

Letter to the Editor

# Borrelia-like organism in heart capillaries of patient with Lyme-disease seen by electron microscopy<sup>☆</sup>

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## Abstract

A case of a patient who developed an acute myocarditis due to Lyme disease is reported. An increased serum antibody titer to *Borrelia burgdorferi* suggested a diagnosis and in addition of basic clinical methods, endomyocardial biopsy performed and analyzed by transmission electron microscopy. The lumen of myocardial capillaries was founded mostly filled with detritus and fibrin precipitate, between them several bacterial fragments were identified. The electron-microscopic characteristics of the microorganisms in this specimen, revealing irregularly coiled appearance and consistent thickness of 0.2  $\mu\text{m}$ , correspond to the spiral-like structure of Lyme disease borrelia. The presence of fibrin deposits on the capillary endothelium and necrosis of myocardiocytes, suggests that the cardiopathy in our patient was represent borrelia-mediated damage of the hearth microcirculation.

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## 1. Introduction

Lyme myocarditis is a common feature of Lyme disease, a multisystem disorder caused by *Borrelia burgdorferi* but, the pathogenesis of borrelia carditis is not fully understood. Only very rarely human tissues from Lyme carditis or the borrelia organism isolated from human heart have been examined. In the few original studies and case reports, *B. burgdorferi* has been reported in the human myocardium at the light microscope level [1–4] and once on the electron microscope [5]. We report here one of the very rarely de-

monstration of *B. burgdorferi* in myocardial biopsy of an acute case of Lyme disease using transmission electron microscopy (TEM).

## 2. Case

The patient concerned was a 36 year-old man from Novi Sad city region, Serbia, without data about ixodide attack, but who has been in the forest professionally, attended at the Clinic for Cardiovascular Disease, Sremska Kamenica. He reported developing a myocardiopathy and was clinically observed. Physical and laboratory examination of patient on admission revealed dyspnoea, syncopal crisis, bradycardia to 40/min., inversion of T wave in electrocardiogram (ECG, Fig. 1), the leukocyte count over  $10.10^9/l$ , and sedimentation rate 32/58 mm. In addition to the basic clinical methods, the myocardial biopsy was performed and four endomyocardial samples were analyzed by TEM. After that, Lyme

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serology was performed and indirect immunofluorescent test on Lyme borreliosis was highly positive, both IgM and IgG antibodies. The diagnosis of Lyme myocarditis in the present case was supported by a clinical history suggestive of Lyme disease and by positive serological testing. After appropriate therapy, the patient recovered and stayed well up today.

Myocardial biopsies for ultrastructural study were fixed in 2.5% glutaraldehyde for 2 h and rinsed thoroughly with cacodylate buffer for 1 h before being post-fixed in 1% aqueous OsO<sub>4</sub> solution for 90 min, rinsed again in cacodylate buffer, dehydrated, and embedded in Epon. Ultra-thin sections were then stained with uranyl acetate and lead nitrate, and examined using a Zeiss 109 electron microscope.

Analysis of bioptic samples revealed strongly marked degeneration of the contractile cardiocyte apparatus, extending to necrosis of particular cells. Series of changes observed in the preparation progressed from the hypercontractility of the myofibrils indicating hypoxia to the myofilament lysis and myofibril destruction to the fine-grain detritus (Fig. 2). Activated macrophages were visible in the surrounding interstices. The most interesting changes were observed in blood capillaries. Endothelial layer was covered with a large amount of fibrin deposits. The lumen was mostly filled with detritus and fibrin precipitate, between them several bacterial fragments were identified. The electron-microscopic characteristics of the microorganisms in this specimen, revealing irregularly coiled appearance and consistent thickness of 0.2 μm, correspond to the irregularly spiral bacterial structure of Lyme disease borrelia (Fig. 1). Apparent transversal sections of the borrelia, extracellular vesicles in the surroundings, like spheroplasts and disseminated filamen-

