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Source: Journal of Wildlife Diseases, 27(1) : 102-104

Published By: Wildlife Disease Association

URL: https://doi.org/10.7589/0090-3558-27.1.102

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Journal of Wildlife Diseases, 27(1), 1991, pp. 102–104
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PREVALENCE OF *MUELLERIUS CAPILLARIS* IN FREE-RANGING SPOTTED DEER (*CERVUS AXIS*) IN INDIA AND ITS EXPERIMENTAL CROSS-TRANSMISSION TO GOATS

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ABSTRACT: A survey to assess the prevalence of parasitic infections among axis deer (*Cervus axis*) in three National Parks in India revealed infections with the lungworm *Muellerius capillaris*. Clinical signs were not evident in infected animals. Therefore, it is suggested that *C. axis* is probably a carrier of the infection. Under laboratory conditions, terrestrial molluscs (*Macrochalamys* sp.) were infected with first stage larvae of *M. capillaris* collected from fecal pellets of *C. axis*. Feeding of third stage larvae collected from these snails on day 14 post exposure produced patent infections in goats. On day 31 post infection, adult *M. capillaris* could be collected from the lungs of infected goats. This study establishes the possibility of cross-transmission of *M. capillaris* between wild and domestic animals in India.

Key words: *Cervus axis*, *Muellerius capillaris*, lung nematode infection, cross-transmission, terrestrial molluscs, sylvatic reservoir hosts.

INTRODUCTION

The axis or spotted deer (*Cervus axis*) is the most widely distributed and abundant cervid species in the wildlife sanctuaries and National Parks in India (Arora, 1982). This animal coexists with other domesticated and wild herbivores, sharing common grazing habitat. Therefore, there is the potential for cross-transmission of many parasitic infections between them, but there have been no systematic studies to assess the prevalence of parasitic infection in free-ranging cervids in India (Arora, 1982). Therefore, we conducted a parasitological survey among cervid populations in three National Parks in India. Among the parasitic infections, a lung nematode infection due to *Muellerius capillaris* was found commonly in *C. axis*. The transmission of this infection requires an intermediate molluscan host and does not involve a prenatal or milk-borne route (Cabaret, 1988). Furthermore, to assess the epidemiological implications of this infection to domesticated animals, we attempted to cross-transmit the infection to goats under laboratory conditions.

MATERIALS AND METHODS

The study areas were within three national parks in India. These were Tadoba (19°48′N, 79°21′E), Corbett (29°23′N, 79°07′E) and Dudwa (29°49′N, 80°18′E).

Fresh fecal droppings from *C. axis* were collected from different localities (especially around grazing places and near water ponds) within three National Parks (Dudwa, Tadoba and Corbett) and were examined by modified Baermann's technique (Cabaret and Pandey, 1986) for the presence of lung nematode larvae. Since the spotted deer remained mostly in herds, only one representative pooled sample was collected from each area. Samples from visibly young animals were collected separately. Precautions were taken to avoid collecting duplicate samples from the same herd by closely monitoring the migratory behaviour of animals. Careful observation of individual animals, where possible, was made to identify any clinical signs such as fever, cough or diarrhea. Fecal droppings also were collected from 22 goats that are domesticated around the periphery of the Corbett (10 goats) and Dudwa (12 goats) National Parks frequented by *C. axis*. Since land snails are intermediate hosts for *M. capillaris*, we collected 143 molluscan hosts belonging to 5 different species (*Limax* sp., *Helicella* sp., *Agrolimax* sp., *Helicigona* sp. and *Macrochlamys* sp.) from different parts of the National Park and domesticated areas to assess the level of *M. capillaris* infection in them.

Adult land snails (*Macrochlamys* sp.) were used for laboratory cross-transmission studies. These snails were collected from areas around the Institute aquarium pond and maintained in the laboratory. Dissection of the snails at several time points showed that they did not carry any

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parasitic larvae. For experimental infections, snails were exposed to first stage larvae of *Muellerius* sp. collected from the fecal pellets of *C. axis* at a concentration of 100 larvae per snail. These snails were then dissected one and two weeks post exposure to recover the larval stages. Third stage larvae recoverd on day 14 post exposure were then counted and given orally to three adult goats (135 larvae/goat) maintained in closed animal quarters of the Division of Parasitology (Indian Veterinary Research Institute, Izatnagar, Bareilly, India 243122) to preclude any other parasitic infection. Following 31 days post infection (pi) the goats were autopsied to recover worms from lungs.

