Epidemiologic and Ecologic Characteristics of Some Diseases Transmitted by Arthropods on the Littoral of the Republic of Croatia

Guarantor: Rosanda Mulic, MD PhD
Contributors: Rosanda Mulic, MD PhD; Brigadier Darko Ropac; Ivan Zoric, MD PhD; Nikola Bradaric, MD PhD

Objective: To show epidemiologic and ecologic characteristics of some diseases transmitted by arthropods on the littoral of the Republic of Croatia. Methods: The pattern of infectious diseases that are transmitted exclusively by vectors was monitored during the period 1985 to 1999. Data on the incidence of the diseases in the Republic of Croatia as a whole and available data on the presence of the vectors for the diseases on the littoral were presented for comparison. Results: Mediterranean spotted fever, murine typhus, Lyme disease, cutaneous and visceral leishmaniasis, and pappataci fever occur sporadically on the Croatian littoral. Tick-borne meningoencephalitis is endemic in the northwestern part of Croatia but is not present on the littoral. Twelve cases of malaria are imported into Croatia per year on average. Conclusion: Diseases transmitted by arthropods are not a major public health problem in Croatia. The medically relevant entomofauna of Croatia has not yet been adequately investigated.

Introduction

The group of diseases transmitted by arthropods includes the diseases transmitted by live hematophagous insects (insects), a class of arthropods (Arthropoda). Seasonal occurrence is one of the characteristics of this group of diseases.1 The islands and coastal area of the Republic of Croatia (Palaeartic zone, Mediterranean subregion) are characterized by mild and humid winters, usually without keen frost, and hot and rainless summers.2 The specific climatic and geographic conditions determine the ecologic features of the niches, with the present animal communities playing a major role in maintaining certain infections and potentially serving as reservoirs and/or vehicles of the microorganisms.

From this group of diseases, tick-borne meningoencephalitis, pappataci fever, hemorrhagic fever with renal syndrome, Lyme disease, Q fever, Mediterranean spotted fever, murine typhus, and leishmaniasis (cutaneous and visceral) occur in Croatia as autochthonous diseases. In addition, some 12 cases of malaria are imported into Croatia per year.3,4 These diseases mostly occur sporadically, implicating no risk for the population at large.5,6 The vectors present in the area include various species of mosquitoes (of the genera Anopheles, Culex, and Phlebotomus), ticks (of the genera Ixodes, Dermacentor, and Haemaphysalis), and fleas, which are animal parasites (of the genus Xenopsylla).7-11 The present study was focused on the diseases transmitted by arthropods potentially associated with the epidemiologic burden of the study area. Although Croatia has a well-developed system of infectious disease surveillance and prevention, thus minimizing the potential risks, the vicinity of the subtropical zone, climatic alterations with a tendency toward average temperature increase, intense international traffic, and the presence of biological vectors call for continuous alertness in the field.12,13 According to World Health Organization estimates, Croatia belongs to a so-called "no-risk zone"; other such zones are other European countries, North America, and Australia.14 The epidemiologic situation concerning diseases transmitted by arthropods is of paramount importance for military forces, because this group is more frequently exposed to the risk of these diseases. This fact has become more relevant with Croatia's joining the Partnership for Peace and the frequent NATO exercises in the Adriatic Sea.

Materials and Methods

For the purpose of this study, the term "littoral of the Republic of Croatia" covers the "epidemiologic zones" on the islands and in the coastal and hinterland drainage area of the rivers flowing into the Adriatic Sea. The pattern of infectious diseases that are transmitted exclusively by vectors was monitored during the period 1985 to 1999. The following diseases were observed: malaria, Mediterranean spotted fever, pappataci fever, murine typhus, Lyme disease, tick-borne meningoencephalitis, and leishmaniasis. Data from the Croatian Institute of Public Health were used in this study. Data on the incidence of these diseases in the Republic of Croatia as a whole and available data on the presence of the vectors for the diseases on the littoral are presented for comparison.

