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The report of *Mycobacterium avium subspecies paratuberculosis* in a wild goat (*Capra aegagrus*) in Iran

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Abstract

Wild and domestic ruminants become infected with *Mycobacterium avium subsp. paratuberculosis* (MAP) leads to chronic enteritis, known as Johne's disease (JD). An eight-year-old male wild goat (*Capra aegagrus*) that lived in the wildlife breeding center in Chaharmahal and Bakhtiari province with symptoms of prolonged diarrhea that did not respond to antibiotic treatment was referred to a veterinary center. After a while, the animal died. JD was diagnosed after laboratory diagnosis (by acid-fast staining). The present study reported the incidence of JD in a wild goat in Iran for the first time. The economic losses and animal health should be considered. Since 2020, the wild goat (*Capra aegagrus*) has been classified in the category Near Threatened (NT) near treated on the list (International Union for Conservation of Nature) IUCN. Therefore, protecting the health of these species is essential. The importance of carrier animals and reservoirs in wildlife should be given special attention.

Introduction

Mycobacterium avium subsp. paratuberculosis (MAP) is a rod-shaped, small, aerobic, acid-fast, and intracellular bacterium of the *Mycobacterium avium* complex (1) that is the causative agent of Johne's disease (JD), which is relatively resistant to harsh environments. MAP is a small bacilli bacterium that causes chronic disease of the intestine, cecum, and mesenteric lymph nodes (2). In a wide variety of free and captive artiodactyls,

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clinical paratuberculosis has been observed (3, 4). However, non-ruminant MAP infections have also been reported, such as odd-toothed hawkers, rodents, lagomorphs, macropods, carnivores, birds, and inhuman primates (5, 6).

Animals are significantly susceptible to infection at an early age (7). JD exists in animals in two forms. In the multibacillary or lepromatous form, the cytoplasm of macrophages is stuffed with bacilli; there is chronically diffused granulomatous enteritis (8). These forms can only be distinguished histopathologically. A mention is useful if pathogens' intermittent or permanent excretion is also discussed (9). Only adult animals older than two years are usually shown to have clinical signs. Descriptions of paratuberculosis in wild species are usually incomplete and include sporadic case reports. The infection is progressive, chronic, and resistant to treatment. The clinical disease does not develop in most infected animals, but the bacteria may be excreted. Clinically, sick animals lose weight and, in some species, develop diarrhea and may die. During this disease, MAP is excreted in feces and milk, and bacteria are transmitted through blood and lymph vessels from infected animals to other internal organs. The infection spreads to both the male and female genitals. Although MAP is not considered a pathogen in humans, discussions are ongoing on the possibility of this mycobacterium playing an important role in public health (2).

An extended granulomatous and enteritis resistant to treatment with or without diarrhea, that leads to gradual weight loss despite ineffective food absorption, is known as classical clinical paratuberculosis (10). Severe diarrhea and intermandibular edema are common in cattle's late stages. Clinical signs are limited to chronic weight loss, disordered appearance, worsening of the condition, and lethargy in sheep and goats. Softer feces or diarrhea are rare and may only appear in the final stages (11).

The clinical signs of the disease are primarily undetectable, but when the clinical signs become apparent, the animal quickly becomes sicker and may die from the disease (4). The disease course provides useful diagnostic clues, failure to respond to treatment, and positive acid-fast lesions at necropsy are seen as clinical signs in individual animals (4).

In the case of periodic vaccination, the risks of transmission, the clinical incidence of the disease, and the rate of bacterial excretion are reduced. Vaccinated animals and tuberculosis surveillance programs interfere with serologic testing for MAP due to nonspecific responses to tuberculin skin tests, and implementation is limited (12). Its proper control can be easily achieved by vaccination (13). Also, for infection control, accurate diagnosis of infected subclinical animals is necessary. The purpose of the study was to report the occurrences of JD in a wild goat in Iran.

Materials and methods

Case history

Wild goat (*Capra aegagrus*) is a species of wild goat that lives in the bush, forests, and rocky areas from Turkey to Pakistan. In October 2021, A wild goat (male, eight years old, weighing approximately 70 kg) lived in the wildlife breeding center in Chaharmahal and Bakhtiari province (south-west of Iran) (Figure 1) with symptoms of prolonged diarrhea that did not respond to antibiotic treatment. A poor body condition was found in the clinical examination. The wild goat was sent to a veterinary center. The goat died shortly after being transported to the veterinary center.

Sample collection

Feces samples were taken fresh from the animal and were quickly sent to the microbiology laboratory with dry ice.

Microbiological investigation

Ziehl-Nelsen-stained feces and intestinal mucosa smears were studied microscopically. Clusters of organisms of small acid-fast bacilli were found (Figure 2a). A smear for coccidia was also done.

Fig. 1. The wild goat (*Capra aegagrus*) in the wildlife breeding center (Chaharmahal and Bakhtiari province, Iran).

Results

For some parts of the small intestine, particularly in the distal ileum, apparent gross pathology had been observed during postmortem examination.

The acid-fast rod-shaped bacteria were detected by acid-fast staining (Figure 2b). No coccidia was found in the direct fecal smear.

