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Borrelia Burgdorferi, Ixodes Ticks and Lyme Borreliosis in Albania—Their Past, Present and Future in an Endemic Country Like Ours

Ermira Muco[1*], Arta Karruli[2], Dhimiter Kraja[1]

[1]Department of Infectious Diseases Service, University Hospital Center "Mother Teresa", Tirana, Albania
[2]Unit of Infectious Diseases, Kukës Regional Hospital, Kukës, Albania
Email: *ermiramuco@yahoo.com

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Abstract

Background: Lyme borreliosis is a zoonotic spirochetal disease of global importance. It has a wide geographic spread, including Albania. It is transmitted to humans through the bite of *Ixodes ricinus* ticks. There are not many publications about this pathology in Albania. The first publications date back to the 1980s, when the first cases were described. **Aim:** This review aimed to describe the situation of Lyme borreliosis in Albania and across other countries with similar climate and geographical conditions. **Methods:** We searched the literature for articles by Albanian and foreign authors to provide data about its transmission vector, the tick, its clinical form, spread, prevalence, and its presence in animals. Also, we searched for articles on the Lyme borreliosis situation in Albania. **Results and Conclusions:** It was evidenced that there are several endemic regions in our country, with a wide range of clinical manifestations from erythema migrans to severe neurological patterns. However, the real incidence in Albania could be higher due to most cases that go undetected. It is of great importance to monitor the disease, paying attention to prophylactic methods on tick infection, and offering relevant advice to the population that lives or temporarily goes there, thus reducing the risk of infection to the maximum.

Keywords

Albania, Ixodes, Borrelia Burgdorferi, Lyme Borreliosis, Tick-Borne

1. Introduction

Albania is a small European country that lies in the western part of the Balkan Peninsula and has wide access to two important seas, the Adriatic and the Ionian

[1]. Albania is known for its mountainous relief with mountains over 2700 meters high that make up three-quarters of the territory and hills over 200 m above sea level [1].

Albania possesses exceptional water potential, ranking among the top countries in Europe. Its hydrographic network spans 49,027 km, featuring a dense network of fast-flowing mountain rivers (such as the Drini and Vjosa) and approximately 247 diverse lakes. These range from coastal lagoons to high-altitude glacial lakes, including the internationally recognized Ramsar wetlands of Shkodra and Prespa [2]-[5].

Climatic, hydrological, geological, geographical, terrestrial biological and marine diversity support different habitats and enable such diverse flora and fauna, with 14 national parks and marine parks that include about 6.7% of the total territory. The forests lying in the north and resembling those of Continental Europe, as well as in the south of the country which resemble the forests of the Mediterranean basin, cover a third of the total area [6] [7]. According to the Köppen classification, Albania has five types of climate: Mediterranean/subtropical climate and oceanic/continental/subarctic climate with four seasons that are quite distinct, ranging from warm and hot summer to precipitation mostly in the winter and summer [8] [9]. Albania, being included in the typical Mediterranean climate zone, stands out for significant amounts of solar radiation among the highest in Europe [5]. The resident population in the Republic of Albania is 2,402,113, with a density of 83.6/km^2, where 49.6% are men and 50.4% are women and where 46.5% of the population lives in rural areas [10].

Ticks of the genus *Ixodes*, primarily *Ixodes ricinus* in Europe, serve as critical hard-bodied vectors capable of transmitting a vast array of zoonotic pathogens, including the bacteria that cause Lyme borreliosis (*Borrelia burgdorferi*) and the tick-borne encephalitis (TBE) virus. Transmission occurs primarily through the biological injection of contaminated salivary secretions into a host during an extended blood meal, which typically requires a duration of 6 to 24 hours of attachment to successfully transfer systemic infection. Humans acquire Lyme borreliosis through the bite of an infected blacklegged tick. Early clinical manifestations typically include fever, fatigue, and a spreading red rash called *erythema migrans*—often resembling a bull's-eye. If untreated, the localized bacterial infection can disseminate, resulting in severe joint pain, facial palsy, heart palpitations, or neurological issues [11]. In Albania, researchers have historically investigated tick distributions, human seroepidemiology, and emerging local infestations [11]. However, the broader fragmented information regarding these vectors in Albania has been officially synthesized by major scientific literature reviews. Notably, a comprehensive review published by Kapo *et al.* [12] explicitly integrated and consolidated scattered historical data on tick fauna, geographic distribution, and associated zoonotic tick-borne pathogens across Albania and the wider Western Balkan region. This disease is common in Albania mostly due to diverse geographical and climate characteristics; the literature is scarce, limiting mostly in Conference pa-

pers and a few published articles. This review aims to describe epidemiology clinical characteristics of Lyme borreliosis in Albania, describing the situation in the past along with the current one and future problems.

