

# Updates on morphobiology, epidemiology and molecular characterization of coenurosis in sheep

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**Abstract.** *Taenia multiceps* (Leske, 1780) is a taeniid cestode that in its adult stage lives in the small intestine of dogs and other canids. The metacestode, previously known as *Coenurus cerebralis*, is usually found in the nervous system including brain and spinal cord in sheep and other ruminants. The presence of cysts typically leads to neurological symptoms that in the majority of cases result in the death of the animal from starvation after some weeks. Coenurosis could cause high losses in sheep farms because the disease affects young animals that the farmers grow up each year as replacements of the older individuals. Coenurosis is also a zoonosis with more than 100 human cases described in literature, of which the last in Italy and almost 5 reported in Sardinia. In the last years, the popularity of coenurosis has increased in sheep breedings because of the necessity to operate a differential diagnosis from another neurological disease, scrapie, particularly in atypical cases of coenurosis that could occur also in adult (2-3 years of age) sheep.

**Key words:** coenurosis, epidemiology, strain typing, sheep.

## Morpho-biology of the parasite

In the small intestine of the final host, *Taenia multiceps* reaches maturity after 40-42 days. After this prepatent period, the dog starts to disseminate daily 3-4 proglottids, which could contain almost 37,000 eggs each (Willis and Herbert, 1984). In despite of what reported for this and other Cestoda, *T. multiceps* eggs are usually released from the proglottids before these are voided in the faeces (Herbert and Edwards, 1984; Varcasia and Scala, unpublished data, 2006).

Eggs could contaminate the environment and waters and resist for 15 days under dry conditions, or 30 days with high levels of humidity. At high temperatures, they died in a few hours (Euzeby, 1966). When ingested by ruminants, in the small intestine the oncospheres spread from eggs and through the blood circulation they reach various locations, but only in the CNS they could develop into mature *Coenurus* cysts (Euzeby, 1966).

## Geographical distribution

In Europe this parasitosis was reported in Wales, where it seems the most widespread neuropathology in sheep (Herbert and Edwards, 1984), in Ireland (Doherty and McAllister, 1989) and in France (Euzeby, 1966). This metacestodosis was also present in other countries, like Ethiopia, with a prevalence ranging from 2.3% to 4.5% (Achenef *et al.*, 1999), in Jordan (Abo-Shehada *et al.*, 2002), Turkey (Ozmen *et al.*, 2005), Russia (Aminzhanov *et al.*, 1988) and India (Tirgari *et al.*, 1987). In Italy it was reported in Sardinia (Deiana, 1971; Scala *et al.*, 1992, Cancedda *et al.*, 2002), in Apulia (Lia and Puccini, 1996 e Troiano *et al.*, 1990), in Sicily (Di Marco *et al.*, 1998; Guarda and Capucchio, 2002) and Latium (Tarantino *et al.*, 2002). The highly variable prevalences shown by these papers

could be related to climatic, bio-ecological and socio-logical differences (Sharma and Chauhan, 2005).

## Epidemiological notes

The life-cycle of the parasite is usually rural, in which the dog-sheep way seems the most important transmission dynamic. Foxes and wild ungulates could also be involved, as reported in Sardinia by Coda *et al.* (1988). In fact, the thinning of the skull bone caused by the growing of the cyst could facilitate the infection even in small canids.

However, the farmer could often facilitate the contamination of the environment by opening the skull of infected sheep for curiosity or to confirm his own "diagnosis", leaving the *Coenurus* cyst free to be eaten by dogs or, feeding them directly with it.

Coenurosis affects sheep during their first year of age, mainly when small lambs of 3-4 months are left in the grass at the beginning of the spring season, when their immune system and rumen activity are not yet well developed (Herbert and Edwards, 1984).