RESULTS

Adult spotted deer, wherever observations could be made, apparently looked healthy and active without any visible clinical signs of infection. Of 197 representative samples examined 61 (31%) had *Muellerius* sp. infection. Corbett and Dudwa National Parks had the highest prevalence (37 infected of 97 examined or 38% and 23 of 63 or 36%, respectively) while Tadoba had a low prevalence (1 of 37 or 3%) of the infection. However, all 12 samples collected from young *C. axis* and 22 samples collected from goats around the National Parks were negative for *M. capillaris* infection. Similarly, none of the land snails collected from the National Parks and domesticated areas were infected with *Muellerius* sp.

Under laboratory conditions, developing second and third stage larvae of *Muellerius* sp. could be collected from *Macrochlamys* sp. Seven days post exposure majority of the larvae were in second stage. However, snails dissected two weeks post exposure had only third stage larvae. Most of the snails had only one or two larvae, but rarely up to five third stage larvae were recovered.

Clinical symptoms were not evident in goats infected with 135 third stage larvae of *M. capillaris*. Fecal examination of these goats regularly up to day 30 post infection (pi) did not reveal any first stage larvae of *M. capillaris*. However, when autopsied on day 31 pi, 12 ± 3 worms of *M. capillaris* were collected from the lungs, some of them within nodules.

DISCUSSION

Our results show the prevalence of *M. capillaris* infection in free-ranging *C. axis* in three National Parks (Dudwa, Corbett and Tadoba) in India. Although there are two earlier reports of this infection in sheep and goats in India (Dhar et al., 1979; Singh et al., 1980), this is the first record of *M. capillaris* in *C. axis*.

The observation that *C. axis* appeared apparently healthy even when they were harboring the parasites suggested that infections routinely are subclinical in the wild and that *C. axis* may serve as carriers or reservoir host for this infection. *Muellerius capillaris* has been reported to be often associated with pathogenic bacteria and fungi causing lungworm pneumonia syndrome resulting in heavy mortality in sheep and goats (DeMartini and Davies, 1977; Ogassawara et al., 1982; Young and Griffith, 1985). However, significance of this parasitic infection in regulating the population of *C. axis* in the National Parks of India needs further investigation.

Muellerius capillaris infection is reported to be prevalent among sheep and goats in the northern parts of India (Dhar et al., 1979; Singh et al., 1980). However, occurrence of this infection in areas around Corbett and Dudwa National Parks (which also are in the northern parts of India) is unknown. Although in our survey domesticated goats were negative for *M. capillaris* infection in one fecal sample examination, there was the possibility of a lighter infection since we failed to detect the infection in goats at least up to day 30 pi under laboratory conditions. Furthermore, several factors such as seasonal changes in prevalence, anthelmintic treatment and/or host immunity can prolong the prepatent periods (>4 mo) of *M. capillaris* and the host may shed the first stage larvae intermittently (Cabaret, 1984), thus making a positive assessment difficult.

Due to high prevalence of this parasitic

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infection in Corbett and Dudwa National Parks, its spread to the adjacent grazing areas, shared by both domesticated and wild ruminants, is possible. Presently it is uncertain whether domesticated animals could acquire infections from *C. axis* or vice versa. However, our study indicates the potential risk of cross-transmission of *M. capillaris* infection between *C. axis* and domesticated goats.

The longevity of adult *M. capillaris* can be over 6 yr (Cabaret, 1984). Hence, the disease may be carried from one season to the next. Furthermore, earlier studies on the bionomics of the first stage larva of *M. capillaris* showed that they can withstand extremes of climates such as frost, snow, dry sunny periods or winds (Beresford-Jones, 1966). These factors coupled with the presence of potential molluscan hosts in areas frequented by both *C. axis* and goats increases the opportunity for spread of the parasite and makes control difficult.

ACKNOWLEDGMENTS

We wish to thank P. N. Bhat, Director, Indian Veterinary Research Institute and the Indian Council of Agricultural Research, New Delhi for providing all the facilities for conducting this work.

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Received for publication 18 April 1990.

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