Coenurosis in the lumbar region of a goat: a case report

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ABSTRACT: Coenurosis caused by *Coenurus cerebralis*, the larval stage of *Taenia multiceps*, particularly affects sheep and goats. In this case report, two coenurus cysts were detected under the lumbar spinal cord (outside the CNS) in a goat. We first described cysts in the macro- and micro-morphological examination. The cysts were identified as *C. cerebralis* on the basis of the arrangement of scolices and the number and size of hooks in the scolices. The morphology of the larval cyst was similar to that of *T. multiceps*: the scolices had four suckers and a rostellum with a double crown of hooks. The hooks and hooklets were 178 and 132 μm in length, respectively. *T. gaigeri* may be synonymous with *T. multiceps.* This may reflect a different host response to the parasite in goats. The difficulty of making a species identification in *C. cerebralis* or *C. gaigeri* based on their morphology is discussed.

Keywords: *Taenia multiceps*; *Coenurus cerebralis*; goat; sheep

Taenia multiceps (Leske, 1780) is a taeniid cestode and its adult stage lives in the small intestine of dogs and other canids (Soulsby 1982). The larval stage of this cestode, known as *Coenurus cerebralis*, affects the central nervous system (CNS), particularly the brain of sheep, goats and sometimes cattle, and gives rise to the neurological signs of coenurosis (Soulsby 1982). However, especially in the goats, cysts may also reach maturity in other organs, subcutaneously and intramuscularly (Bhalla and Negi 1962; Sing and Sing 1972; Sharma et al. 1995). Cysts located in muscles may cause muscular pain or impaired function of the organs involved. However, the animals in most cases remain normal without clinical symptoms and the condition is usually diagnosed only after the death of the animal (Sharma and Chauhan 2006).

Coenurus cerebralis poses serious problems for sheep production. It is worldwide in distribution but is most common in the developing countries of Africa and Asia (Yoshino and Momotani 1987; Nooruddin et al. 1996; Achenef et al. 1999; Abo-Shehada et al. 2002; Sharma and Chauhan 2006; Welchman and Bekr-Ochir 2006; Gicik et al. 2007; Nourani and Kheirabadi 2009) where sheep and goat rearing is a common source of income. The sheep and goat populations in Turkey were estimated at 23 974 591 and 5 593 561, respectively (Anonymous 2010). Based on abattoir surveys, the prevalence of cerebral coenurosis in Turkish sheep was reported to be 1.3–36.8% (Hakioglu et al. 1974; Kalkan 1977–1978; Zeybek 1977; Akkaya and Vurusaner 1998; Gicik et al. 2007; Uslu and Guclu 2007). In addition, *C. cerebralis* has been reported from the muscles and the heart of goats (Tinaz 1952; Coskun et al. 1989–1990) and from the brain of cattle (Yilmaz and Can 1986).

Adult *T. multiceps* and *T. serialis* parasites but not *T. gaigeri* have been reported in dogs in Turkey (Doganay 1992; Umur and Arslan 1998). The identity of *Multiceps* spp. have been reviewed by Hall (1919), Clapham (1942), Verster (1969) and Edwards and Herbert (1981). But, information on intermuscular and subcutaneous (other organs) Coenurosis in goats is limited and incomplete.Here we describe the macro- and microscopical characteristics of *C. cerebralis* in a goat. The morphological features of *T. multiceps* and *T. gaigeri* in the intermediate hosts are also described in this paper.