The disease could be revealed as an acute or chronic gid. The first form is produced by the penetration and migration of the oncospheres in the tissues and particularly in the CNS. This generally happens 14-33 days after infection (Willis and Herbert, 1984), and as reported by Murzanandiev (1953), symptoms are caused mostly by an acute inflammatory response due to a toxic and allergic reaction than by a mechanical action of the larval cestode. The clinical signs and the gravity of the acute gid are strictly connected with the number of viable eggs ingested by the lamb, by the immune state of the host (animals grown up without colostrum are most susceptible), by the localization of the parasites in the CNS and by the entity of the inflammatory response. Willis and Herbert (1984) reported that only 13% of lambs experimentally infect-

ed with *T. multiceps* viable eggs showed the acute gid. After the acute gid (from 33 days p.i.), a quiescent phase is reported in which the parasite grows up into a cyst; sometimes the young metacestode could be destroyed by the immune response with the complete recovery of the animal. In these subjects, during necropsy, only little caseous lesions could be underlined (Edwards and Herbert, 1982). The chronic gid appears in sheep of 9-18 months of age, and it is due to the development of the coenurus metacestode that causes clinical signs. The infected sheep usually stay isolate from the flock and show a diminution of its reactivity to external stimulation. When the cyst increases its volume, clinical signs become more evident with depression, blindness, circular movements, head deviation and ataxia (Bussell and Kinder, 1997). In the greatest part of the cases the infected animal dies after some weeks for starvation (Herbert and Edwards, 1984).

In Sardinia this metacestodosis affected 85% of 1-year-old sheep, with a seasonal trend which shows highest rates of infection during the spring and the fall season (Cancedda *et al.*, 2002).

In spring acute forms are more common in lambs, while in fall, chronic gid is reported in sheep of one year of age (Scala *et al.*, 1992).

Literature reports that *Coenurus cerebralis* specimens for infected sheep are usually one or two, but in Sardinia it is not unusual to find up to 10 cysts for sheep (Scala and Varcasia, unpublished data, 2006). The number of *coenuri* is usually negative correlated with age, while the sizes of the cysts are positive correlated with this parameter (Cancedda *et al.*, 2002).

In the countries where the disease is widespread, like Sardinia, the parasitology is probably underestimated, because the farmers know the disease and never inform the veterinarian. Another problem is represented by the high rate of illegal butcheries in the farms (almost 100%) that increase the risk of sheep-dogs infection (Varcasia and Scala, unpublished data, 2006). The above said difference in the number of cysts per sheep in Sardinia and also other variations reported for clinical and pathology aspects in coenurosis lead us to hypothesize the presence of genetic intraspecific variability within this species, such as in other members of the genus *Taenia* and *Echinococcus*. For these reasons DNA sequence variability was investigated within the CO1 (Cytochrome c subunit 1) and the ND1 (NADH dehydrogenase I) mitochondrial genes that have been used successfully for distinction of other cestodes (Gasser *et al.*, 1999). Several samples were obtained from various locations of Sardinia and examined through the sequencing of the above said mitochondrial genes. Pairwise comparison between the ND1 sequences of the *T. multiceps* isolates showed differences ranging from 1.27 to 2.54% using an isolate obtained from Wales as an outgroup, while COI sequences showed within the samples coming from Sardinia a lesser degree of variability, ranging from 0.22% to 0.67%. Considering the two genes, it was possible to define at least three specific genetic variants

in Sardinian samples, which we have termed Tm1, Tm2 and Tm3. Further investigations will be required to understand to what extent the genetic variability described here would be reflected also in phenotypic differences (Varcasia *et al.*, 2006).

## Conclusions

Coenurosis constitutes, as other well known metacestodosis, an important parasitic disease that could cause important losses in ovine breedings and a not negligible zoonotic risk to human health (Sabbatani *et al.*, 2004; Pau and Turtas, 1987).

This aspect should be stressed considering that outbreaks of this disease mean the effective failure of all prevention measures against other cestodes, like *Echinococcus*. In this context, it should be appropriate to deepen the research of chemical-prophylactic protocols (vaccines, drugs) and also alternative measures such as the prevention of illegal butcheries and the valorisation of sheep meat that could provide a more effective control of this metacestodosis.

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