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# Lyme Carditis Complicated by Polymorphic Ventricular Tachycardia and Cardiac Arrest: A Case Report

**Negar Esfandiari, BHSc[1], Tanesha Beebe-Peat, MD[2], Anna Quinlan, BA[1], Beth Wagner, DO[3], Tyler Wark, MD[4], and Robert Lobel, MD[4]**

**Abstract**

Lyme disease is commonly encountered in endemic areas of the United States harboring the causal organism *Borrelia burgdorferi*. Lyme carditis can manifest in early disseminated infections, usually as atrioventricular nodal blockade. Timely antibiotic therapy typically suppresses myocardial inflammation and reverses cardiac conduction disturbances. We present a case of a previously healthy male who presented to the emergency department with non-prodromal syncope, multifocal annular rashes, and antecedent inflammatory knee pain and effusion, found to have positive 2-tier Lyme testing and pause-dependent polymorphic ventricular tachycardia leading to cardiac arrest. Lyme carditis occurs in early disseminated infections but rarely leads to cardiac arrest. Acute management is entrained in well-established guidelines for therapy, and together with risk stratification scoring can be considered by emergency care physicians in the workup of undifferentiated syncope with concern for Lyme disease with cardiac involvement.

**Keywords**

Lyme carditis, polymorphic ventricular tachycardia, complete heart block, cardiac arrest, case report

## Introduction

*Borrelia burgdorferi* is the spirochetal bacterium responsible for causing Lyme disease. This tick-borne illness is endemic to states in New England, as well as in New York, Wisconsin, and Minnesota.[1] Lyme disease can be successfully treated with doxycycline in the early stage and with ceftriaxone in disseminated stages. Bacterial infiltration and inflammation commonly cause atrioventricular (AV) nodal blockade, ranging from first-degree to third-degree heart block.[2] Lyme carditis can also manifest with infra-nodal blockade, with supraventricular or ventricular ectopy or arrhythmias, and with ST segment and T wave changes on the electrocardiogram (ECG) representing active myocardial involvement.[2] Timely treatment with antibiotics can reverse cardiac conduction disturbances like AV nodal blockade, with transvenous pacemaker support reserved as a temporizing safeguard measure to allow sufficient time for antibiotics to work.[3] Lyme carditis is important to recognize because it is easily treated.

## Case Report

A 26-year-old male presented to his primary care physician in the late summer with 1 week of subjective fevers and an erythematous and painful swollen knee. He denied recent tick bites, but noted spending ample time outdoors walking in the local woods. Arthrocentesis demonstrated an inflammatory profile with positive calcium pyrophosphate crystals and no organisms. His knee pain and effusion resolved with a short course of nonsteroidal anti-inflammatory treatment. Two weeks later he presented to the emergency department (ED) at a community hospital following 2 episodes of syncope, the first with minimal exertion and the second occurring at rest several minutes later. He denied chest pain,

[1]Robert Larner, M.D. College of Medicine, University of Vermont, Burlington, USA
[2]Department of Medicine, The University of Vermont Medical Center, Burlington, USA
[3]Department of Medicine, Central Vermont Medical Center, Berlin, USA
[4]Division of Cardiovascular Medicine, The University of Vermont Medical Center, Burlington, USA

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**Corresponding Author:**
Negar Esfandiari, BHSc, Robert Larner, M.D. College of Medicine, University of Vermont, 89 Beaumont Ave, Burlington, VT 05405, USA.
Email: negar.esfandiari.1@med.uvm.edu