Results

Malaria

The last autochthonous case of malaria in Croatia was recorded in 1958.3,10 Twelve cases of malaria are imported into Croatia per year on average, more than half of them on the littoral. Plasmodium falciparum and Plasmodium vivax are most commonly isolated as the causes of malaria, and transmission of the infection to humans is attributable to the resistance of the microorganism to antimalarial agents or to inappropriate chemoprophylaxis.3,4,14

Mediterranean Spotted Fever

In Croatia, the first laboratory-verified case of this disease was reported in 1984.15 The disease has been demonstrated by
laboratory tests in all Mediterranean countries. In the Mediterranean basin, and in Croatia as well, the main vector is *Rhipicephalus sanguineus*. The tick shows a worldwide distribution. Epidemiologic data on the incidence of the disease in Croatia show it does not occur north of Zadar (Fig. 1). During the last 15 years, 67 patients with Mediterranean spotted fever have been recorded in Croatia.

**Pappataci Fever**

As early as 1908, Doerr, an Austrian army medical officer, reported on an endemic disease in southern Croatia and Herzegovina, named it dog fever, and demonstrated the presence of a filterable virus in both the blood of patients and in the species *Phlebotomus papatasi*. Although pappataci fever belongs to the group of reportable diseases, no case was reported during the period of observation because it is rarely diagnosed.

**Murine Typhus**

Although this disease occurs all over the world, it is more common in the areas of temperate and subtropical climate. During the last 15 years, only 11 cases were reported in Croatia, all of them along the littoral. *Xenopsylla cheopis*, a rat flea parasitizing rats all over the world, serves as a vector.

**Lyme Disease**

During the period 1985 to 1999, 2,156 cases of Lyme disease were reported in Croatia, 94 (4.36%) of them on the littoral, mostly in its northward areas (Fig. 2).

**Tick-Borne Meningoencephalitis (Meningoencephalitis Acarina)**

Northwest Croatia is an endemic area of tick-borne meningoencephalitis. During the 15-year study period, 680 cases of the disease were recorded, 2 (0.29%) of them on the littoral. Foci of tick-borne meningoencephalitis in Istria, in the Zadar and Šibenik area, near Split, on the island of Brač, and around Dubrovnik have been described (Fig. 3).

**Leishmaniasis**

*Leishmania infantum* (*Leishmania donovani infantum*) is the causative agent of the visceral form, and *L. tropica* and *L. major* are the causative agents of the cutaneous form of leishmaniasis. Sporadic occurrence of both forms of the disease has been recorded in Dalmatia, where the first case of the visceral form of leishmaniasis was described in 1911. During the period 1954 to 1999, 99 cases of kala-azar (visceral leishmaniasis) were recorded in Croatia, 16 of them in the last 15 years. Most of these cases were recorded in the coastal area south of Zadar, with some isolated cases on the islands of Brač, Hvar, and Korčula (Fig. 4). Five of the 16 cases recorded...
during the period 1985 to 1999 were in the inland area; however, these cases suggested disease manifestation rather than the site of acquisition of infection.14

The cutaneous form of the disease was recorded only sporadically in the last 15 years, also on the littoral. A total of 15 cases were recorded.

**Discussion**

The climate and soil characteristics entail some specificities of the flora and fauna of the littoral, differentiating it from the inland area of Croatia and favoring the existence of vectors that transmit certain infectious diseases.2,6-11,22,33 The geographic distribution of these vectors was found to differ from the spread of the diseases. The natural flora and fauna have been modified by different human activities in the area. In addition to human activities and the presence of vectors and causative agents, some other as yet incompletely investigated factors that determine the existence of an infection in particular ecological niches have been presumed to be involved.6-11

Although no case of autochthonous malaria has been reported in Croatia since 1958, 12 cases of imported malaria on an average are recorded per year. Immediately upon malaria eradication, close epidemiological surveillance was established through the network of health institutions and professional laboratories, thus allowing the sporadically imported cases to be detected on time.5,8 Although autochthonous malaria has long been eradicated in Croatia, constant vigilance surveillance has been maintained for the presence of mosquitoes serving as vectors for malaria (Anopheles). The surveillance for malaria is regulated by the Act on the Population Protection from Infectious Diseases and includes laboratory blood testing for all individuals returning from endemic areas, completion of questionnaires in all cases of malaria, and compulsory prophylaxis for individuals traveling to endemic areas.12,13

