

Original Article**Distribution of Soft Ticks and Their Natural Infection with *Borrelia* in a Focus of Relapsing Fever in Iran**Z Aghighi¹, M Assmar¹, N Piazak¹, E Javadian², MA Seyedi Rashti², EB Kia², Y Rassi²,
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(Received 10 May 2007; accepted 15 Oct 2007)

Abstract

Tick-borne diseases such as relapsing fever and Crimean-Congo Hemorrhagic Fever (CCHF) are of public health importance in Iran. There are 471 reported cases of relapsing fever in 2003, according to the Ministry of Health of Iran. The number of cases has been increased in recent years. Its distribution is more or less prevalent in different parts of Iran. The aim of this study was to find out the fauna and natural infection of soft ticks with *Borrelia* in Qazvin Province, during their seasonal activity. The province covers 15821 km² between 48-45 to 50-50 east of Greenwich Meridian of longitude and 35-37 to 36-45 north latitude of the equator. For this purpose a field study was carried out in the region. A total of 54 villages from 19 districts were selected randomly and ticks were collected from their habitats according to the standard method. A total of 3197 Argasidae ticks were collected from human dwellings, poultry and animal shelters. They belonged to *Argas* and *Ornithodoros* genera which 36.8% were *Argas persicus*, 4% *A. reflexus*, 6.4% *O. canestrini*, 45.5% *O. lahorensis* and 7.3% *O. tholozani*. It should be noted that 12 ticks of *O. erraticus* were collected from 12 rodents borrows. We found that 8.82 % of *O. tholozani* ticks were infected with *Borrelia persica* and half of the *O. erraticus* were infected with *Borrelia microti*. All the people who are involved with veterinary activities should be aware of disease transmission by the ticks. In the endemic area of the disease tick control is recommended.

Keywords: Ticks, *Borrelia*, Relapsing fever, Iran**Introduction**

Tick borne relapsing fever (TBRF) is a zoonotic disease involving many species of rodents in widely distributed areas throughout the world (Gray et al. 2002). Relapsing fever-like spirochetes infect 3.5% of questing vector ticks in European sites near the Rhein vally (Richter et al. 2003). TBRF is caused by one of many *Borrelia* designated by the species of *Ornithodoros* ticks responsible for its transmission.

TBRF occurs sporadically and in small clusters throughout rural in the northern temperate region of the world. Crimean-Congo

Hemorrhagic Fever (CCHF) Tick-Borne and relapsing fever (TBRF) are the most common tick borne diseases in country. Soft ticks play an important role in transmission of bacteria, rickettsia and viral diseases to human (Cunha 2000).

In Iran soft ticks of the genus *Ornithodoros* spread the tick-borne diseases. The responsible *Borrelia* species are identified closely with its tick vector and they share parallel nomenclature, for example: *Borrelia persica* infected *O. tholozani* in Northern Provinces of Iran. *B. microti* is transmitted by *O. erraticus* which are found in rodent burrows. They are reported from several areas located in central and southern Iran.

According to the Ministry of Health of Iran (Unpublished documents), the total number of 201, 205 and 471 relapsing cases have been reported in 2001, 2002 and 2003, respectively. The disease distribution is different in various parts of Iran.

The aim of this study was to find out the fauna and infection of soft ticks with *Borrelia* in Qazvin Province during their seasonal activity. The province is between 48-45 to 50-50 east of Greenwich Meridian of longitude and 35-37 to 36-45 north latitude of the equator.

Materials and Methods

Study area

Qazvin Province is located in northern of Iran. Among 540 villages, the total number of 54 (10%) were randomly selected for investigation. This study is a field and experimental study.

Tick collection

Tick collection was carried out in human dwellings, animal and poultry shelters in 30 min. Ticks were collected from cracks, crevices, ceiling, floor and rodents burrows and transferred into the holding tubes. All the specimens were identified on the basis of their morphological characteris-

tics. Some of the specimens were selected and prepared for electron microscopy studies.

Infection of ticks with *Borrelia*

O. tholozani was fed on Guinea pig but *O. erraticus* on new borne mice for 30-45 minutes. After 2 weeks blood samples were obtained from infected Guinea pig and mice were examined microscopically to determine the presence of *Borrelia* in their blood. *O. tholozani* were smashed and then injected subcutaneously to sensitive animals. The animals' blood samples were examined for the presence of *Borrelia* after one week using dark field microscopy stained with Wright and Geimsa dye. The ethical issue was approved by the Institute of Pasteur of Iran.

Results

A total number of 3197 soft ticks were collected and identified. The percentages of *O. lahorensis*, *O. canestrini*, *O. tholozani*, *O. erraticus*, *A. persicus*, and *A. reflexus* were 45.4%, 6.3%, 7.2%, 0.4%, 36.7% and 4%, respectively (Fig. 1). Out of 3197 ticks, 243 of *O. tholozani* (Fig. 2) and *O. erraticus* from Qazvin Province only ticks in AmirAbad from central area were infected with *B. persica* and *B. microti*, respectively.

