IDCases 20 (2020) e00761

Contents lists available at ScienceDirect

IDCases

journal homepage: www.elsevier.com/locate/idcr

Possible Lyme Carditis with Sick Sinus Syndrome

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ARTICLE INFO

Article history:
Received 29 April 2019
Received in revised form 19 March 2020
Accepted 21 March 2020

Keywords:
Lyme Disease
Lyme Carditis
Bradycardia
Sick Sinus Syndrome

ABSTRACT

Borrelia burgdorferi (*B. burgdorferi*) is a spirochete bacterium that is transmitted via the *Ixodes* tick. Infection results in Lyme disease with possible cardiac manifestations, which is also known as Lyme carditis. Patients can present with bradycardia due to rapidly fluctuating atrioventricular block (AVB), which is the hallmark of Lyme carditis. However, we present a rare case of sick sinus syndrome (SSS) without AVB in a 47-year-old man with Lyme disease. He initially presented with a headache and subsequently developed new onset bradycardia and a right cranial nerve (CN) VI palsy with diplopia. *B. burgdorferi* enzyme-linked immunosorbent assay (ELISA) screen and IgM western blot were positive. He was admitted to the intensive care unit. Electrocardiography (EKG) indicated a heart rate in the high 30 s beats per minute (BPM) with several pauses, but no AVB was present. The patient responded well to therapy, and was discharged with an outpatient regimen of doxycycline. Lyme carditis should be considered in patients who develop new onset bradycardia and live in endemic areas.

Introduction

Cardiac manifestations of Lyme disease, also known as Lyme carditis, were first described in 1977 [1]. The responsible pathogen is *B. burgdorferi*, which is a gram-negative spirochete bacterium that was first isolated in 1982 from the *Ixodes dammini* (*I. dammini, I. scapularis*) [2]. The *Ixodes* ticks serve as the vector, as *B. burgdorferi* is not transferred via direct person-to-person contact [3]. Lyme disease is the most commonly reported tick vector-borne illness in North America with most infections occurring during the summer months [4]. It is most endemic in the Northeastern, the Middle Atlantic, and the Upper Midwest [5,6].

About 1% of patients with Lyme disease develop cardiac manifestations [6]. Although fluctuating AVB is the most common manifestation in Lyme carditis, patients can also develop endocarditis, myocarditis, pericarditis, cardiomyopathy, decreased left ventricle ejection fraction (LVEF), and bundle branch blocks [7–9]. There is one reported case of tachycardia-bradycardia syndrome due to Lyme disease [10]. However, we describe a rare case of SSS secondary to Lyme carditis who presented with isolated bradycardia without any AVB, which resolved with the administration of antimicrobials.

Case

A 47-year-old man from Minnesota presented to his primary care provider during the month of July with a seven-day history of a severe headache that was localized to the right temple region. The patient admitted to light sensitivity but denied any unilateral eye tearing, rhinitis, neck stiffness, nausea, vomiting, shortness of breath, dizziness, palpitations, skin lesions, myalgia, joint pain, radiculopathy, or any known history of recent tick bites. Initially, the patient reported tactile pyrexia, which resolved with antipyretics. He subsequently developed chills and non-drenching diaphoresis. He denied any sick contacts. The only significant travel was that the patient went to western Tennessee one month prior to admission. He had a history of localized melanoma on his right temple status post resection. He denied a history of Lyme disease or Epstein-Bar Virus infection and had no prior testing. He had no previous military service. He had two dogs and one indoor/outdoor cat. He worked as a cable and satellite dish installer in rural areas in the Midwest.

On initial examination, his pulse was 77 BPM, and all other vitals were stable. There were no pertinent findings on physical exam. The patient tested positive on a *B. burgdorferi* ELISA screen. In turn, serial convalescent serum testing was not performed. A *B. burgdorferi* Western blot was performed, which was later shown to be positive with two IgM bands but no IgG bands. Doxycycline was started empirically on an outpatient basis. The patient returned the next day due to the persistence of his headaches. An EKG indicated

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https://doi.org/10.1016/j.idcr.2020.e00761

normal sinus rhythm (NSR) with no AVB. A head computed tomography (CT) without contrast was performed, which did not show any significant findings. The patient was then referred to the emergency department.