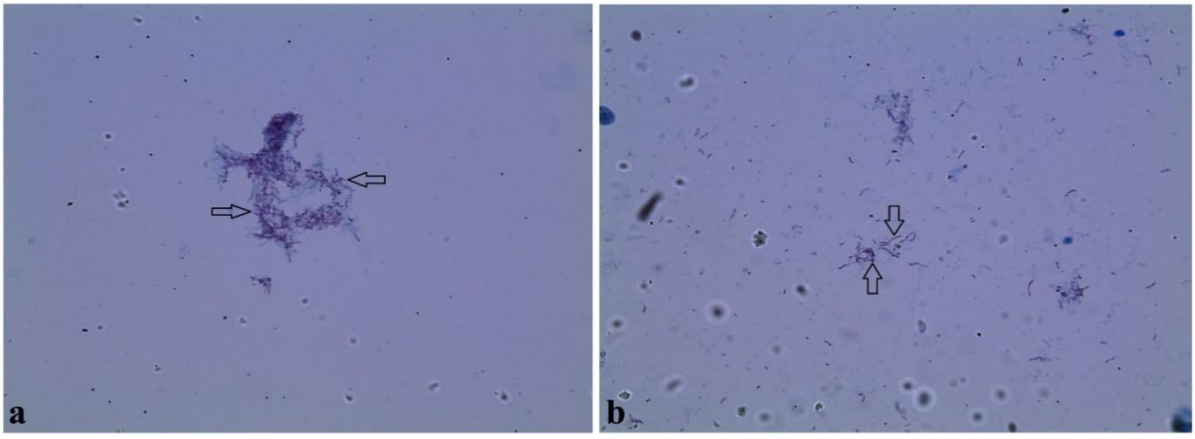

Fig. 2. a: Clusters of organisms of small acid-fast bacilli under the light microscope (×100 magnification). **b**: The acid-fast rod-shaped bacteria under the light microscope (×40 magnification).

Discussion

There is little information on the presence of MAP in different animal species in Iran. In this study, the presence of MAP was detected in a wild goat through necropsy and microscopic examinations.

The tentative diagnosis was JD made based on clinical signs, supported later by the postmortem examinations. Although MAP species is not recognized as a zoonotic disease (14), the possibility of transmission of a common disease

between humans and animals should not be ignored. Another significance of this report is that since 2020 the wild goat (*Capra aegagrus*) has been classified in the category NT near treated on the IUCN list. Therefore, protecting the health of these species is essential.

Because the information on JD in domestic animals is limited, therefore, it is not a priority disease to control in Iran, and the ongoing spread of JD among and within goat herds must be expected. Predictably, this will be the topic for future examinations. Few previous studies have reported the presence of MAP in wild ruminants. MAP occurrence in goats, sheep, cattle, buffaloes, and deer showed the ability to infect many animal species in the country. In Iran, Nassiri et al. identified 44% of fecal samples (from 243 specimens) and 18% of raw milk samples (from 56 specimens) of suspected cattle from some farms of Mashhad as infected with MAP (14). In another study, the MAP was detected in 15.1% of 212 fecal samples taken from four cattle farms in Kerman province, southeast of Iran (15).

Clinical cases with characteristic lesions on domestic dwarf goats of Western Africa have been mentioned in the disease reports from Germany's zoos (16). In a zoo in Missouri (USA), slow weight loss, thickening of animal hair, and diarrhea without odor were observed in Barbary sheep (*Ammotragus lervia*), and mouflon (*Ovis orientalis*) in adjacent areas with rapid disease progression and early death (17). After confirmation of fecal culture, necropsy, and histopathologic evaluation, a similar control regimen was administered in a top of Jimela (*Damaliscus lunatus jimela*), a subspecies of African antelope species in the USA, California (18). Dukes et al.'s report on zoos' problems with MAP described the spread of MAP in a herd of saiga antelopes (*Saiga tatarica*; Central Asian plains antelope) and their infection with mycobacterial infections in two zoos in Canada (Manitoba), has been explained (19). The risk of interspecific transmission between animals that share a home has also been reported from a zoo in Turkey. In this report, the goats infected subclinically were identified by complement fixation and ELISA (20). A positive saiga antelope was reported by Orinbayev et al. In the Volga-Ural region of Kazakhstan, blood samples were collected from 286 free animals; the results showed that paratuberculosis in this species is also present in the natural population (21). MAP DNA has been detected in environmental samples as well as feces of snow goats (*Oteroreamnos americanus*) and pygmy goats at another zoo in Germany (22). In the study by Pourmahdi Borujeni et al., the seroprevalence of MAP in goats, sheep, and cattle in southwest Iran was compared. They announced no significant relationship between animal species and MAP infection (23).

Establishing an undeniable link and the risk of transmitting MAP from animals to humans should be considered an essential preventive measure. Therefore, developing vaccines and diagnostic systems to control MAP infection in the country's livestock population is essential.

Conclusion

Due to the risk of transmission of MAP from animals to humans, important preventive measures should be considered. Identifying the transmission of this pathogen from animals to humans allows for better evaluation of safety measures. These measures help to improve the level of public health. Therefore, developing vaccines and diagnostics systems to control MAP infection in the country's animal population is essential.

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Conflict of Interests

The authors declare that there is no conflict of interest.

Ethical approval

Not applicable.

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