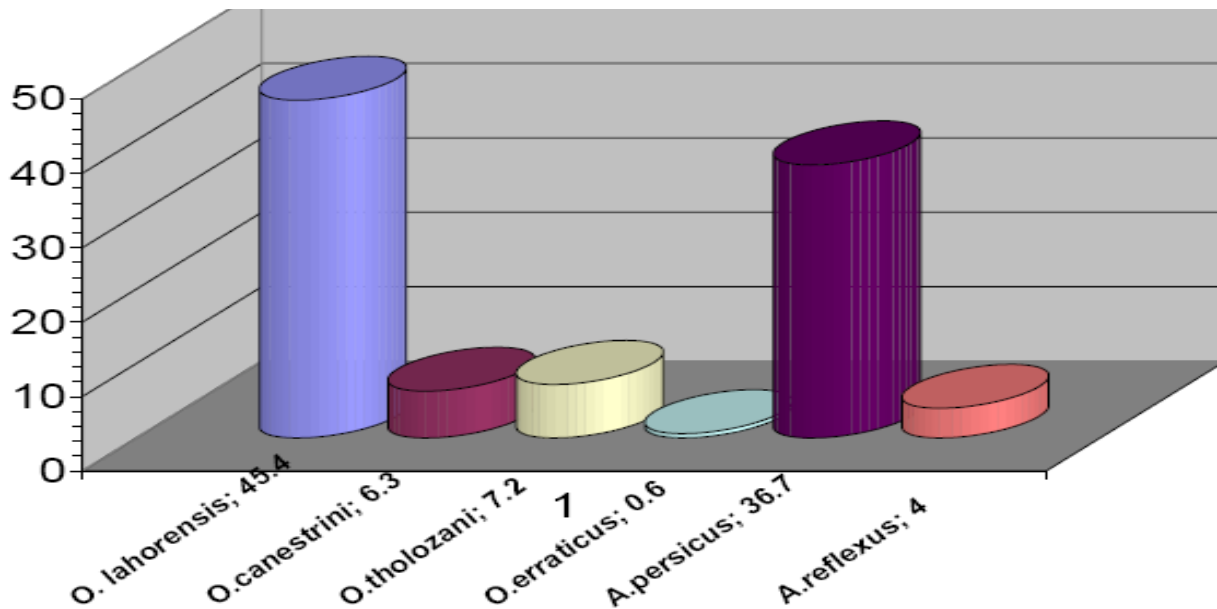


Fig. 1. Distribution of ticks in the study area



Fig. 2. Dorsal view of *O. tholozani*

Discussion

Relapsing fever is caused by spiral-shaped bacteria of the genus *Borrelia*. This bacterium lives in rodents and in insects, specifically ticks and body lice. The form of relapsing fever acquired from ticks is slightly different from that acquired from body lice. In TBRF, rodents (rats, mice, chipmunks, and squirrels) which carry *Borrelia* are fed upon by ticks. The ticks then acquire the bacteria, and are able to pass it on to humans. TBRF is most common in sub-Saharan Africa, parts of the Mediterranean, areas in the Middle East, India, China, and the south of Russia. Soft ticks of the genus *Ornithodoros* spread tick borne disease in Iran. TBRF is a systemic spirochetal disease and patient spikes a very high fever, with chills, sweating, terrible headache, nausea, vomiting, severe pain in the muscles and joints, and extreme weakness. The patient may become dizzy and confused. The eyes may be bloodshot and very sensitive to light. A cough may develop. The heart rate is greatly increased, and the liver and spleen may be swollen. Because the substances responsible

for blood clotting may be disturbed during the illness, tiny purple marks may appear on the skin, which are evidence of minor bleeding occurring under the skin. The patient may suffer from a nosebleed, or may cough up bloody sputum. All of these symptoms last for about three days in TBRF lasting 2 to 9 days alternating with a febrile periods of 2 to 4 days. Symptoms of infection include high fever, headache, prostration, myalgia, and sometimes gastrointestinal manifestations.

The responsible *Borrelia* species are identified closely with its tick vector and they share parallel nomenclature for example: *B. persica* infected *O. tholozani*, *B. microti* infects *O. erraticus*. *B. latychevyi* infects *O. tartakovsky* and *B. baltazardy* infects unknown vector.

The main reservoirs of the *Borrelia* are wild rodents and *Ornithodoros* ticks. It can be concluded that *O. lahorensis* and *O. erraticus* encompass the highest and lowest frequency, respectively. Among 231 specimens of *O. tholozani* only 8.82% revealed infection with *B. persica* and 12 specimens of *O. erraticus* (50%) were infected with *B. microti*. The infection of ticks is correlated with disease distribution in the province.

In an investigation in Iran, *O. tholozani* was infected with *Borrelia* in Kazeroon area, southern Iran (Janbakhs and Ardelan 1997).

