Cystocaulus ocreatus Infection in Anatolian Wild Sheep and Dwarf Goats

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Abstract: An Anatolian wild sheep (Ovis orientalis anatolica) from a wild ruminant farm near Kırıkkale, Turkey, was necropsied. Parasitic nodules were situated beneath the pleura of the caudodorsal lobes of the lungs. First stage larvae of Cystocaulus ocreatus were detected both in bronchial fluid and in lung paraffin sections. Clinical and parasitological examinations of the other animals (4 dwarf goats and 3 wild sheep reared on the same farm) were also performed. First stage larvae of C. ocreatus, and eggs of Nematodirus spp. and Strongyloides spp. were observed in coproscopic examination. Anthelmintic treatment, Rabenzole® (rafoxanide thiabendazole, Topkim), was administered to the animals infected by parasites. At the end of the treatment the combination of rafoxanide and thiabendazole was found to be markedly effective for the treatment of lungworm infection and no parasitic eggs were detected in the faeces of any of the treated animals.

Key Words: Anatolian wild sheep, dwarf goat, Cystocaulus ocreatus, lungworm, Ovis orientalis anatolica

Introduction

Anatolian wild sheep (Ovis orientalis anatolica) phylogenetically belong to a subspecies of Asian mufflon. Although this species is endemic throughout Turkey, their presence, with dense populations, has been established, especially around Bozdağ province in Central Anatolia. It is thought that Anatolian wild sheep originated from domestic sheep (1).

Cystocaulus ocreatus (protostrongylidae) is a small lungworm that occurs in the lung parenchyma and in subpleural nodules of small ruminants. The land snail acts as the intermediate host in the life cycle of the parasite, and swallowing the intermediate host with its food infects sheep. The infective larvae usually reach the lung by the hepatic portal system or lymphatic drainage. The parasite molts twice in interstitial tissue of the lung and migrates...
to the alveolar ducts (2,3). *C. ocreatus* forms both worm knots and brood-type nodules in the lung parenchyma. Worm knots in subpleural nodules of the lung, including *C. ocreatus*, generally are brown to black and the size of a pin head. Brood-type nodules contain mature *C. ocreatus* in large numbers and first stage larvae. These nodules are grey and walnut sized, and can be seen in the parenchyma as well as in interstitial lung tissue (3). The severity of infection can be assessed quite accurately by superficial inspection (4).

There are only a few reported cases of parasitic infection of wild ruminant species (5-8). Similarly, the number of reported cases related to protostrongylid species in wild animals is limited (7,8). In the present study, clinical, parasitological, and pathological findings of *C. ocreatus* infection in an Anatolian wild sheep, as well as anthelmintic therapy administered to the other infected animals on the same farm are described.

**Materials and Methods**

A 2-year-old female Anatolian wild sheep (*Ovis orientalis anatolica*) that was in agony before dying was brought to the Pathology Department for necropsy. This sheep came from a wild ruminant farm near Kırıkkale, Turkey. The number and localisation of the grossly visible lesions and nodules detected in the lungs were recorded. The grossly visible lesions in the lungs were dissected with a lancet. The parasitological examination of the small amount of bronchial fluid obtained by squeezing the lungs was performed under a light microscope. Then, the trachea and bronchial branches were opened with scissors.

The tissues of the sheep were immediately fixated in 10% buffered formalin overnight at 4 °C. Subsequently, the tissues were dehydrated in ethanol and xylene, and embedded in paraffin wax. We stained 5-µm thick sections with haematoxylin and eosin. Separate samples of lung, liver, spleen, and kidney were collected for microbiological analysis.

Clinical and parasitological examinations were also conducted on the other animals (4 dwarf goats and 3 wild sheep reared on the same farm). Faeces samples were collected for parasitological examination and processed with Baermann, sedimentation, and flotation methods. Rabenzole® (150 mg rafinoxide and 2000 mg thiabendazole) was given to each animal, only once, at the dose of one pill per 20 kg bodyweight for anthelmintic therapy. For secondary bacterial infections, Synulox® suspension (140 mg amoxicillin trihydrate and 35 mg potassium clavulanate) and Nervit® solution (100 mg vitamin B1 and 10 mg vitamin B6) were administered intramuscularly over 1 week at the dose of 1 ml per 20 kg bodyweight and 2 ml per animal, respectively. At the end of the treatment period (15th day), a faecal examination was performed and we compared the differences in larval counts obtained with the Baermann method. Statistical analysis was not performed because the number of animals was limited.