MATERIAL AND METHODS

The animal examined was a two-years old male ordinary goat which was bred in Antalya. The goat did not show typical clinical neurological signs such as circling behaviour, visual defects, and peculiarities in gait, stumbling, uncoordinated move-

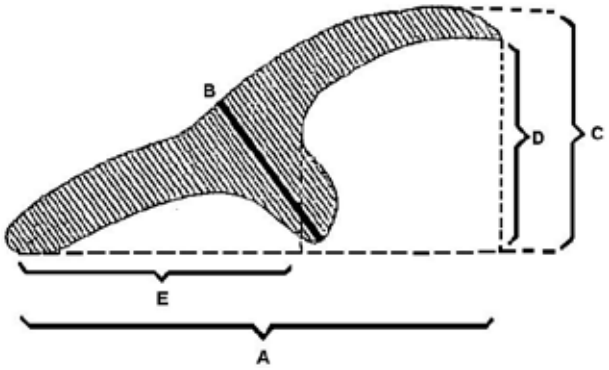

Figure 1. The diagram of measurement and shape of the rostellar hooks

A–C = dimension of rostellar hooks

ments, hyperaesthesia or paraplegia. The animal was slaughtered as a sacrifice for a feast and was subsequently examined for parasites and gross pathological lesions.

Two cysts were taken out from the lumbar region. The larval cysts were examined macroscopically and microscopically. The scolices were observed by stamp smear preparation. Fifty scolices were measured. Identification was carried out following the characteristics of the species (Hall 1919; Clapham 1942; Verster 1969; Edwards and Herbert 1981; Soulsby 1982). Measurements of sucker diameters were recorded from fresh larval scolices. The size of the rostellar hooks was measured according to the method of Yamashita et al. (1957); see Figure 1.

Statistical analysis

SSPS for Windows 14.01 (Licence No. 9869264) was used to determine mean and standard deviation of the size of the hooks in scolices. In addition to that, the coefficient of variation was applied to the data.

RESULTS

At necropsy, one large (8.5 × 6.3 cm) and one small fluid-filled cyst (4 × 2.5 cm) were recognised under the lumbar spinal cord (Figure 2). The outer layer of the cyst was characterised by a very thick, fibrotic, grey-brownish capsule while the inner layer was characterised by a thin transparent wall with several white scolices clumped on the inner surface. White clusters consisting of numerous (more than 125) rice-shaped scolices were attached to the lucent germinal layer of the cysts (Figure 3). No internal or external daughter cysts were present.

The numerous invaginated scolices were dispersed to the inner surface. The scolices had four suckers, 260 to 370 µm (mean ± SD = 319 ± 29.84) diameter, and one rostellum, with a double crown of 24 to 28 hooks with hooklets (Figure 4). The hooks were 164 to 188.5 µm (mean±SD 178±6.39) in length and 43.8 to 65 µm (mean ± SD = 55 ± 6.13) in width. The hooklets were 117 to 146 µm (mean ± SD = 132 ± 7.85) in length and 29.2 to 53.6 µm (mean ± SD = 46 ± 6.88) in width (Table 1).

DISCUSSION

Although bovine and caprine Coenurosis caused by *T. multiceps* is referred to in the parasitological text book the occurence of *T. multiceps* in goats and cattle is less common than in sheep (Soulsby

Figure 2. The *Coenurus* cyst on the lumbar region

Figure 3. Numerous scolices seen as white clusters on the internal layer of the cyst

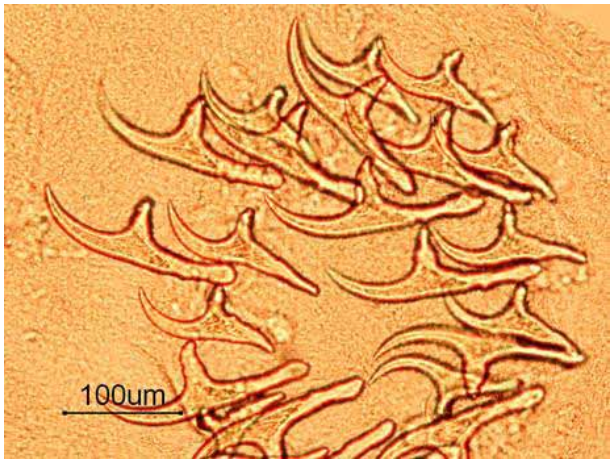

Figure 4. Large and small rostellar hooks removed from a scolex, pressed somewhat strongly

1982). Previous literature on Coenurosis contains considerable contradictory reports for the species of *Taenia*, which is capable of infecting animals and accounts for the intermediate host as well as epidemiological and anatomical site differences (Yamashita et al. 1957; Soulsby 1982). Much of the evidence, however, has been based on the morphology of Coenurus; in particular, the shape and size of rostellar hooks (Hall 1919; Yamashita et al. 1957; Verster 1969; Edwards and Herbert 1981; Soulsby 1982).