2. Methods

We reviewed the literature and scientific research in Medline, Google Scholar, Google, PubMed and other medical sources (Web of Science, EBSCO (including Medline, CIHAHL, Academic Search Complete and ERIC)) for this narrative review. Keywords used were: Albania, Ixodes, borrelia burgdoferi, Lyme borreliosis, climate, tick-borne, erythema migrans, serology, geographic distribution, etc. to identify relevant sources.

We also used scientific medical literature written or reviewed by our infectious disease colleagues, epidemiologists, biologists or veterinarians published in journals or abstracts in national and international conferences which have not been published in PubMed.

We included all studies, case reports and case series, conference papers, published in English independently of the time of publishing. Exclusion criteria were articles describing Lyme borreliosis in countries other than Albania. Those articles were used as part of the discussion for comparison of data.

The relevant English and Albanian language results are collected, but the Latin names of the pathogen and known tick vectors are also used.

We provided data on the main vector of the spirochete, the *Ixodes ricinus* tick, on its geographical distribution, the epidemiological side of Lyme borreliosis, its clinical history, epidemiological aspects, seasonality of the disease and demographic and clinical characteristics of affected patients.

Cases were considered confirmed if the serological examination with ELISA performed at the Institute of Public Health, Tirana, was positive for IgM antibodies, or if a positive PCR test was present.

3. Results

We identified 17 articles/conference papers that described past and current situation of ticks and tick-borne diseases in Albania, including Lyme borreliosis. No article describing Lyme borreliosis in Albania was excluded, only those which were found to be duplicates.

3.1. Epidemiological Studies of *Ixodes* and Spirochetes in Albania (Distribution and Ecology)

In our country, *Ixodes ricinus* are the most common types of hard ticks and at the same time an important vector for the transmission of pathogens, including *Borrelia burgdorferi*. The data on the presence of ticks in our country were documented for the first time by Enigk in 1947, who published the results of the identification of ticks collected from horses in different places in Albania between 1943-44, and where *Ixodes ricinus* occupied their place [11]. While the first sci-

entific data on the appearance of ticks in the Western Balkans date back to the beginning of the twentieth century, when Neumann in 1910 gave the first data on Ixodit ticks in the Western Balkans [12]. Subsequently, the tick fauna of Albania was studied through surveys reported in the 1960s and 1970s [11]. The geographical map of the distribution of these vectors is quite wide, including regions from the north of Albania (Tropojë, Has, Kukës, Burrel), the central part (Tirana, Elbasani) to its south, southwest and southeast (Kolonje, Korce, Pogradec, Përmet, Berat, Gjirokastër, Sarande) [13].

Ixodes ricinus have their own habitats, the places where they grow, feed, live and multiply up to 1000 m above sea level [14] [15]. In our country there are fourteen species of ixodid ticks that have been seen in cattle, water buffalo, sheep, goats, horses, donkeys, dogs, rodents, wild birds, reptiles [16]. The first epidemiological study of the types of ticks in Albania was carried out by Christova *et al.*, who in their survey collected 90 ticks from cattle in five localities of northern and central Albania and tested them alongside others for the presence of *B. burgdorferi* s. l [17]. The presence of ticks in hosts such as dogs, etc., has been described much earlier [15] [18] [19]. The prevalence of *Ixodes ricinus* in dogs is 0.6% - 0.8% [11] [16]. The presence of *Ixodes ricinus* in dogs in the winter months has been noted [20]. In Myrseli *et al.* study, it was seen that 49.4% of the sera obtained from the study dogs had antibodies against Borrelia Garinii. They were examined with the indirect fluorescent antibody test (IFAT). Dogs from different parts of Albania were included and seropositivity resulted in 11 out of 13 study areas [21]. Our Kosovar compatriots in their study with samples taken from Kosovo and Albania, talk about a seropositivity for *borre* s. l in the value of 2% of 340 flagged tested ticks [22]. In the summer of 2001 in the region of Morina (place that connects the Kosovar capital of Pristina with Albania), the French troops of the United Nations in Kosovo, in the ticks collected both on asymptomatic soldiers and dogs, noticed the presence of *Ixodes ricinus* in 16.66% of them [23].

