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COENUROSIS OF SHEEP IN SERBIA - CASE REPORT

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Abstract: Coenurosisa is a zoonotic disease caused by the larval forms of *Taenia multiceps* which are great host's animals from the family of canids. The disease is global distribution but is most present in the Mediterranean, Middle East, Central Africa and Australia. Larvae exhibit tropism toward brain tissue, and cysts are usually located in the left hemisphere of the brain of small ruminants. Involvement of the brain can cause increased intracranial pressure, seizures, loss of consciousness, and focal neurologic deficits. During 2022 we examinee one flocks of 78 milking sheep reared on hilly pastures located below the Zmajevac hill (397 m), between the branches of the Osimćki mountains and the river Zapadna Morava, at an altitude of 178 m. Symptoms of ataxia, such as unsteady gait and stumbling, and depression were observed in 12 animals. In 5 sheep, continuous aimless or circular movement, wandering, was also manifested. In addition to these symptoms, in one sheep that died, visual disturbances were observed depression and unilateral blindness. All affected sheep were slaughtered and a pathoanatomical examination was performed. In the brain of all animals we revealed the presence of infestation with one to four coenuri 4.1-5.5 cm in size. The sites of predilection were the left hemisphere (48%), followed by the right hemisphere (40%) and the cerebellum (12%). The coenurus has a thin wall surrounding a single cavity that contains a clear fluid. When the cysts were opened, numerous scoleces were found inside, from 2 to 3 mm in diameter attached to the cyst wall. Each scolex has four circular suckers and two rows of hooks on a rostellum. The hook lengths are 147 to 165 μm and 87 to 125 μm.The results show that *C. cerebralis* was a major cause of the nervous manifestations of cenurosis in clinically affected sheep.

Key words: *Coenuris cerebralis, Taenia multiceps,* sheep

Introducton

The grazing way of feeding enables sheep to have constant contact with transitional hosts, eggs and larval forms of parasites, so that there is no sheep that is not infected with at least one parasite species *(Ash and Truong, 2003; Pavlović et al., 2012; Pavlović et al., 2013; Pavlovic, 2009).*

Permanent pastures pose the greatest health risk for sheep, especially if they have been used unplanned for many years. According to M.Hall's famous quote, "permanent pastures perpetuate parasites", which has been proven many times *(Vlassoff et al., 2001; Pavlović et al., 2012)*. Uncultivated pastures with poor floristic composition cause nutritional imbalances, but cultivated pastures that are improperly used are also a place of constant infections, especially by parasitic agents *(Pavlović et al., 1991; 1995; 2018; Ash and Truong, 2003).* The cumulative effect of accumulated agents is reflected through reinfections and superinfections and conditions their permanent circulation *(Truong and Baker 1998; Truong et al., 2000)*. The presence of parasites leads to numerous health problems and significant economic losses due to the reduction of production results *(Pavlović et al., 2003a,b).*

In addition to the parasites that are hosted by domestic and wild ruminants, a large number of parasite eggs are found on pastures, for which these animals are transitional hosts. Namely, animals from the genus canida (dogs, foxes, wolves and jackals) and felids (cats, wild cats) are the true hosts of a large number of cestodes for which small ruminants are transitional hosts *(Pavlović, 1994; 2023; Pavlovic, 2023; Pavlovic et al., 2008; Ivanović and Pavlović, 2017, Petrovic et al., 2021; Pavlovic and Ivanovic, 2022).*

Through the eggs thrown out in the feces, the transitional hosts become infected and develop larval forms of the parasite that are incised on their organs *(Jovanović et al., 2012).* After slaughter or death, these organs, if not removed, become a source of infection of the real hosts. Echinococcosis/hydatidosis, cenurosis, cysticercosis, sarcocystosis, etc. are the most important diseases caused by this method *(Pavlović and Ivanović, 2005; 2006; 2022; Jovanović et al., 2012; Ivanović and Pavlović, 2015; Petrović et al., 2021).*

One of these diseases is coenurosis - a disease caused by larval forms of the tapeworm *Tenia* (syn. *Multiceps*) *multiceps* (Soulsby, 1977). This tapeworm lives in the small intestine of dogs and other canids *(Pavlović, 1994; Pavlović et al., 2008)*. The transitional hosts of this tapeworm are ruminants, equids, and humans can also be infected. *Coenurus cerebralis*, the larval stage or metacestode of *T. multiceps*, develops in the central nervous system of sheep, goats, cattle, buffaloes, yaks, horses and pigs, as well as other domestic and wild ruminants *(Nourani and Kheirabadi, 2009*). These are transparent bubbles 3-5 cm in size.

