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First survey on hard ticks (Ixodidae) collected from humans in Romania: possible risks for tick-borne diseases

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Abstract The importance of studies on the diversity of ticks attacking humans resides mostly in the relatively highly-specific tick-pathogen associations. Human tick bites are commonly reported worldwide but removal of ticks from patients is rarely followed by specific identification of the ticks, leaving to some degree of hazard the preventive treatment of possible associated diseases. A total number of 308 ticks were collected between April and June 2010 from 275 human patients who voluntarily presented to a hospital from Cluj-Napoca, Romania. The mean intensity of infection was 1.12 ± 0.46. Four species of ticks were identified *Ixodes ricinus*, *Dermacentor marginatus*, *Haemaphysalis concinna* and *H. punctata*. *Ixodes ricinus* was the most abundant species feeding on humans in the study area. A brief review of possible associated pathogen is provided.

Keywords Ixodidae · Humans · Tick-borne disease · Romania

Introduction

Ticks are obligate, blood-sucking parasites attacking tetrapod vertebrates worldwide. In humans, ticks can induce severe local lesions (irritations, allergy) or systemic effects (paralyses, toxicoses). However, the most important medical importance of ticks resides in their ability to transmit various infectious agents (viruses, bacteria, protozoans).

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Table 1 Species of hard ticks reported to attack humans (updated, after Estrada-Peña and Jongejan 1999)

Genus	Total number of species*	Number of species attacking humans	References
Amblyomma	143	23	Merten and Durden 2000; Horak et al. 2002; Venzal et al. 2004; Szabó et al. 2006
Anomalohimalaya	3	0	–
Bothriocroton	6	0	–
Cosmiomma	1	0	–
Cornupalpatum	1	0	–
Dermacentor	36	14	Merten and Durden 2000; Bursali et al. 2010
Haemaphysalis	166	23	Horak et al. 2002; Bursali et al. 2010
Hyalomma	27	9	Horak et al. 2002; Bursali et al. 2010
Ixodes	249	26	Merten and Durden 2000; Horak et al. 2002; Bursali et al. 2010
Margaropus	3	0	–
Nosomma	1	0	–
Rhipicentor	2	0	–
Rhipicephalus	79	23	Merten and Durden 2000; Horak et al. 2002
Total	717	118	

* After Barker and Murrell 2008

Considered globally, ticks are second only to mosquitoes regarding the vectorial importance to humans (Goddard 2007). Barker and Murrell (2008) listed a total of 717 valid species of hard ticks (family Ixodidae) in 13 genera. Less then 20% of these were reported to attach on humans (Table 1).

The importance of studies on the diversity of ticks attacking humans resides mostly in the relatively highly-specific tick-pathogen associations. Various tick-borne diseases are confined strictly to the areas where the tick vector occurs. Moreover, most tick species lack host-specificity, attacking several vertebrates during their life cycle. Knowledge of the tick diversity attacking humans facilitates the understanding of epidemiological links between these hosts. Therefore, to determine specific structure of ticks parasitizing humans is essential for establishing the epidemiologic background for tick-borne disease control. However, according to our knowledge, no data is available on diversity of ticks attacking humans in Romania.

Materials and methods

A total number of 308 ticks were collected between 1st April and 30th June 2010 from 275 human patients who voluntarily presented to the Clinical Hospital of Infectious Diseases from Cluj-Napoca, Cluj County, Romania. All patients acquired the ticks in Cluj county or neighbouring counties, all situated within Transylvanian Plateau. Transylvanian Plateau is characterized by a continental climate, with altitude ranging from 250 to 800 m. All ticks were removed by medical personnel, collected to plastic bags and submitted to the Department of Parasitology and Parasitic Diseases of the University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca, Romania. Each tick was individually

identified based on morphological features, recording the species, developmental stage and sex (only for adult ticks). For epidemiologic data analysis we used Statistica 9.0 software.

Results

A total number of 308 ticks were collected from 275 patients with an intensity of 1–5 ticks/individual (mean intensity 1.12 ± 0.46). Four species of ticks were identified in our study: *Ixodes ricinus* (96.1%), *Dermacentor marginatus* (3.3%), *Haemaphysalis concinna* (0.3%) and *Haemaphysalis punctata* (0.3%). Their distribution according to month, developmental stage and sex is shown in Table 2.

Analysis of the dataset showed the following: the most abundant species was *I. ricinus* female ticks were more abundant than males ($P = 0.0001$); most ticks were reported in May ($P = 0.00001$). Interestingly, the percent of males was significantly higher in *D. marginatus* than in *I. ricinus* ($P = 0.0001$). In *I. ricinus* the nymphs were the most prevalent compared to other stages ($P = 0.00001$). The peak month for *I. ricinus* was May ($P = 0.007$).