3.2. Epidemiological, Clinical and Diagnostic Characteristics of Lyme Borreliosis in Albania

Table 1. Time-frequency and seasonality of Lyme Borreliosis cases in Albania.

Year	1982-1983	1991	1999	2001	2002	2003	2004	2005-2006	2007
No. of cases	3	1	3	1	2	2	2	6	7
Season		Spring		Summer		Autumn		Winter	
No. of cases		9		15		3		0	

The first reports of Lyme borreliosis in Albania date back to 1982, when the first laboratory diagnosis was made. Eltari *et al.* in their study estimated a 30% seropositivity (15/50 clinically suspected cases) [24]. Albania was an endemic country, but this disease began to be imported. Como *et al.* also noticed that 74% of cases

were indigenous and 26% imported from Germany, USA, Italy, Austria, North Macedonia, and Czechia [25]. The study of age groups is important in the country's demographic analysis. There was a total of 27 patients with Lyme borreliosis from 1982 to 2007 and 11 cases from 2011 to 2015. Our patients belonged to different age groups and ranged from 18 - 64 years old, coinciding with the time period from 1982 to 2007 (**Table 1**) [25].

In a subsequent study, conducted between 2011 and 2015, Myrseli *et al.* reported 11 new cases, with an average of 2.2 cases per year. The disease is registered for the first time in pediatric age, in 7- and 9-year-old boys [21]. Our patients had a variety of symptoms and signs starting from febrile condition, erythema, neurological disorders such as meningoencephalitis and facial paralysis [24]. The meningoencephalitic form has been described by other clinicians. Thus, Muco *et al.* describe the case of a 62-year-old woman who was hospitalized in 2009 with these signs and symptoms: headache, vomiting, nuchal rigidity, and which in lumbar puncture resulted in LCS with 890 cells with lymphocytic predominance. ELISA and PCR tests for Borrelia Burgdoferi in LCS and blood were positive. She had problems with the locomotor system for more than a year, but without a rheumatological diagnosis [26]. Como *et al.* report five clinical syndromes: skin system/15 cases (erythema/15 cases); locomotor system/7 cases (knee joint 4, coxofemoral joint 3 cases); cardiovascular system/1 case (infective endocarditis); neuropsychiatric system/3 cases (bipolar disorders 1, depression 1, meningoencephalitis 1 case); auditory system/1 case (complete deafness 1 case) [25]. Post borreliosis syndrome has also been described in our patients. Kica *et al.* have described this syndrome in a 23-year-old patient, from the city of Gjirokastra, identified in the chronic stage, seven years after the infection. The patient initially had as a clinical manifestation the appearance of erythema migrans, and later over the years the appearance of arthralgia, headache and neuropsychic disorders [27]. Di Meo *et al.* evidence the case of a woman from Albania who had a positive history of Lyme borreliosis (confirmed by the positivity of PCR and the presence of IgM antibodies) and who manifested clinical Parry-Romberg Syndrome. The authors mention a possible close relationship of this pathology with Lyme borreliosis, since in this patient the clinical progress of the disease stopped and the serological and microbiological tests for *Borrelia burgdorferi* sensu lato were negative after treatment and 2-year follow-up [28]. The diagnosis of our cases was made through indirect immunofluorescence test, ELISA test (IgM, IgG) and diagnosis through PCR. In the study by Como *et al*, the patients were diagnosed using: Indirect immunofluorescence/5 cases, ELISA test (IgM, IgG)/22 cases, PCR/2 cases [25]. Also, Kica *et al.* for an accurate diagnosis applied the scoring system according to the CDC in their cases and showed that the cases ranged from 7-19 points (7 points/9 cases, 8 points/6 cases, 10 points/5 cases, 13 points/5 cases, 19 points/2 cases) [27].