The intermediate hosts have been recorded for Taenia species (Yamashita et al. 1957; Verster 1969; Soulsby 1982). In particular, two species, *T. multiceps* and *T. serialis*, have been reported for herbivores. The relationship between these different species and disease has been discussed in detail by several authors (Hall 1919; Clapham 1942; Yamashita et al. 1957; Verster 1969; Edwards and Herbert 1981; Soulsby 1982). According to them, the disease might be attributed to several separate species or a variant of the parasite, each requiring a different natural intermediate host, i.e., the CNS (sheep) and intermuscular and subcutaneous connective tissues and other organs (rabbit, rodent). The natural intermediate host in *T. serialis* is the lagomorph. Considering the usual intermediate host, however, the parasite in the present goat might be *T. multiceps* or *T. gaigeri*.

The Coenurus cysts seen in locations outside the CNS in goats were recorded as *T. multiceps* (Bhalla and Negi 1962; Sing and Sing 1972; Sharma et al. 1995) or *T. gaigeri* (Hago and Abu-Samra 1980; Varma and Malviya 1989; Moghaddar 2007). In the present study, the Coenurus cysts were found under the lumbar spinal cord. This may reflect a different host response to the parasite in goats or, alternatively, parasitism by larvae of another cestode species, *T. gaigeri* (Verster 1969; Soulsby 1982; Sharma et al. 1995; Moghaddar 2007), although *T. gaigeri* was not recorded in Turkey until now. In studies carried out in Turkey, the prevalence of *C. cerebralis* in sheep has been reported to range from 1.3% to 36.8% and (Hakioglu et al. 1974; Kalkan 1977–1978; Zeybek 1977; Akkaya and Vurusaner 1998; Gicik et al. 2007; Uslu and Guclu 2007). In addition, *C. cerebralis* has been reported in goats (Tinaz 1952; Coskun et al. 1989–1990) and cattle (Yilmaz and Can 1986) in Turkey.

The rostellar hooks have been shown not to grow after ingestion by definitive hosts (Edwards and Herbert 1981). Hook lengths in the scolices of metacestodes are similar to those from adult worms. The chitinous hooks are not influenced by fixation and their lengths are frequently used for identification but, because of the range of values possible and the overlap between species, it is only when the specimen under examination falls within a limited portion of the quoted species range that hook length can be used reliably for identification (Edwards and Herbert 1981). The range of values

Table 1. The size of rostellar hooks in scolices obtained from cysts in the present study

Dimension of rostellar hooks	Large hook			Small hook		
	range (μm)	mean ± SD (μm)	CV (%)	range (μm)	mean ± SD (μm)	CV (%)
A	164.1–188.5	178 ± 6.39	3.58	117–146.2	131.9 ± 7.85	5.95
B	43.8–65.0	55.0 ± 6.13	11.13	29.2–53.6	46.0 ± 6.88	14.94
C	65.0–78.0	72.4 ± 4.34	5.99	58.5–68.2	62.3 ± 3.35	5.37
D	39.0–65.0	54.9 ± 9.50	17.30	32.5–55.2	45.0 ± 7.87	0.17
E	73.1–110.5	98.0 ± 9.12	9.25	65.0–87.7	76.0 ± 5.79	7.61

CV = coefficient of variation

Table 2. A comparison of *T.multiceps* and *T.gaigeri* based on the number and size of rostellar hooks