While there, opiates were started because his headache increased in size, including the right retro-orbital and now maxillary area. A LP was performed without any complications. Ceftriaxone and acyclovir were added to the patient's regimen of doxycycline due to concerns of meningitis.

Of note, the patient was bradycardic at the time of admission. A repeat EKG indicated sinus bradycardia with a ventricular rate of 45 BPM and no AVB (Fig. 1). A transthoracic echocardiogram did not show any evidence of valvular disease or myocardial dysfunction. The patient subsequently developed more prominent bradycardia with a heart rate in the high 30 BPM and several two second pauses. The results of the LP eventually showed 7 cells/μL (all non-polymorphonuclear neutrophils) with slightly elevated protein (54 mg/dL) and normal glucose (88 mg/dL with serum glucose 170 mg/dL) in the CSF. The *B. burgdorferi* polymerase chain reaction (PCR) testing was negative. IgG antibodies against *B. burgdorferi* tested positive in the CSF, but IgG antibody index was negative. A CSF cytology revealed no malignant cells. Acyclovir was discontinued when Herpes simplex virus and Varicella zoster virus PCR testing on the CSF were negative. The patient subsequently developed diplopia and a right CN VI palsy. Brain magnetic resonance imaging was unremarkable.

Since the patient had asymptomatic sinus bradycardia with no AVB in the setting of a positive IgM *B. burgdorferi* Western blot, the patient was diagnosed with SSS secondary to early disseminated Lyme disease. The bradycardia resolved over 7 days on antimicrobials and did not require a pacemaker during the entirety of his admission. The patient was discharged and completed a 28-day course of oral doxycycline. The patient remained in NSR without any AVB after discharge. He still complained of occasional headaches, but they were not as painful as compared to the initial presentation. His diplopia resolved over 4 weeks.

Discussion

There are three stages of Lyme disease. Patients, as seen here, do not have to present with the full continuum of symptoms and may not develop symptoms associated with all stages in a step-wise fashion [7]. The early localized stage of Lyme disease, also known as stage 1, can involve the development of erythema migrans (EM), which was previously referred to as Erythema Chronicum Migrans [11]. The lesion can present as a macule or papule and develop into an annular lesion with central clearing [8,11]. Patients can present with a singular lesion or with multiple lesions along with burning sensation, warmth, induration, pruritis, or tenderness [8].

Prior to the development of the EM, patients can present with fevers, chills, malaise, fatigue, myalgia, headache, neck stiffness, and back pain [8,11]. These symptoms typically last for less than a week. However, symptoms of fatigue and malaise can persist for weeks, even after the resolution of the EM [8]. Patients may also be asymptomatic and not present with any early localized symptoms, including EM [8,11].

Cardiac manifestations can present during the early disseminated stage, also known as stage 2, of Lyme disease. Only about 1% of Lyme disease patients have confirmed Lyme carditis. [6]. Symptoms typically develop about 3 weeks after developing EM; however, others can develop cardiac features anywhere from 1 to 12 weeks after the appearance of EM [7]. The pathogenesis involves the direct infiltration of *B. burgdorferi* into cardiac tissue [12]. The resulting inflammatory process involves macrophages and lymphocytes and disrupts the conduction system [12,13].

The most common cardiac manifestation is rapidly fluctuating degrees of AVB that can progress to complete heart block over the course of minutes [7,8]. Complete heart block can result in junctional escape beats from the Purkinje fibers and Bundle of His [7]. However, we present a case of bradycardia due to SSS, as our patient presented with sinus bradycardia with pauses and no AVB. Other findings of Lyme carditis on EKG include left bundle branch block, right bundle branch block, diffuse ST segment depression with prominence in the anterolateral leads, and T wave flattening or inversions, which are typically present in the inferolateral leads [7]. Patients can also have atrial fibrillation that can present with rapid ventricular response, isolated tachycardia-bradycardia syndrome, endocarditis, myocarditis, pericarditis, pericardial effusions, and rarely cardiomegaly [7–10]. Patients can develop decreased LVEF that is reversible with treatment [7,8]. Patients can also present with dizziness, syncope, dyspnea, palpitations, and chest pain [7,8]. Failure to provide timely treatment can ultimately result in sudden cardiac death, but this is quite rare [12].