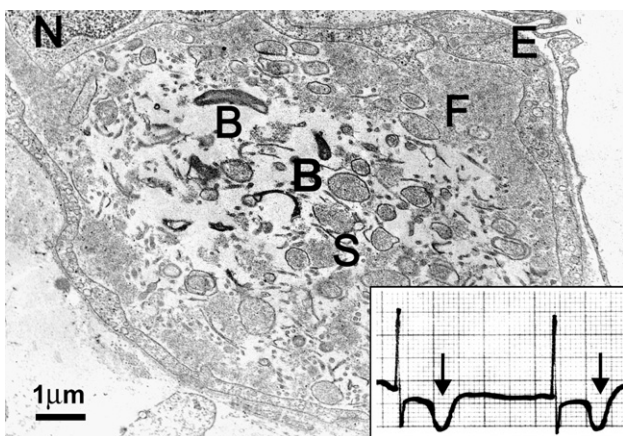


Fig. 1. Heart biopsy of patient, transmission electron microscope (TEM). Longitudinal and cross-sections of convoluted borrelia-like organism in the capillary lumen filled with fibrin and detritus. Insert picture: ECG of patient on the admission, inversion of T-wave. B-borrelia-fragments; E-endothelial cell; N-nucleus of endothelial cell, F-fibrin deposits; S-borrelia-spheroplasts, line bar-1 μm.

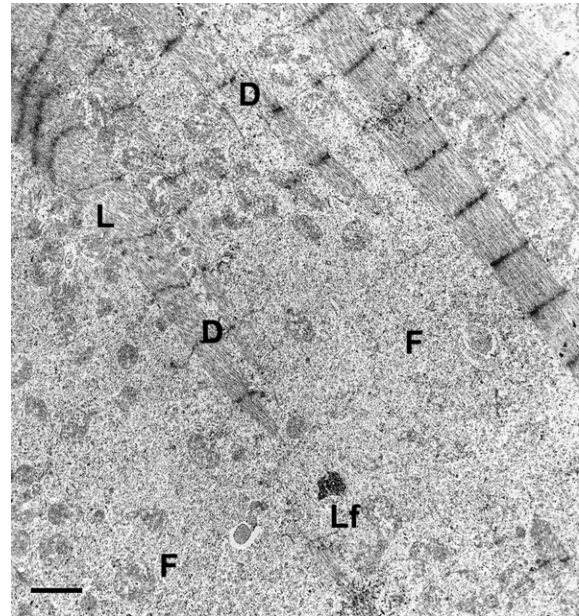


Fig. 2. Heart biopsy of patient, TEM. L-lysis of myofilaments; D-destruction of myofibrils; F-fine grain detritus; Lf-lipofuscin granula, line bar-1 μm.

tous structures like flagella of destructed borrelia, are also observed.

### 3. Discussion

MEDLINE database was searched using PubMed for articles containing “Lyme borreliosis myocarditis human” and founded 121 articles. Searching on “Lyme borreliosis biopsy electron microscopy” revealed only 18 papers. Results about direct finding of borrelia in capillaries in biopsy of human heart examined by TEM, to our knowledge, have only one group of authors [5,6]. Ultrastructural demonstrations of borrelia in synovial fluid and synovial membrane or in cutaneous tissue in human cases of Lyme disease were reported previously [7–12]. Obliterative alterations of blood vessels and fibrinoid were characteristic for infection of synovium when borrelia-like organisms were demonstrated in biopsies of all 14 patients with Lyme disease by the Bosma–Steiner silver impregnation method [13].

Our ultrastructural study confirmed the clinical diagnosis and provided further information about the condition and location of the borrelia organisms. The main finding of the study was that identifiable fragments of borrelia organisms have been shown to be located in the lumen of small myocardial capillaries and represent the massive borreliaemia. This localization may cause complement system and other inflammatory mediators activation, as described in the study of Cadavid et al. [14] on nonhuman primate Lyme carditis model. Interpretation of the multiple vesicular and disseminated filamentous structures seen on Fig. 1 as degenerated borrelia corresponded with experimental studies

in vitro which documented the potential of *B. burgdorferi* to transform itself into a metabolically inactive cystic form under unfavorable conditions [15].

Damage to heart tissues occurring in cardioborreliosis after dissemination of *B. burgdorferi* infection, derive from multiple mechanisms, including direct injury by the agent. The present case suggests that *B. burgdorferi* may be able to induced cardiac involvement by compromised microcirculation with microthrombosis of myocardial capillaries coated with fibrin deposits. Microcirculation damage and necrosis of some myocardiocytes in our case supported the evidence of the Lyme borreliosis infection involvement in the development of dilated cardiomyopathy, as was also indicated recently in the study of Bartůnek et al. [6].

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The authors of this manuscript have certified that they comply with the Principles of Ethical Publishing in the International Journal of Cardiology [16].

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