INTRODUCTION

Q fever is caused by an obligate intracellular small gram-negative bacterium, *Coxiella burnetii*. This zoonotic disease is endemic throughout the world, occurring in various geographic regions and climatic zones. Domesticated ruminants, including cattle, sheep, and goats, are considered to be the primary reservoirs of *C. burnetii* for human infection, but pets such as cats and dogs, as well as ticks and other arthropods, may also transmit infection. The organism is shed in high numbers in the amniotic fluids and the placenta during parturition. Because of the resistance of these bacteria to heat, drying, and many common disinfectants, they can survive for long periods in the environment. Transmission of infection to humans is mainly through the inhalation of contaminated aerosols, but may also occur after consumption of raw milk and dairy products. Person to person transmission is extremely rare. *C. burnetii* infection in humans usually is asymptomatic or manifests as a mild disease with spontaneous recovery. However, Q fever may lead to serious complications and even death in patients with acute disease, especially those with meningoencephalitis or myocarditis and more frequently in chronically infected patients with endocarditis. Infection in animals is mainly subclinical but has been associated with late abortions and stillbirth. Abortions during coxiellosis epizootics have been described in goats and sheep, but abortion in dairy cows is rare, although reproductive disorders and mastitis can occur. *C. burnetii* has been reported in many countries except New Zealand. Among serologic tests for detection of antibodies against *C. burnetii*, ELISA and immunofluorescence assay (IFA) are commercially available. ELISA is preferable to IFA for serologic study because it has higher sensitivity.

To the authors’ knowledge, there are very few serologic reports of Q fever in Iran and these are old reports. The aim of this study was to investigate the presence of *Coxiella burnetii* antibodies among goat and dairy cattle herds in southeast Iran. A total of 169 sera (76 caprine samples from 9 goat flocks and 93 bovine samples from 12 dairy herds) were collected randomly. The CHEKIT Q fever ELISA kit was used to identify specific antibodies against *C. burnetii* in goats and cattle. The results showed that 35.5% (N = 60) of all sera were positive. Goats had a significantly higher average seroprevalence (65.78%) than cattle (10.75%). All of the goat herds and only two dairy cattle herds were positive. This study represents an update on Q fever prevalence in Iran. Goats seem to be a more important risk for human infection in this area than cattle. *C. burnetii* would be a potent candidate for goat abortion in this region and other nearby provinces.

MATERIALS AND METHODS

**Samples.** A total of 169 serum samples (76 caprine serum samples from 9 goat flocks and 93 bovine serum samples from 12 dairy herds) were collected from February to October 2008. The herds were selected randomly, and 10% of the population of each herd was tested. Blood samples were transported on ice to the laboratory, and sera were separated immediately by centrifugation of blood at 1,500 × g for 15 min at room temperature and were kept at −20°C until the day of analysis.

**ELISA.** Serum samples were tested for Q fever antibodies using the indirect ELISA kit (CHEKIT®; Idexx Switzerland, Switzerland), which was carried out following the protocol recommended by the manufacturer using Phase I + II purified antigens of *C. burnetii*. Sera were prepared at 1:400 dilution, and specific antibodies were measured using a peroxidase-labeled anti-ruminant immunoglobulin G (IgG) conjugate. Results were expressed as a percentage of the optical density reading of the test sample (value), calculated as value = 100 × (S − N)/ (P − N), where S, N, and P are the OD of the test sample, negative control, and the positive control, respectively. Sera were considered to be ELISA positive if they had a value of 40% or more, suspect if the value was between 30% and 40%, and negative if the value was < 30%.

**RESULTS**

Of the animals tested, 60/169 (35.5%) had antibodies to *C. burnetii*: 50/76 (65.78%) goats and 10/93 (10.75%) cattle. All the goat herds had at least one positive member, and of the cattle herds tested, 2/12 (16.6%) were positive.

**DISCUSSION**

Very few old studies (> 50 years ago) have been conducted on Q fever in Iran. Q fever cases have been reported from some countries neighboring Iran, such as Turkey and Oman. Results of a serosurvey undertaken on 42 sheep flocks in Turkey showed that 20% of sheep were seropositive. Recently, an outbreak of Q fever occurred with high morbidity in U.S. marines located in Iraq. In this study, all goat flocks had at least one positive member, but only two (16.6%) dairy cattle herds were positive. In total, a higher percentage of antibodies were detected in goats (65.78%) than in cattle (10.75%). Differences have also been observed in the United States, where goats have been shown to have a significantly higher average seroprevalence of antibodies to *C. burnetii* (41.6%) than cattle (3.4%), and in Albania, a slightly higher percentage of antibodies were found in sheep and goats (9.8%) than in cattle (7.9%).
Pregnant ruminants are highly susceptible to infection, and abortions occurred only at the first parturition after infection. The following gestations terminated normally without any reproductive failures. The tendency of goats for transmitting \textit{C. burnetii} infection to humans was made known by several documented outbreaks in different parts of the world. In addition, because of more human cases of Q fever related to goat transmission, more attention should be paid on the role of goats in \textit{C. burnetii} circulation.\footnote{A high seroprevalence or prevalence of strong serologic levels was observed in goat herds affected by Q fever abortions.\cite{16, 17, 18, 19} However, a relationship between abortion and response level of \textit{C. burnetii} antibodies could only be suggested.\cite{9} }

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The goat herds investigated in this study had a recent abortion history and many of them had strongly positive ELISA results to \textit{C. burnetii}. Perhaps high seropositivity obtained in these goat flocks correlated to \textit{C. burnetii} infection. The numbers and distribution of seropositive individuals, especially in goat flocks, suggest that Q fever is an endemic phenomenon in this area and that the role in abortion is largely underestimated. This study of \textit{C. burnetii} seroprevalence in domestic ruminants in southeast Iran indicated that seropositive animals can be found throughout the country. Further works are now required to characterize the epidemiology of the infection more thoroughly.

Based on local Veterinary Organization reports, reproductive indexes are very low in goat flocks in southeast Iran. Because, significant abortions caused by \textit{C. burnetii} have been reported in wide ranges and \textit{C. burnetii} infection is still considered a common cause of caprine abortion in several countries, further studies are needed.

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\section*{REFERENCES}