Neurological manifestations can develop during Lyme neuroborreliosis, which is also a part of the early disseminated stage of Lyme disease. The most common symptoms are excruciating headaches and neck stiffness [11]. Patients can also present with the triad of lymphocytic meningitis, radiculoneuritis, and cranial neuritis, which can involve CN III, IV, V, and VI [6,11,14,15].

The Suspicious Index in Lyme Carditis (SILC) Risk Score is a risk stratification tool that was developed by Besant et al. in order to assess if the etiology of undifferentiated patients with high-degree AVB could be due to Lyme carditis. This tool has a sensitivity of 93.2%; however, there is no data on the specificity because no control group was used. This tool assigns one point to patients who are under the age of 50 years-old, are male, or participated in outdoor activities and/or living in endemic areas. Two points are assigned for constitutional symptoms, which were defined as fevers, malaise, arthralgia, dyspnea, pre-syncope, and syncope. Three points are assigned for those with a history of tick bites, and four points are assigned for the presence of EM. A score of 0-2 suggests a low risk for Lyme carditis, and routine standard of care for the treatment of AVB is recommended. A score of 3-6 suggests intermediate risk, and a score of 7-12 is considered high risk. For patients with an intermediate to high risk, Besant et al. recommends serological testing for Lyme disease, starting empiric antimicrobials, possible pacemakers for patients with symptomatic bradycardia, and admission for close monitoring [16].

Our patient did not have an AVB and had a SILC Risk Score of 3 (age, gender, and outdoor exposure), suggesting an intermediate risk for Lyme carditis. However, this tool is designed specifically to risk stratify patients with AVB [16]. Further research is needed to evaluate if the SILC Risk Score can be used to risk stratify for Lyme carditis in patients presenting solely with bradycardia without AVB.

The Centers for Disease Control and Prevention recommends a two-tiered serological testing modality for diagnosing Lyme disease. First tier testing includes running enzyme immunoassay or indirect immunofluorescence assay. If these results are negative, no other testing for Lyme disease is recommended. However, empiric antimicrobials may be started if there is suspicion of Lyme carditis despite the negative first tier testing. Afterward, serial convalescent serum should be drawn at two and four weeks. If first tier testing is positive or equivocal, second tier testing can be performed depending on the duration of the patient's symptoms. If symptoms have been present for 30 days or less, an IgG and IgM western blot for *B. burgdorferi* antigens is recommended. If symptoms are present for more than 30 days, an IgG western blot that detects IgG antibodies against *B. burgdorferi* antigens is recommended [17].