Taenia multiceps				*Taenia gaigeri*				References
Rostellar hook lengths (μm)				Rostellar hook lengths (μm)				
number of hooks	large hook	small hook	suckers diameters (μm)	number of hooks	large hook	small hook	suckers diameters (μm)	
22–32	150–170	90–130	290–300	28–32	160–180	115–150	310–330	Hall 1919
24–32	120–170	76–130	n.d.	n.d.	145–180	103–160	n.d.	Clapham 1942
22–30	157–177	98–136	200–273	28	n.d.	n.d.	n.d.	Verster 1969
24–32 (20–32)*	132–185 (132–171)*	79–148 (81–126)*	228–342	–	–	–	–	Edwards and Herbert 1981
24–28	164–188	117–146	260–370	–	–	–	–	Present study

**Coenurus*
n.d. = not done

of the quantitative characters presented here for the scolices examined are in close agreement with the ranges given by former researchers (Hall 1919; Clapham 1942; Verster 1969; Edwards and Herbert 1981; see Table 2). There was overlap between species for hooks between these values. Published values for *T. multiceps* hook lengths cover most of the range of *T. gaigeri* lengths (Hall 1919; Clapham 1942; Verster 1969; Edwards and Herbert 1981); therefore, hook lengths cannot be used to differentiate between these two species.

According to the published studies (Hall 1919; Verster 1969; Edwards and Herbert 1981), sucker diameter was 200 to 342 μm and 310 to 330 μm in *T. multiceps* and *T. gaigeri*, respectively. In this case, it ranged from 260 to 370 μm. The range of values given here for sucker diameter of fresh scolices is therefore extended compared to those previously reported (Hall 1919; Clapham 1942; Verster 1969; Edwards and Herbert 1981). The characteristics of soft tissue structures such as scolex, rostellum and sucker diameter, and proglottid shape have been reported to be invalid for fixed specimens because of fixation distortion (Verster 1969; Edwards and Herbert 1981) and this was borne out in our study.

The numbers of rostellar hooks were recorded to be 22 to 32 and 28 to 32 in *T. multiceps* and *T. gaigeri*, respectively (Hall 1919; Clapham 1942; Verster 1969; Edwards and Herbert 1981). In our case, the number of hooks was 24 to 28. It was noted that the number of hooks in these two species (*T. multiceps* and *T. gaigeri*) was very similar to those reported previously (Hall 1919; Clapham 1942; Verster 1969; Edwards and Herbert 1981; Yoshino and Momotani 1988; Sharma et al. 1995). These species could not be differentiated from one another by the number and shape of the rostellar hooks. According to the shape and number of hooks in the cyst, our results were similar to those of other studies (Hall 1919; Clapham 1942; Verster 1969; Edwards and Herbert 1981).

Yamashita et al. (1957) and Soulsby (1982) reported that the numerous scolices form radiating rows and daughter cysts in *C. serialis* cysts but, not *C. cerebralis*. However, an arrangement of scolices in clusters in the cysts has never been described for *C. gaigeri*. In this study we have described that the numerous invaginated scolices were dispersed (ordinary arrangement) to the inner surface of the *C. cerebralis* cyst. Internal or external daughter cysts were not contained. This is similar to what has been reported previously (Soulsby 1982; Yoshino and Momotani 1988; Nourani and Kheirabadi 2009).

It was found that there were no significant differences in morphological features between *T. multiceps* and *T. gaigeri*. *Taenia gaigeri* may therefore be synonymous with*T. multiceps*. However, the difference in habitat of the larval stage appears to be related to the species of the host and not the parasite. This is probably due to host differences. Considering the usual intermediate host, however, the parasite in the present goat was diagnosed as *C. cerebralis* on the basis of the arrangement of scolices, and the number and size of hooks in the cysts. *Taenia multiceps* and *T. gaigeri* have been differentiated on the morphological basis but no molecular methods for the differentiation of *T. multiceps*

and *T. gaigeri* have yet been developed. There is therefore a wide gap in immunological studies and much remains to be done in diagnostic research to overcome the problem of Coenurosis.

Conflict of interest: The authors declare that they have no protected, financial, occupational or other personal interests in a product, service and/or a company which could influence the contents or opinions presented in the above manuscript.

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