, and number of the scolices were recorded. The infection rate of coenurosis was recorded at 15.5% (60/387) in the examined heads. Clinical symptoms of coenurosis were seen in only 17 of the animals (4.3%). The cysts were located in the cerebral hemispheres in 96.7% of the cases and in 3.3% in the cerebellum. The infected heads contained 1-4 coenurus cysts. The disease, according to the season, was more prevalent in October (28.5%) and less prevalent in April (3.1%). The infection rates according to the age of animals were 15.0% in one-year-old, 21.7% in two-year-old, and 11.4% in 3-year-old or older animals. The number of coenurus cysts in morkaraman sheep was higher (15.9%) than that of akkaraman sheep (14.1%). The incidence of coenurosis was 14.4% in males and 15.9% in females.

Key words: sheep, *Coenurus cerebralis, Taenia multiceps*, disease survey, Turkey.

Coenurus cerebralis, the metacestode or larval form of the dog tapeworm *Taenia multiceps,* causes coenurosis, otherwise known as gid or sturdy. Authentic records of coenurosis began to appear in literature during the 17th century, although references to the disease with nervous symptoms have been found in texts from the time of Hippocrates (23). It has been reported to affect principally the cerebrum or cerebellum of older lambs and adult sheep (16). The disease causes a serious problem in sheep production. The clinical signs are variable and may be confused with other nervous conditions. The mortality rate can reach up to 100%.

Turkey has a long tradition of rearing sheep and there is extensive local information on the management of sheep. Sheep is the main livestock in the Kars Province after cattle. In this province, 46% of farm animals are sheep. The sheep population in Turkey is estimated to be at 23 million and farmers in the province of Kars have 296000 sheep. Although it is an offence to slaughter animals outside the abattoirs, clandestine slaughtering of sheep is a common practice. Sheep are usually kept together, and mainly under free-range roaming, trans-humane husbandry. Dogs are always kept with the flocks for guarding purpose. The akkaraman and morkaraman sheep are fat-tail breeds that originate from Central Asia, and they are the most common breeds in the Kars province as well as in Turkey. Lambing is seasonal between February and April in this region. The Kars province is located in the north-eastern highlands of Turkey, about 1100 km east of Ankara. The area has a relatively cool temperature throughout the year with the average of 6.3°C. The average monthly minimum and maximum temperatures range from -11.6°C in January to 17°C in July. The mean relative humidity is 70% (76% in November, 61% in September). This region is relatively underdeveloped when compared to the other parts of Turkey.

The prevalence of *C. cerebralis* in Turkey has been reported in sheep, goat, and cattle (25, 11, 20, 25). This metacestode has not been reported in humans in Turkey officially, but it is suspected that some cases might occur and it might be confused with the metacestode of *E. granulosus*. Adult *T. multiceps* parasite is prevalent between 0.32% and 12% in dogs in Turkey, and in 7.1% in Kars province (21). Despite the frequent occurrence of coenurosis in sheep in the Kars province or elsewhere in Turkey, information regarding the epidemiology and correlation of clinical signs with size and location of the cysts is scarce. This article aims to give sufficient information on the prevalence of this metacestode in the province.

Material and Methods

The heads of akkaraman and morkaraman sheep (white Karaman and reddish-brown Karaman), slaughtered at the Kars regional abattoir, were examined for brain cysts of *Taenia multiceps*. One visit per week was paid to the abattoir during the 12-month period.

Every week, 7 to 9 heads were brought and examined in the laboratory. The heads, except those of sheep showing clinical signs of coenurosis, were chosen randomly. The origin, breed, sex, and age of the animals were recorded. The age of the animals was estimated by the stage of dentities and by questioning the owners. Only animals originating from the Kars province were examined in the study. Information on a prior antiparasitic treatment was not available. The heads of the slaughtered sheep were separated from the rest of the carcass by butchers and the skull was removed by ventral disarticulation of the atlanto-occipital joint, and after removal of the skin, the area just caudal to the frontal bone was cut cross-sectionally using handsaw, followed by two parallel cuts on the parietal bone. The bone was removed using a chisel and hammer and the meninges were incised with a scalpel blade, so exposing the brain. The brains were carefully examined for gross pathological lesions. The locations of cysts were recorded and their sizes were measured in a floating condition using a calliper. The fluid was measured using a measuring cylinder after rupturing the cyst on a Petri dish. The scolices recovered from the cysts were counted using a stereomicroscope. The data were analysed by simple statistics and *Chi*-square test.