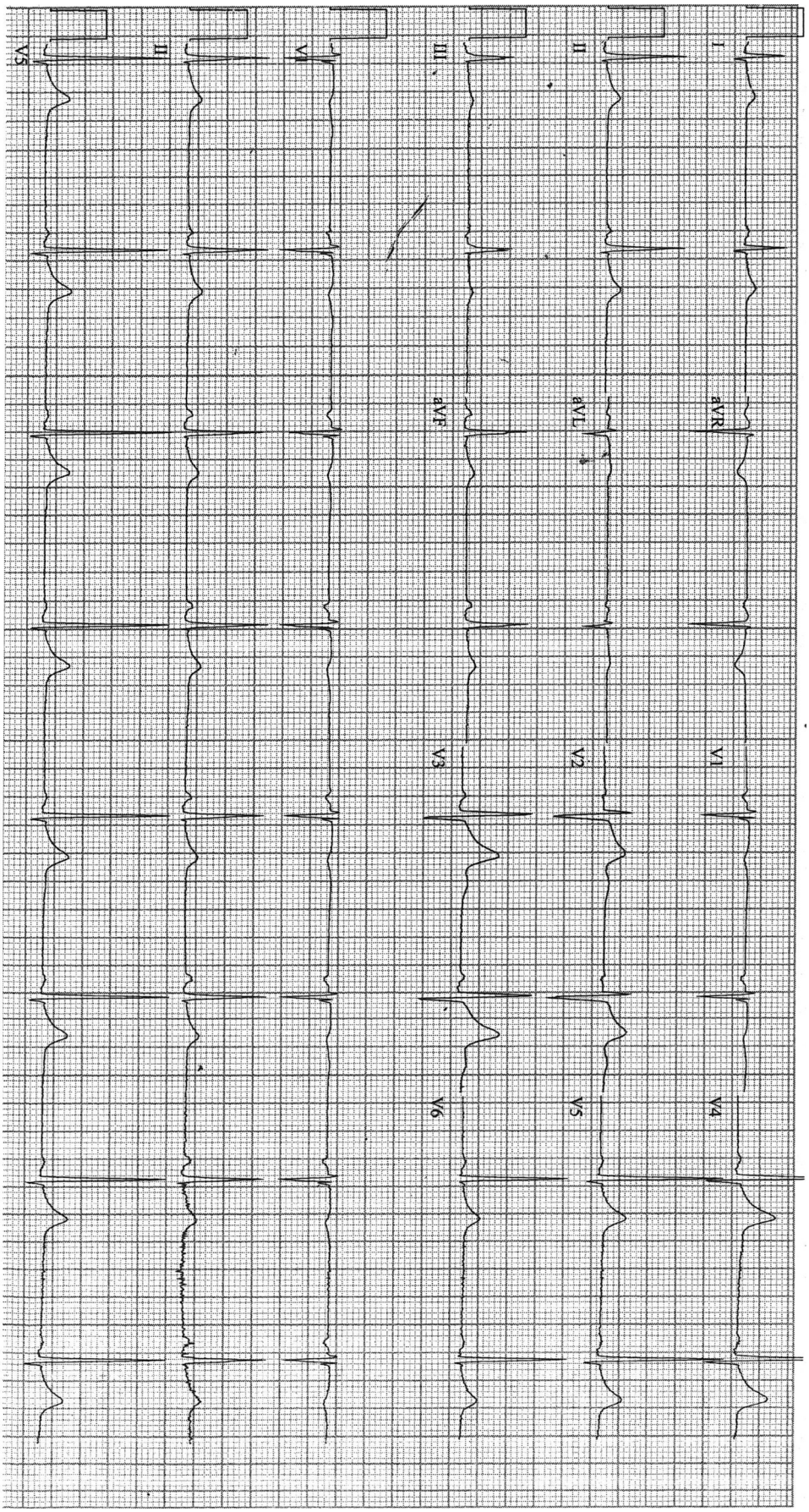

Fig. 1. EKG at admission. It indicates a heart rate of 45 BPM with no AVB.

For patients with early localized Lyme disease, doxycycline, amoxicillin, and cefuroxime are first line. For children younger than 8-years-old, pregnant women, and lactating mothers, amoxicillin and cefuroxime are first line, and doxycycline should be avoided due to the discoloration of teeth [18].

For patients with early dissiminated Lyme disease, ceftriaxone is first line for patients with AVB, myopericarditis, meningitis, or radiculopathy. Doxycycline is an alternative oral therapy. For symptomatic bradycardia and 2nd or 3rd degree AVB, temporary pacemaker can be used in conjunction with antimicrobials. Cefotaxime and penicillin G can be used as alternatives for neurological manifestations. For patients with late disseminated Lyme disease without cardiac or neurologic manifestations, doxycycline, amoxicillin, or cefuroxime are first line. Nonsteroidal anti-inflammatory drugs, disease-modifying antirheumatic drugs, and steroid intra-articular injections can be used for symptom relief [18].

We present a patient with SSS without AVB in a patient with Lyme disease with an intermediate SILC risk score. SSS is an exceedingly rare presentation of Lyme carditis. Further research is needed to evaluate if the SILC Risk Score can successfully risk stratify for Lyme carditis in undifferentiated patients presenting with SSS.

Sources of funding

None declared.

Ethical Approval

Written informed consent was obtained from the patient for publication of this case report. A copy of the written consent is available by the Editor-in-Chief of this journal on request.

CRediT authorship contribution statement

Brian Cheung: Conceptualization, Resources, Writing - original draft, Writing - review & editing, Project administration. **Larry Lutwick:** Conceptualization, Investigation, Data curation, Writing - review & editing, Supervision, Project administration. **Michelle Cheung:** Resources, Writing - review & editing.