In the West Azerbaijan of Iran of the 1421 ticks collected from Ardebil, northwestern Iran, 45.9%, 40.3% and 13.8% were of the *O. lahorensis*, *O. tholozani* and *A. persicus* species, respectively. The prevalence of ticks was highest in Khandabil village. The ticks collected from three villages were found to be infected with *Borrelia* (Arshi et al. 2002).

A case of meningitis from borreliosis was found in Ardebil Province (Majid-pour 2003). Telmadarraiy et al. (2004) described the fauna of ticks in west Azerbaijan. They found 15 species of hard and soft ticks. Vatandoost et al. (2003) conducted a survey in a borreliosis focus in Hamadan Province, Iran. They found the *A. persicus*, *A. reflexus*, *O. tholozani*, *O. canestrini* and *O. lahorensis* are present in the region. *O.*

tholozani was found infected by *B. persica* Robinson and Spradling (2006) cited the main important tick borne disease transmitted by different ticks in Iran and neighboring countries of Caucasus region. They referred tick-borne relapsing fever transmitted by *O. tholozani*, *O. erraticus* and *O. asperus*.

It should be noted that in Europe the main vector of *Borrelia* is *Ixodes* and there are several species of *Borrelia* reported from this region including: *B. burgdorferi*, *B. afzeli*, *B. garini*, *B. valaisi* and *B. lusitaniae* (Gern et al. 2007).

A relapsing fever-like spirochete, *B. miyamotoi* has been added to this array of parasitic microbes (Fukunaga et al. 1995).

For control of ticks there are several measures which can be classified as follows: Prevention of rodent access to the foundations and attics of homes or vacation cabins reduces the potential for tick exposure in these dwellings. Structures infested with soft ticks should be treated professionally with acaricides, rodent-proofing measures. Interior residual application, animal treatment, personal protection using repellent and impregnated bed nets, removal of ticks from body, impregnation of clothing with permethrin can provide long-term protection against infestation, the development of a biological tick control method has been neglected as compared to the control of plant pests or dipterous insects harmful to men and animal (Samish 2007) vaccination, environmental sanitation, active case detection, prompt treatment and health education. Reporting of suspected cases of relapsing fever to health authorities is important for initiating prompt epidemiological investigation and control measures.

Acknowledgements

The authors would like to appreciate very much for kind collaboration of staff of Department of Medical Parasitology, Pasteur Institute of Iran as well as Department of Medical Entomology and Vector Control, School of

Public Health, Medical Sciences/Tehran University. The research was financially supported by the Education Department of the School of Public Health.

References

- Arshi Sh, Majidpoor A, Sadeghi H, Asmar M (2002) Relapsing fever in Ardabil, a north-western province of Iran. *Arc Iran Med.* 5(3): [4]-145.
- Cunha BA (2002) Tick-borne Infectious Disease. Diagnosis and Management. Marcel Dekker. Inc. Publication, New York.
- Fukunaga M, Takahashi Y, Tsuruta Y, Matsushita O, Ralph D, McClelland M (1995) Genetic and phenotypic analysis of *Borrelia miyamotoi* sp. Nov, isolated from the Ixodid tick *Ixodes persulcatus*, the vector for Lyme disease in Japan. *Int J Syst Bacteriol.* 45: 804-810.
- Gern L, Perret JL, Gremion F, Guigoz E, Rais O, Mosman Y (2002) Five years survey on the prevalence of *Borrelia burgdorferi* sensu lato in *Ixodes ricinus*, on tick density and clinical cases of Lyme borreliosis in an endemic area of Switzerland. *Int J Med Microbiol*, 291 (supp 133): 21.
- Gray JS, Kahl O, Lane RS, Stanek G (2002) Lyme Borreliosis: Biology and control. CABI Publishing Book.
- Janbakhs B, Ardalan A (1977) The nature of sporadic cases of relapsing fever in Kazeroon area, southern Iran. *Bull Path Exot.* 70: 587-89.
- Majid-pour A (2003). A case of *Borrelia meningitis*. *Arch Iran Med.* 6(3): 222-223.
- Richter D, Schlee DB, Matuschka FR (2003) Relapsing fever-like spirochetes infecting European vector tick of Lyme disease agent. *Emerg Infect Dis.* 9(6): 697-701.
- Robinson RG, Spradling MS (2002) Vector – borne infectious disease in Iran. Washington DC publication. USA. Available in: <http://www.afpmb.org/pubs/dveps/iran.pdf>
- Samish M (2000) Biocontrol of ticks. *Ann New York Acad Sci.* 916: 127-8.

Telmadarraiy Z, Bahrami A, Vatandoost H (2004)
A survey on fauna of ticks in west Azerbaijan
province, Iran. Iranian J Publ Health. 33: 65-69.
Vatandoost H, Ghaderi A, Javadian E, Zahir nia
AH, Rassi Y, Piazak N, Kia EB, Shaeghi

M, Telmadarreiy Z, Aboulghasam M (2003)
Distribution of soft ticks and their infection
with *Borrelia* in Hamadan province, Iran.
Iranian J Publ Health. 32(1): 22-24.