Strict surveillance is needed not only because of the intense international traffic but also for the presence of mosquitoes of the genus *Anopheles*, which serve as vectors for malaria on the littoral and all over the territory of the Republic of Croatia.6-11 The population of mosquitoes has generally been reduced by the campaign of malaria eradication and frequent disinfestation.9-11,21 The vectors for malaria found on the Croatian littoral are *Anopheles sacharovi*, *Anopheles superpictus*, and *Anopheles maculipennis*, the latter being most common.5-11

A study of the presence of *Aedes albopictus* on the Croatian littoral is under way.30 These facts suggest the potential risk of new foci that may, in extremely poor living conditions, increase to a much greater extent.7,8 The existence of the genus *Anopheles*, a vector for malaria, on the Croatian littoral as well as in some other parts of Croatia, along with huge areas endemic for malaria worldwide and intense international traffic, make the surveillance for malaria and its vectors an important public health issue.5,8,14

Mediterranean spotted fever is characteristic of Mediterranean countries. The disease is caused by *Rickettsia conori* and transmitted by *Rhipicephalus sanguineus*, which are present all over the world.5,11,19,23 There is a discrepancy between the low number of reported cases in the area of observation and the results of seroepidemiologic studies indicating a higher presence and circulation of *rickettsiae* in Dalmatia.16-20 This could be attributable to a number of cases being undiagnosed or misdiagnosed because of the absence of tache noire or the occurrence of atypical forms of the disease.16

During the 15-year study period, not a single case of papular fever was recorded in the area of observation; however, seroepidemiologic studies suggest the presence and circulation of the causative agent on the Croatian littoral. Studies conducted in 1980, 1984, and 1987 demonstrated the presence of the disease in the area.21,24 In these studies, screening of the population from the islands of Brač, Hvar, and Mljet for antibodies against the Naples and Sicilian serogroups of the phlebovirus revealed a high rate of infection, predominantly with the Naples serotype. Serologically recognized infection was also found along the coastal line and on the islands, from Mali Losinj to Korčula, with a mean prevalence in various age groups of 23%.14 Dalmatia and Istria are characterized by a high presence of the vector, *P. papatasii*; however, it has not yet been detected in the inland areas of Croatia.11 The following species of the genus *Phlebotomus* were demonstrated in northern and southern Dalmatia: *P. papatasii* (Scopoli, 1786), *Phlebotomus major* (Ammandale, 1910), *Phlebotomus perfluitans* (Parrot, 1930), *Phlebotomus tobbii* (Adler and Theodor, 1930), and *Sergentomastus minutus* (Rondani, 1843). In Istria, the presence of *Phlebotomus perniciosus* was demonstrated by Newsleed in 1911. On the islands of Brač, Hvar, and Korčula, the same species as those that occur along the coastal line were detected, with the exception of *P. perfluitans*.5,8-11,24

Studies performed in Mediterranean countries and Dalmatia showed the antimarial campaign to have reduced but not eradicated the populations of the species from the genus *Phlebotomus* and those of the genus *Anopheles*, the vector for malaria.5-11,25 However, because of its mild clinical picture, papular fever is not of major public health importance.21,22,25

At present, murine typhus is one of the most widely spread rickettsioses worldwide, especially in temperate zone littorals.30 Infection with *Rickettsia typhi* (*Rickettsia mooseri*) is a natural
infection of rats and mice. It is transmitted from animal to animal by rat flea, which also serves as vector for human infection.  

26,27 Murine typhus occurs on the Croatian littoral. Results of a seroepidemiologic study have shown the Zadar area to be highly endemic for the disease;  

26 however, epidemiologic data reveal that overt manifestations or the need for hospital treatment are not as common as might be expected from the high and large-scale exposure of the area population to R. typhi.  