4. Discussion

Ticks and Lyme borreliosis have been around for thousands of years. This was

proved after an autopsy of a 5,300-year-old mummy was made and showed the presence of the bacteria that causes Lyme borreliosis [29]. Lyme borreliosis is a chronic infectious disease caused by the spirochete *Borrelia burgdorferi*, and at the same time, it is the most widespread vector-borne disease in Europe, with an incidence that seems to increase from south to north [30]. This disease is transmitted to humans by the bite of ticks of the genus *Ixodes ricinus*, which are infectious in all stages of their development (larva, nymph, adult). In Europe, the main vector of the spirochete is the tick *Ixodes ricinus* and the prevalence of the spirochete in these ticks is 13.7% with a dominance in adults 18.6% and in nymphs 10.1% [31]. *Ixodes ricinus* are nature's most suitable vectors as they feed for longer periods, bite painlessly, and are satisfied with just one meal of blood from the legs, trunk, arms of vertebrate hosts, which are numerous [32] [33]. Ixodes ticks need 17 - 48 h to transmit Borrelia to humans and animals [34]. The particular climate in our country is a key factor in diseases transmitted by vectors, which is also pointed out by other authors [35]. Our country has ideal ecosystems for the development of roots, as they provide them with suitable conditions of moisture, temperature and soil composition. Vegetation and microclimatic factors provide excellent habitat for the large population of ticks in the coastal region of the Adriatic Sea [36]. The diverse topography of our country, which accompanies equally diverse climatic regions, from the typical Mediterranean to the continental, is the one that determines the seasonal activity of ticks as well as the range of their distribution. The wet microclimate of the earth's surface here significantly favors the survival of *Ixodes ricinus*, bringing a significant expansion of the geographical map of the distribution of vectors from the south to the north of the country and a variety of them, fourteen species found in cattle, water buffalo, sheep, goats, horses, donkeys, dogs, rodents, wild birds, reptiles [13] [16]. The infection occurs more in the spring-autumn period, in the months of May-November with a peak in the months of June-July. And in the study by Como *et al*. we observed a similar distribution of cases according to seasons and months: spring/9 cases; wine/15 cases; autumn gave 3 cases and no case in winter [25]. After infection, ticks transmit the spirochete *B. burgdorferi* by feeding on vertebrates such as sheep, cows, dogs, deer, horses, etc., thus completing their cycle. Larvae can find rodents, rabbits, birds, reptiles or bats [37]. Albania is particularly rich in bats, deer, rodents, carnivores, insects and migratory birds. The vast majority of recent veterinary studies of tick prevalence in livestock have been conducted in countries of the Mediterranean region, indicating a greater perceived importance of these parasites here than in other parts of Europe [38]. In Albania, rodents play a very important role as reservoirs in the transmission of this spirochete, at the same time they have a high density risking the spread of infectious diseases especially in rural areas [39]. Agriculture is an important risk factor for the occurrence of Lyme borreliosis, as it brings people into close contact with ticks. In our country, it occupies the main place of the economy, being more developed in the rural areas of the country where 46.5% of the population lives. This sector has the highest weight in relation