Results

The brains of 387 sheep were examined and 60 of the heads had the coenurus cysts. The characteristics and morphology of *Coenurus cerebralis* were seen in all the cysts as described by Williams and Boundy (23). Clinical symptoms of coenurosis were seen in only 17 (4.3%) of the animals before slaughter. The major clinical signs were circling, head deviation, visual impairment, dullness, separation from the flock, and loss of appetite, muscle tremors. Circling was seen in only 12 of the animals and 2 of them besides circling had visual impairment. In addition to that, 3 of the sheep had abnormal proprioceptive reflex, especially in the hind legs, and 1 sheep showed hyperaesthesia. The remaining animals were quite bright and feed taking was normal according to the owners and butchers. It is necessary to report that 156 of 387 (40.3%) sheep had also *Oestrus ovis*. The cyst numbers in the brains varied from 1 to 4. Forty-two of 60 infected sheep had only one cyst. Thirteen of the sick animals had 2 cysts, 3 animals had 3 cysts, and 1 sheep had 4 cysts. The cysts were mostly located in the cerebrum (96.7%) and only two of them located in the cerebellum (3.3%). The diameters of the cysts ranged from 1.5 to 6.2 cm; 32% of the cysts had a diameter of 3 cm, 41% of them had a diameter of 3 to 4 cm, and 27% had a diameter of more than 4 cm. The number of scolices in the cysts was from 37 to 84. The scolex numbers were higher in a big cysts and older animals. Monthly prevalence of *C. cerebralis* was low (3.1%) in April, while it was higher (28.5%) in October ($P>0.05$) (Table 1). The rate of infection was 14.1% for the akkaraman breed, and 15.9% for the morkaraman breed ($P>0.05$). The prevalence was 16.2% in females and 14.4% in males ($P>0.05$). The detailed information is given in Table 1. It was found that the breed and sex had no statistical impact on the prevalence of *C. cerebralis* infection. The prevalence of the metacestodes among the different age groups of sheep in the Kars province was important to note. The infection rate was 15.0% in a 1-year-old sheep, 21.7% in 2-year-old ones, and 11.4% in 3-year-old or older animals (Table 2). The differences among age groups were statistically significant ($P\leq0.05$).

Table 1
Infection rates according to sex and breed

Month	Infection rate (x/n), (%)	Sex (x/n), (%)		Breed (x/n), (%)	
		Male	Female	Morkaraman	Akkaraman
June	4/35 (11.4)	0/10 (0.0)	4/25 (16.0)	2/22 (9.0)	2/13 (15.3)
July	2/35 (5.7)	1/21 (4.7)	1/14 (7.1)	2/28 (7.0)	0/7 (0.0)
August	6/35 (17.1)	2/4 (50.0)	4/31 (12.9)	6/29 (20.6)	0/6 (0.0)
September	4/35 (11.4)	2/15 (13.3)	2/20 (10.0)	4/30 (13.3)	0/5 (0.0)
October	10/35 (28.5)	5/13 (38.4)	5/22 (22.7)	8/27 (29.6)	2/8 (25.0)
November	5/30 (16.6)	3/17 (17.6)	2/13 (15.3)	3/20 (15.0)	2/10 (20.0)
December	7/30 (23.3)	2/15 (13.3)	5/15 (33.3)	5/25 (20.0)	2/5 (40.0)
January	7/30 (23.3)	3/19 (15.7)	4/11 (36.3)	5/22 (22.7)	2/8 (25.0)
February	6/30 (20.0)	2/14 (14.2)	4/16 (25.0)	5/21 (23.8)	1/9 (11.1)
March	3/30 (10.0)	0/10 (0.0)	3/20 (15.0)	2/20 (10.0)	1/8 (12.5)
April	1/32 (3.1)	1/9 (11.1)	0/23 (0.0)	1/23 (4.3)	0/9 (0.0)
May	5/30 (16.6)	1/6 (16.6)	4/24 (16.6)	3/19 (15.7)	2/11 (18.1)
Total	60/387 (15.5)	22/153 (14.4)	38/234 (16.2)	46/288 (15.9)	14/99 (14.1)

x/n - infected sheep/number of examined sheep

Table 2
Infection rates according to age

Month	Number of examined sheep	Age (x/n), (%) 1	2	3≥
June	35	1/6 (16.6)	2/16 (12.5)	1/13 (7.6)
July	35	1/20 (5.0)	0/12 (0.0)	1/3 (33.3)
August	35	6/26 (23.0)	0/4 (0.0)	0/5 (0.0)
September	35	2/12 (16.6)	1/15 (6.6)	1/8 (12.5)
October	35	0/3 (0.0)	5/11 (45.4)	5/21 (23.8)
November	30	1/5 (20.0)	2/9 (22.2)	2/16 (2.5)
December	30	0/3 (0.0)	4/8 (50.0)	3/19 (15.7)
January	30	0/1 (0.0)	4/9 (44.4)	3/20 (15.0)
February	30	0/1 (0.0)	3/12 (25.0)	3/17 (17.6)
March	30	-	2/14 (14.2)	1/16 (6.0)
April	32	-	1/8 (12.5)	0/24 (0.0)
May	30	1/3 (33.3)	3/6 (50.0)	1/21 (47.6)
Total	387	12/80 (15.0)	27/124 (21.7)	21/183 (11.4)