26 For this disease, the rate of population infection demonstrated by seroepidemiologic studies also exceeds the number of reported cases. The disease is not associated with major public health interest as long as the preventive measures keeping the population of rodents (and thus of rat flea) at an acceptable level are regularly performed.  

9,20,26,27

For several years now, Lyme disease has been intensively investigated in the neighboring Republic of Slovenia and, recently, also in Croatia.  

3,4,5 According to disease reports, the disease has been restricted to the northern part of the Adriatic and inland areas. The vector for this disease, the tick Ixodes ricinus, is found all over the world.  

1,14 Künstli et al.  

8 have shown that erythema migrans is the most common form of the disease in Croatia, with cutaneous manifestations being considerably more frequent in central Croatia and west Slavonia than in other parts of Croatia, which is consistent with the epidemiologic data on the disease.  

3 There are no exact data available on the distribution of this tick species along the Croatian littoral. Studies indicate that the population of this tick is denser in the northern parts of Croatia, whereas the species Dermacentor pictus predominates in the lowland areas.  

35 The percentage of infected ticks correlates with the level of the infection risk in humans.  

84 In wild nature, the reservoirs of the disease are small murine rodents.  

45 Ecosystem differences and specificities of the tick biological cycle have been postulated as some of the reasons for the absence of this disease in southern Croatia.

Tick-borne meningoencephalitis is not typical for the Croatian littoral, as northwestern coast is endemic for the disease. The vector for the disease, I. ricinus, is found all over Croatia, with varying densities in mountain and lowland areas.  

9,12,28-33 Besides I. ricinus, the virus of tick-borne meningoencephalitis has also been isolated from D. pictus.  

30 The occurrence of the disease on the Croatian littoral has been postulated to follow the same pattern as for Lyme disease. The highest activity of these ticks and the greatest density of their population occur in April and May, their number increasing with temperature to a certain limit. In endemic area, the virus circulates among ticks and wild vertebrates. The tick parasitizing on birds is included in the cycle, thus spreading the infection to other areas. The greatest number of ticks has been recorded along the margins of wood, glades and forests.  

9,12,30 The ticks are dormant during winter. All of these specificities result in the seasonal occurrence of this tick-borne disease.  

9,12

Cutaneous leishmaniasis has been recorded sporadically in Dalmatia. The visceral form of the disease, or kala-azar, shows high regularity, occurring exclusively in central and southern Dalmatia, including some islands.  

5,34 Its possible occurrence in the inland areas of Croatia is epidemiologically related to the patient’s stay on the littoral.  

34 Dogs have been demonstrated as reservoirs for the visceral form of the disease. Other suspected reservoirs are rats (Rattus rattus and Rattus norvegicus) and jackals (Canis aureus Linn.).  

31 The species Phlebotomus major, and perhaps also P. tobbi, the insects that are found in a relatively great number in the respective part of the littoral, as well as P. perfiliewi and Phlebotomus simici, have been postulated as the main vectors for visceral leishmaniasis.  

5,34,5 P. papatasi is the primary vector, and P. perfiliewi (and probably Phlebotomus sergenti) is the secondary vector, for cutaneous leishmaniasis.  

5,35 Since World War II, the disease has been ever less frequently recorded in Croatia.  

34 The population of P. papatasi has also been rarefied by the systematic extensive use of insecticides.  

3,25 Both of these diseases have become quite rare and represent no major public health problem in Croatia.  

1,4,23-25

Conclusion

Diseases transmitted by arthropods occurring on the Croatian littoral are no major public health problem in Croatia. The medically relevant entomofauna of Croatia has not yet been adequately investigated for the presence of the genera, their distribution, their infectivity with microorganisms causing diseases in humans, and their insecticide sensitivity.

It has been anticipated that fast changes in the ecosystem may allow for such a mosquito invasion, upon which it would become a potential vector for malaria again or at least a serious urban molestant. The number of fleas and ticks is also expected to increase. All of these facts suggest the need for vigilant epidemiologic and entomologic surveillance, as well as for more comprehensive investigation of the medically relevant entomofauna in Croatia.

References


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