Usually 2-3 blisters are found in which there is a different number of scolex and there can be 10-500 of them *(Pavlović and Anđelić-Buzadžić, 2011).*

Materials and Methods

During 2022 we examination flock consisting of 78 milking sheep reared on hilly pastures located below the Zmajevac hill (397 m), between the branches of the Osimćki mountains and the river Zapadna Morava, at an altitude of 178 m. Symptoms of ataxia, such as unsteady gait and stumbling, and depression were observed in 12 animals. In 5 sheep, continuous aimless or circular movement, wandering, was also manifested. In addition to these symptoms, in one sheep that died, visual disturbances were observed depression and unilateral blindness. All affected sheep were slaughtered and performed a pathoanatomical examination.

Results And Discusion

At autopsy in the brain of all animals we revealed the presence of infestation with one to four cysts 4.1-5.5 cm in size. (Picture 1). The sites of predilection were the left hemisphere (48%), followed by the right hemisphere (40%) and the cerebellum (12%). The cystss has a thin wall surrounding a single cavity that contains a clear fluid. When we opened the cysts they were found in them numerous scoleces from 2 to 3 mm in diameter attach to the cyst wall. Each scolex has four circular suckers and two rows of hooks on a rostellum. The hook lengths are 147 to 165 μm and 87 to 125 μm.

Picture 1 and 2. Brain with *Coenuris cerebralis* cysts

Based on the morphological characteristics of the scolex, we found that it is the *Coenurus cerebralis*, larval form of *Taenia multiceps.* Because of the characteristic clinical symptoms in transitional hosts (uncoordinated movement), this disease is colloquially known as gid, sturdy, or staggers *(Bhalla and Negi,*

1962; Akkaya and Vurusaner, 1998; Achenef et al., 1999). The disease is of global distribution and occurs most often in Mediterranean countries, North Africa, Central Asia and Australia *(Bhalla and Negi, 1962; Edwards and Herbert, 1982; Akkaya and Vurusaner, 1998; Achenef et al., 1999; Desouky et al., 2011; Giadinis et al., 2012).*

What is the epizootiological state of coenuruses in Serbia is not known, considering that the last researches were done more than 50 years ago and only sporadically. Given that the disease is evidently present in herds of small ruminants in Serbia, and that adults of this tapeworm have been found in dogs, foxes and wild canids in Serbia, it is necessary to carry out extensive research on the prevalence of this parasitic disease in transitional hosts - mainly small ruminants *(Pavlović et al., 2017).*

Taenia (syn. *Multiceps*) *multiceps* is a tapeworm that lives in the small intestine of dogs and other carnivores. It is widespread throughout the world and in a large number of wild canids and dogs *(Edwards and Herbert, 1982; Soulsby, 1977; Pavlović and Anđelić-Buzadžić, 2011).* The parasite is typically prevalent in rural areas, where the dog-sheep route appears to be the most important transmission pathway. The disease may also potentially be spread by wild animals, such as foxes and wild ungulates. Farmers can also contribute significantly to environmental contamination with this parasite by opening the skulls of diseased sheep out of curiosity or to establish their own personal diagnosis, enabling stray dogs to freely access *Coenurus* cysts or directly contaminating dogs by feeding them with infected tissue. In Serbia, it was found in foxes, wolves, jackals and dogs *(Pavlović, 1994; Pavlović et al., 2008; Cirović et al., 2015 a,b).* It is 0.4-1 m long. The scolex is pear-shaped with 4 round leeches and a rostrum armed with two crowns of hooks. The front legs are wider than longer, in the middle they are of the same length and width and have a serrated appearance, and the rear legs are longer than wider *(Soulsby, 1977).* In mature articles there are eggs that are excreted into the environment. Coenurosis affects sheep during their first year, and mainly lambs aged 3–4 months. There are rare reports of clinical signs in sheep older than 3 years, in animals with a general immunodeficient condition where they fail to produce antibodies, or in intensively bred sheep that have never been exposed to the parasite before.

In the small intestine of an intermediate host, the oncosphere hatches from an egg and travels through the intestinal wall, primarily reaching the CNS via the bloodstream, where it encysts and matures over several months into an infective coenurus *(Gauci et al., 2008).*

There are several strains of this tapeworm that are morphologically similar but differ genetically, which leads to a partial change in larval tropism *(Scala and Varcasia, 2006; Oge et al., 2012; Varcasia et al., 2014).* The metacestode may also

develop and mature in subcutaneous, intramuscular tissues and peritoneal areas as well as in organs such as the heart and lungs of sheep and goats *(Schuster et al., 2010; Oryan et al., 2014; Christodoulopoulos et al., 2016; Noamn, 2019)*. Through genetic analysis, it was determined that these are genetic variations, which was also confirmed by mitochondrial DNA research, proving that strains Tm1-Tm3 differ in their tropism and that they definitely belong to a different genotype of M.multiceps *(Varcasia et al., 2014).* However, the largest number of these tapeworms belongs to common strains that show neurotropism and incyst in the brain or spinal cord *(Welchman and Bekr-Ochir, 2006; Oryan et al., 2014).* After migrating through the blood and arriving at the predilection site, the larvae are fixed. The larval development of the parasite takes place on the meninges, and less often on the spinal cord of sheep, goats, cattle, less often horses, pigs and humans.