Table 2 Distribution of ticks on human patients from Cluj-Napoca, Romania

Ticks species	Stage/sex	April	May	June	Total
Ixodes ricinus	Larvae	0	7	5	12
	Nymphs	20	100	71	191
	Male	0	0	2	2
	Females	5	47	39	91
	Total	25	154	117	296
Dermacentor marginatus	Larvae	0	0	0	0
	Nymphs	0	0	0	0
	Male	3	1	0	4
	Females	2	4	0	6
	Total	5	5	0	10
Haemaphysalis concinna	Larvae	0	0	0	0
	Nymphs	0	0	0	0
	Male	0	0	1	1
	Females	0	0	0	0
	Total	0	0	1	1
Haemaphysalis punctata	Larvae	0	0	0	0
	Nymphs	0	0	0	0
	Male	0	1	0	1
	Females	0	0	0	0
	Total	0	1	0	1
Total	Larvae	0	7	5	12
	Nymphs	20	100	71	191
	Male	3	2	3	8
	Females	7	51	39	97
	Total	30	160	118	308

Discussion

Human tick bites are commonly reported worldwide. However, removal of ticks from patients is rarely followed by specific identification of the ticks, leaving to some degree of hazard the preventive treatment of possible associated diseases. This costly approach might be improved if at least identification of tick's genus would be accomplished. Published records of species diversity of ticks involved in human bites from Europe are surprisingly few, compared to similar studies from North America or Asia. Moreover, information is rather scattered within epidemiological studies on tick-borne pathogens.

In a study from Italy, Manfredi et al. (1999) found *I. ricinus* to be the most common tick collected from humans (89.3%). A recent survey from Turkey, Bursali et al. (2010) found ticks of genus *Hyalomma* to be the most commonly encountered on human patients, while genus *Ixodes* was found on only 1.25% of the cases. The other three species of ticks found feeding on humans in our study were only in their adult stage. Genus *Dermacentor* accounted for 10% of the total number of ticks collected on humans in Spain (Estrada-Peña and Jongejan 1999), 0.9% in Italy (Manfredi et al. 1999), 3.23% in Turkey (Bursali et al. 2010) and 3.3% in our study. Ticks of genus *Haemaphysalis* were only accidentally found on humans in our study (0.6%) but a higher frequency (11.09%) was noted in Turkey by Bursali et al. (2010). Overall, we can state that *Ixodes ricinus* is the most important tick feeding on humans in Transylvanian Plateau, confirming its medical importance throughout Europe.

Ixodes ricinus is a three-host questing tick, with very low host specificity, regardless of their developmental stage. It is one of the most widely distributed ticks of Europe, ranging from the Atlantic Coast to as far east as 50–60° longitude in Central Asia and from Iceland to as far south as North Africa (Hillyard 1996). More than 300 hosts were reported to be parasitized by *I. ricinus* ticks (Anderson 1991). Among all stages of *I. ricinus*, nymphs seem to be the most commonly encountered on humans, followed by adults and larvae (Manfredi et al. 1999). From all the species identified in our study, *I. ricinus* is associated with the transmission of most human pathogen species (Table 3). *Dermacentor marginatus*, the most common species of the genus involved in human bites (Estrada-Peña and Jongejan 1999) is involved in the transmission to of several viruses, bacteria and protozoans, some of them pathogenic to humans (Table 3). *Haemaphysalis concinna* and *H. punctata* are the most commonly reported from humans from this genus, being confined to forest habitats from Europe and Asia (Estrada-Peña and Jongejan 1999).

However, from epidemiological point of view not only species is important to asses this risk but also developmental stage. As transovarial transmission and transstadial passage were described for the vast majority of tick-pathogen associations, adults should be the most important vectors, especially in tick species with a three-host life cycle (Eisen and Lane 2002) because of pathogen accumulation during ontogenesis. Our study revealed that the most common stage of *Ixodes ricinus* parasitizing humans are nymphs, followed by adults and larvae. Even if most epidemiological studies on *Borrelia burgdorferi* sensu lato infection in ticks (reviewed by Hubálek and Halouzka 1998) showed that adults have higher infection prevalence than nymphs, the later could eventually pose an increased threat because of their small size which delays or impairs the detection of ticks on the skin's surface (Mihalca, personal observation).

As morphological identification of ticks, at least to genus level is easily achievable in any laboratory we strongly recommend this as a routine for a proper prevention of possible associated tick-borne infections.

Table 3 Tick-borne pathogens of humans associated with the tick species found in our study (updated, after Estrada-Peña and Jongejan 1999)

Pathogen	*I. ricinus*	*D. marginatus*	*H. concina*	*H. punctata*
Viruses				
Tick-Borne Encephalitis virus	+	−	+	+
Omsk Hemorrhagic Fever virus	−	+	−	−
Crimean-Congo Hemorrhagic Fever virus	−	−	−	+
Bhanja virus	−	+	+	+
Tribec virus	+	−	−	−
Tettnang virus	+	−	−	−
Eyach virus	+	−	−	−
Bacteria				
Borrelia burgdorferi s.s.	+	−	−	−
B. afzelii	+	−	−	−
B. garinii	+	−	−	−
B. lusitaniae	+	−	−	−
B. valaisiana	+	−	−	−
Rickettsia helvetica	+	−	−	−
R. slovaca	−	+	−	−
R. monacensis	+	−	−	−
Anaplasma phagocytophilum	+	−	−	−
Ehrlichia equi	+	−	−	−
Coxiella burnetii	+	+	+	+
Francisella tularensis	+	−	+	−
Protozoa				
Babesia microti	+	−	−	−
B. divergens	+	+	−	−

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