Declaration of Competing Interest

B.C. received a cash prize from Amgen for the National Lipid Association Young Investigator Award. L.L. is the Editor-in-Chief or ID Cases and one of the physicians of the patient described in this case.

References

[1] Steere AC, Malawista SE, Snydman DR, et al. Lyme arthritis: an epidemic of oligoarticular arthritis in children and adults in three Connecticut communities. Arthritis Rheum. 1977;20:7–17.
[2] Burgdorfer W, Barbour AG, Hayes SF, Benach JL, Grunwaldt E, Davis JP. Lyme disease-a tick-borne spirochetosis? Science 1982;216:1317–9.
[3] Steere AC, Broderick TF, Malawista SE. Erythema chronicum migrans and Lyme arthritis: epidemiologic evidence for a tick vector. Am J Epidemiol. 1978;108:312–21.
[4] Rosenberg R, Lindsey NP, Fischer M, et al. Vital signs: trends in reported vectorborne disease cases - United States and territories, 2004-2016. MMWR Morb Mortal Wkly Rep. 2018;67:496–501.
[5] Lyme Disease Maps: Most Recent Year | Lyme Disease | CDC. 2019. . Published January 3, Accessed February 4, 2019 https://www.cdc.gov/lyme/datasurveillance/maps-recent.html.
[6] Lyme Disease Charts and Figures: Historical Data | Lyme Disease | CDC. 2018. . Published December 21, Accessed February 4, 2019 https://www.cdc.gov/lyme/stats/graphs.html.
[7] Steere AC, Batsford WP, Weinberg M, et al. Lyme carditis: cardiac abnormalities of Lyme disease. Ann Intern Med. 1980;93:8–16.
[8] Steere AC, Malawista SE, Hardin JA, Ruddy S, Askenase W, Andiman WA. Erythema chronicum migrans and Lyme arthritis. The enlarging clinical spectrum. Ann Intern Med. 1977;86:685–98.
[9] Anish SA. Case report: possible Lyme endocarditis. N J Med. 1993;90:599–601.
[10] Bartůněk P, Němec J, Mrázek V, Gorican K, Zapletalová J. [Borrelia burgdorferi as a cause of sick sinus syndrome?]. Cas Lek Cesk 1996;135:729–31.
[11] Steere AC, Malawista SE, Bartenhagen NH, et al. The clinical spectrum and treatment of Lyme disease. Yale J Biol Med. 1984;57:453–64.
[12] Muehlenbachs A, Bollweg BC, Schulz TJ, et al. Cardiac tropism of Borrelia burgdorferi: an autopsy study of sudden cardiac death associated with Lyme carditis. Am J Pathol. 2016;186:1195–205.
[13] Ruderman EM, Kerr JS, Telford SR, Spielman A, Glimcher LH, Gravallese EM. Early murine Lyme carditis has a macrophage predominance and is independent of major histocompatibility complex class II-CD4+ T cell interactions. J Infect Dis. 1995;171:362–70.
[14] Cardenas-de la Garza JA, De la Cruz-Valadez E, Ocampo-Candiani J, Welsh O. Clinical spectrum of Lyme disease. Eur J Clin Microbiol Infect Dis. 2019;38:201–8.
[15] Garcia-Monco JC, Benach JL. Lyme neuroborreliosis. Ann Neurol. 1995;37(6):691–702.
[16] Besant G, Wan D, Yeung C, et al. Suspicious index in Lyme carditis (SILC): systematic review and proposed new risk score. Clinical Cardiology 2018 (October).
[17] Two-step Laboratory Testing Process | Lyme Disease | CDC. 2019. . Accessed March 13 https://www.cdc.gov/lyme/diagnosistesting/labtest/twostep/index.html.
[18] Wormser GP, Dattwyler RJ, Shapiro ED, et al. The clinical assessment, treatment, and prevention of Lyme disease, human granulocytic anaplasmosis, and babesiosis: clinical practice guidelines by the Infectious Diseases Society of America. Clin Infect Dis. 2006;43:1089–134.