**Results**

The pathological changes in the lungs of the Anatolian wild sheep were prominent in necropsy. The most prominent lesions in the lungs were parasitic nodules, which were situated beneath the pleura of the dorsocaudal lobes. In all, 7 grey 1-2 cm nodules were observed in the lungs. Some of them projected over the pleural surface. First stage larvae of *C. ocreatus* were observed in both bronchial fluid and in histological sections of the infected lung tissues (Figures 1 and 2). These parasitic lesions were considered brood-type nodules. Lymphocytic infiltration was seen around the blood vessels, bronchioles, and alveolar septa. A mild fibrous thickening of the alveolar septa was prominent in some areas of the lungs. The epithelium of the bronchioles was hyperplastic and the muscularis mucosa of the bronchioles was thick.

In addition to above findings, the heart was hypertrophic and many white ulcers 2-3 mm long were observed in the mucosal surface of the small intestine. In the microbiological examination, *Fusobacterium necrophorum* was isolated from tissue samples of the Anatolian wild sheep.

On clinical examination, the wild dwarf goat from the same farm that presented with a history of anorexia, weakness, diarrhoea, and respiratory distress revealed sero-mucous discharge from the eyes and nose, listlessness related to anorexia, and mild dehydration due to diarrhoea. Crackles, severe coughing, polypnea, and inspiratory and expiratory distress were the other clinical findings.
Faeces samples were watery and dark. First stage larvae of *C. ocreatus*, and eggs of *Nematodirus* spp. and *Strongyloides* spp. were detected by coproscopic examination.

The affected ruminants responded to anthelmintic and antibiotic treatment. At the end of the treatment period, the frequency of clinical signs gradually decreased and then later disappeared completely. The lungworm larvae were no longer observed in the faeces of the treated animals.

**Discussion**

The infection of *C. ocreatus* in sheep is widely recognised in Turkey (9-11). It was reported that *C. ocreatus* was also found in domestic sheep in Kirikkale province and the lungworm was found in 34% of Akkaraman sheep with necropsy. Thus, *C. ocreatus* was found to be the dominant lungworm species in this region (11). The source of infection in these Anatolian wild
sheep was most likely infected Akkaraman sheep brought to that region for pasture.

The number of brood-type nodules indicated the severity of infection (4). In the present study, 7 C. ocreatus brood-type nodules were detected in the necropsied Anatolian wild sheep. Some researchers suggest that more than 4 brood nodules observed in the lungs indicates a severe infection (4); thus, the nodules seen in the necropsied case can be considered an indication of severe infection, which highlights the seriousness of the ongoing infection on the farm.

Protostrongylus species can result in bronchitis or pneumonia, or both, and predispose animals to pulmonary bacterial and viral infections. Diminished weight gain has been reported in severely infected lambs (2). Thus, C. ocreatus infection may not have been the only cause of death in the presented case, partly due to its more restricted localisation in the lungs. However, F. necrophorum was isolated in some organs in this wild sheep. It was certain that secondary bacterial infection by F. necrophorum increased the severity of the C. ocreatus infection in the presented case.

Parasitic eggs and first stage larvae were found in the alveolar spaces of the lungs with histopathological examination. These parasitic forms may provoke inflammatory response and this cellular reaction reflects the stage of the parasite and resistance of the host (2). In this study, lymphocytic infiltration around the blood vessels, bronchioles, and alveolar septa was prominent. A mild fibrous thickening of the alveolar septa was seen in affected areas of the lungs. The epithelium of some bronchioles was hyperplasic and the muscularis mucosa of these bronchioles was thick; thus, these parasites were first stage larvae.

In the present study, bronchopneumonia was detected in both wild sheep and wild goats with signs of coughing, polypnea, and respiratory distress. Parasitic pneumonia associated with protostrongylids strongly impairs gas exchange and alters the respiratory rate; thus, the clinical signs occur especially in the respiratory system, but are non-specific (12).

According to our review of the current literature, anthelmintic treatment for protostrongylid lungworms is not effective. There are several methods of anthelmintic use, such as double administration or administration of elevated doses for a significant reduction of lungworm larval output (13). There are only a few papers describing the efficacy of anthelmintics against small lungworms of sheep; however, ivermectin, doramectin, moxidectin, fenbendazole, and rafoxanide have frequently been used for antiparasitic therapy (3,5,6,14-17). In the present study, the combination of rafoxanide and thiabendazole was effective for the treatment of the lungworm parasite in these wild animals. Following the treatment the severity of clinical signs in the animals decreased and lungworm larvae were no longer observed in the faeces of the treated animals. In this study, the treatment was effective because C. ocreatus larvae were not found in examined faeces 15 days after the treatment, and, additionally, the prepatent period of this parasite is almost 4 weeks.

In conclusion, C. ocreatus can be considered an aetiological agent of serious lung infection in Anatolian wild sheep and dwarf goats, and secondary bacterial infection (F. necrophorum in one animal) can increase the severity of the infection. It is thought that this parasite might not be the only cause of death in the presented case. Lastly, the combination of rafoxanide and thiabendazole treatment was effective for lungworm infection in these wild animals.

References