x/n - infected sheep/number of examined sheep

Discussion

Taenia multiceps and its larvae *C cerebralis* are endemic in Kars as well as in the whole of Turkey. The present study reports the presence and prevalence of coenurosis in Kars province. The presence of shepherd dogs on grazing land as well as in paddocks, greatly contributes to the existence of the disease. Dogs are frequently fed on viscera, trimmings, and heads of butchered animals, and they are not treated for parasitic diseases, thus maintaining *C. cerebralis –T. multiceps* life cycle. Fifteen percent of all sheep are affected with the disease. One- or two-year-old sheep (15% and 21.7%, respectively) are more susceptible to the parasite when compared to older sheep (11.4%). The reasons for the lower prevalence of the disease in older sheep may be explained by the presence of an acquired immunity. It was suggested that most taenid eggs are not capable to develop into mature metacestodes (9). Only 7% of eggs will transform into cysts in the case of *T. hydatigena*. Nevertheless, the remaining 93% of the eggs can stimulate immunity under conditions of high infection pressure and the immunity is life-long (9). It is thought that this may happen with *T. multiceps*. Relatively low prevalence in 1-year-old sheep could have a number of reasons. Maternal immunity can be one of them, which was described previously with *T. hydatigena* and *T. ovis* (8, 19). Clinical signs of coenurosis, such as circling, head pressing, and blindness, reported previously in other studies (6, 15), were recorded also in this study. It was reported that the presence of coenurus cysts in the brain might cause softening and pressure atrophy of the overlying skull bone, leading to its perforation (12, 16, 18). This was not observed in our study. Although Achenef *et al.* (1) reported that multiple cysts cause acute coenurosis; there was no relationship between cyst numbers and the clinical course of the disease in our study. According to our observations, there is a correlation between the severity of the clinical signs and the size of the area occupied by the cysts.

The coenurosis cyst localise in any part of the brain, mostly in the cerebral hemispheres (14, 16). The great majority of the cysts (96.7%) was located in the cerebral hemispheres (60% in the left and 40% in the right one). The sick animals were mostly circling to the left. It is unclear why the cysts settled in the left hemisphere. According to the literature, circling is frequently towards the side of the brain in which the cyst is located (12, 14).

The determined prevalence of coenurosis was higher compared to several other publications where the prevalence rates 5% to 10% were given (12, 13). It is unclear at what stage the cysts start causing symptoms. It is unknown whether a state of latency can exist, in which the cyst does not cause neurological symptoms and does not increase in size. In this study, the prevalence of coenurus cysts was found to be 15.5, which was relatively higher than that in the recent prevalence studies (4% to 10%) previously reported from Turkey (2, 5), but some similar results were also reported in some old local studies. Hakioglu *et al.* (10) reported the infection rate was 36.8% in sheep in Marmara and Aegean regions of Turkey. Similarly, Vural *et al.* (22) reported that 20% of the sheep died because of coenurosis in a Karacabey stud farm, and Zeybek (25) reported the prevalence of the disease as 17.6% from Samsun province. The high prevalence of *Coenurus cerebralis* in the Kars region could be due to

selling sick animals to abattoirs by owners as soon as they noticed the coenurosis without informing the local authorities. Sheep are always grazed in pastures of the Kars province where the area was heavily contaminated with *T. multiceps* eggs, what is also the cause of high infection rates in sheep of the region.

The incidence rates are reported from Bulgaria and Romania, which are neighbouring countries to Turkey. Angelov and Belchev (3) reported the incidence rate as 28% and in a case 48 of 160 sheep died due to acute coenurosis in Bulgaria. Siko and Negus (17) examined the heads of 1800 sheep and they found that 391 of the animals (21.7%) were infected with *C. cerebralis* and they supposed that the incidence rate could be different at the acute and chronic disease.

Biyikoglu and Doganay (5) carried out an experimental infection study in sheep and they reported that the cyst sizes were between 0.3-4.2 cm. Bafii-Yeboa (4) reported the cyst sizes as 1-3 cm. In our study the cyst sizes were between 1.5 and 6.2 cm. Necrosis and calcification of cysts were reported in some studies (5, 7, 24), but those findings were not observed in this study.

It is concluded that this work confirms the presence *C. cerebralis* in the Kars province. According to this prevalence report, coenurosis is one of the major contributors to sheep mortality, especially in young sheep of the region. It is shown that the breed and sex of sheep does not have correlation with the prevalence of the parasite. Transferring sheep from the Kars province into other provinces of Turkey, where the disease is less prevalent, could pose a considerable risk for the introduction of coenurosis into these provinces. Effective control measures must be taken, such as prohibition of backyard slaughtering, disposal of heads, and public awareness of the epidemiology of the *C. cerebralis*.

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