The oncosphere develops in the following stages: on day 8–10 post-infection (PI), it reaches the CNS and then migrates actively in the CNS from day 10 to 33 to reach its final destination; on day 40, it turns into a pyriform vesicle with just visible scoleces; after 2 months, it is the size of a cherry. Three months after infection, the cyst matures with well-formed protoscoleces, and finally, after 7–8 months, it reaches its final size of 5–6 cm in diameter. The life cycle is complete when the definitive host ingests the coenurus containing the mature protoscoleces.

True hosts become infected when they eat the brains with cysts of diseased transient hosts. In the right host, this taeniasis manifests itself in the form of digestive disorders with alternating diarrhea and constipation, weakness and weight loss *(Giadinis et al., 2005; Polizopoulou et al., 2016).*

Pathological changes begin during larval migration. A hexacanth embryo on its migration path through nervous tissue leaves meandering fields of bleeding and necrosis until it stops. Having reached the meninges, they stay there and form cysts known as *Coenuris cerebralis (Nourani and Kheirabadi, 2009; Oge et al., 2012; Pavlović et al., 2017)*. After 2-5 weeks of penetration into the nervous system, the cyst reaches a size of about 3 mm and after six weeks about 1 cm. Two months after reaching the central nervous system, it is about 2 cm in size and the beginning of protoscolex formation can be observed in it. A mature cenurus blister completes development and becomes infectious 6-8 months after infection. It is a transparent bubble of size 3-5 cm and usually 2-3 bubbles are found, rarely more *(Kheirandish et al., 2012; Varcasia et al., 2022).* They contain a clear liquid and each one has a different number of scolex (depending on the size of the bladder, there can be 10-500 of them).

Due to the characteristic clinical symptoms in transitional hosts (uncoordinated movement), this disease is also called fidget spinner. Ataxia manifests itself as unsteady gait and stumbling. Characteristic is the endless

movement in a circle, to the side opposite to the localization of the cenrus bubble. Continuous aimless or circular movement, wandering is also manifested. Vision disorders are manifested in the form of hypermetropia, drops in the field of vision, or blindness. As the bubble grows, compressive atrophy of the brain tissue occurs, and if it is present on the surface of the brain, the pressure can be so strong that atrophy and bulging of the corresponding part of the head bone occurs *(Nourani and Kheirabadi, 2009).*

Pathological changes and symptoms depend on the size and location of the cyst *(Welchman and Bekr-Ochir, 2006)*. The acute form of the disease usually occurs 17-23 days after infection and is a consequence of the migration of oncospheres through the brain tissue. Symptoms of meningoencephalitis appear, rapid and strong pulse and excitement, which is replaced by depression and tremors, paresis and paralysis *(Giadinis et al., 2006; Polizopoulou et al., 2016).* Deaths are possible.

In the chronic form, which occurs 3-5 months after infection, disorders of locomotion and vision are manifested, animals move in circles, loss of vision is possible. If the cenurus is located in the spinal cord, paralysis and paresis occur. Animals lose weight and die from cachexia *(Nourani and Kheirabadi, 2009).*

Human infection occurs by accidental consumption of parasite eggs. In them, larval development takes place as in other hosts with similar clinical symptoms *(Ing et al., 1996; Benifla et al., 2007).*

Conclusion

Cenurosis is a zoonotic disease caused by the larval forms of the tapeworm Taenia (syn. Multiceps) multiceps, whose real hosts are animals from the canid family. The disease is of global distribution, but it is most present in the Mediterranean area, the Middle East, central Africa and Australia. Larvae show a tropism towards brain tissue and cysts are most often located in the left hemisphere of the brain of small ruminants. Diagnosis is based on clinical symptoms *(Scott, 2012).* Suspicion is confirmed by the finding of papillae nervi optici edema (increased intracranial pressure) with spot bleeding. Papilledema occurs 1-2 months before clinical symptoms appear. Therapy in the acute phase of the disease can be performed with praziquantel and benzimidazoles (50-100 mg/kg) *(Ghazaei, 2005).* An operative procedure is also possible, which is routinely performed in some countries (e.g. Greece) *(Komnenou et al., 2000; 2005).*

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