to the Gross Domestic Product in Europe, even by a deep margin, since according to data from the World Bank database belonging to the year 2017, agriculture took 19% of the GDP with a difference of 10 percentage points with Kosovo as the second country with the highest weight of agriculture in Europe, and was ranked 36th in the world for the high weight of agriculture in the economy, next to African countries [40]. The incidence in our country, according to Myrseli *et al.* was 2.2 cases per year [21], while Romania has an incidence of 2.1/100,000 inhabitants; Serbia 10.7; Bulgaria had a seroprevalence of 5.4% [41]. It is a pathology with a professional character that endangers a certain group of people, since forestry, hunting, and eco-tourism increase human contact with ticks. Thus, some studies have shown that over 80% of forestry workers report being bitten by at least one tick (83% in France, 86% in Friuli-Venezia, Italy, and 90% - 95% in Lublin, Poland), and the risk of disease after a tick bite is estimated at 0.8% - 5.2% [42]-[44]. Lyme borreliosis is an endemic disease in our country. Many tick-borne diseases are probably endemic in the Balkan area [17]. Residents and visitors, tourists or military forces are at risk of infection, as it is emphasized in this article about the French military troops of the United Nations in Kosovo [23]. The number of infected ticks also determines the risk of disease occurrence. Human activities, natural causes affecting tick habitats and host animal populations affect the abundance of vector and reservoir animals. Ticks have a wide range of pathogens that they can transmit, including viruses, bacteria, protozoa, etc. [11]. Erythema migrans is an important clinical sign that can often interfere with serological detection. About 60% - 80% of cases with LB have it as the first early manifestation [45]. This clinical sign as the beginning of pathology is also mentioned by Kica *et al.* in a description of a case with post borreliosis syndrome [27]. Neuroborreliosis occurs in about 20% of LB cases [46]. The meningoencephalitic form of this pathology is described by us as well as facial paralysis [24] [26]. However, other Albanian authors, in addition to skin manifestations, have also described other clinical forms affecting the locomotor system, the cardiovascular system, the neuro-psychiatric system and the auditory system, so the presence of five clinical syndromes was observed [25]. The diagnosis in these patients was done through indirect immunofluorescence ELISA test (IgM, IgG) with PCR [25]. On the other hand, Kica *et al.* described the post-borreliosis syndrome and also described the difficulties in making the diagnosis, since there were several similar diseases such as allergic dermatosis, brucellosis, rheumatological diseases, neuropsychic diseases, etc. [27]. In 1968, the first patient with erythema migrans and neurological sequelae in North America benefited from penicillin treatment [47]. Doxycycline and amoxicillin are mainly used as first-line therapy. A single dose of 200 mg of doxycycline within 72 hours of tick removal is 87% effective in preventing the development of EM around the bite site [48] [49]. The use of antibiotics such as Ceftriaxone and Doxycycline is also supported by our authors [26]. In Europe, antibiotic prophylaxis is not generally recommended as its efficacy is not considered proven [49]. This study has several limitations. First, it covers sparse surveillance data, hetero-

geneous diagnostic approaches, and the reliance on case reports, conference material, and mixed-source evidence. Second, the low incidence of this disease in Albania is mostly due to a lack of data and most cases that go undetected in terms of laboratory confirmation. Also, in Albania, there is a lack of an active surveillance system on Lyme borreliosis and the real incidence of this disease is probably much higher in Albania compared to data in the literature.

5. Conclusions

The Balkans, of which our country is a part, have an abundance of ticks favored by the climate, which makes it possible for this pathology, which is ubiquitous in our country, to spread more and more. Vector-borne diseases, including Borreliosis, are a public health emergency in our country and beyond. Also, the change in dermographism makes this pathology an even more worrying public health problem, especially in urbanized areas. Knowing the prevalence of pathogens that are transmitted by ticks, we will be able to assess in time the danger to human health. It is important to use biocidal products (insecticides and rodenticides). Serological surveys in us, as an endemic country, will be able to assess the importance of various infectious diseases, as well as the national quality coordinating program of vector control, and entomological surveillance. Control and surveillance of vectors, reservoirs and identification of pathogens transmitted through mosquitoes will improve the health of the population by reducing morbidity and its consequences. This control program, through modern techniques and methodologies, should be offered to health centers in municipalities through scientific support, information, recommendations, and training. Management in endemic forest areas, which can be used by both local residents and tourists, will reduce exposure to ticks, which will prevent infection that can come from direct contact with contaminated water, animals, soil and its foods. It is necessary to create and update data on the geographical and seasonal distribution of vectors. Establishing an accurate and timely diagnosis of pathologies transmitted by vectors should be done according to international standard diagnostic protocols, possessing all the necessary material base for the realization of a confirmatory diagnosis.

With the research we did in the literature, we noticed the presence of a limited number of writings, articles or case reports about this human zoonotic pathology, knowing the favorable climate and the spread of transmission vectors. We think that there should be more evidenced cases, starting from the fact that this pathology was identified in the 1980s by our infectious disease colleagues. So we can say that this pathology has been present among us for more than 4 decades. The scientific management of natural assets remains an important issue, since the damage to biodiversity and the reduction of all these natural resources such as water, solar radiation, wind, etc. will negatively affect public health and especially pathologies transmitted by vectors.

Clinicians should be further informed about Lyme borreliosis, as an important proportion of Lyme borreliosis cases (particularly patients with EM rash) can be

diagnosed by clinicians without laboratory testing. There is a need for enhanced access to adequate laboratory diagnostics. Establishing public health surveillance for Lyme borreliosis would further help identify the incidence and the disease burden of Lyme borreliosis in Albania.

Conflicts of Interest

The authors declare no conflicts of interest regarding this manuscript.

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