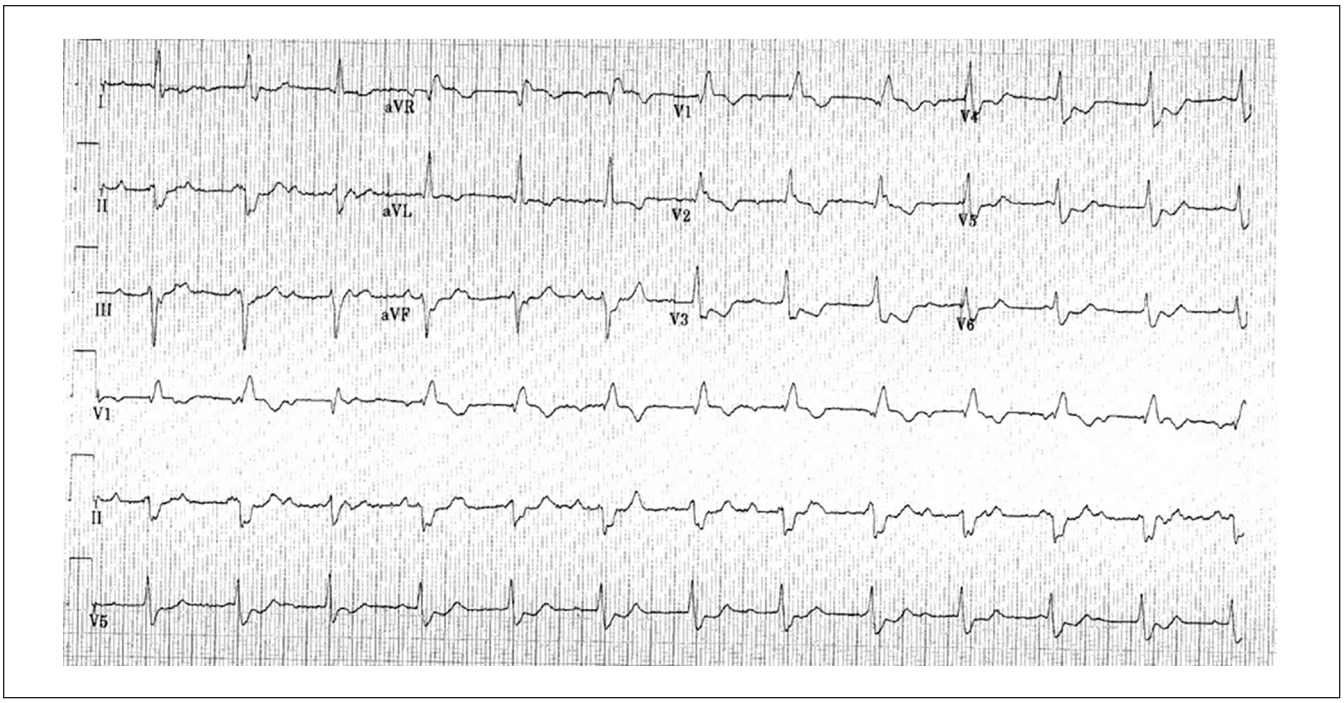


**Figure 1.** Admission electrocardiogram demonstrating high-grade block with atrioventricular dissociation and an infrahisian escape rhythm with a right bundle branch and left anterior fascicular pattern (corrected QT interval: 480 milliseconds).
Abbreviation: VF, ventricular fibrillation.

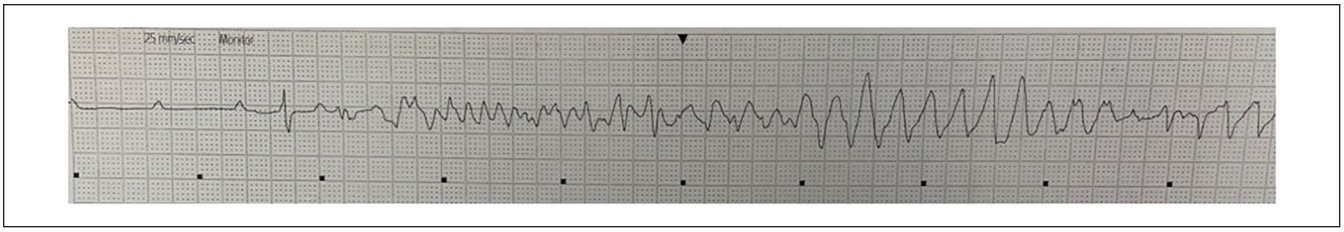


**Figure 2.** Representative electrocardiographic tracing from continuous cardiac monitoring demonstrating pause-dependent polymorphic ventricular tachycardia in the setting of high-grade atrioventricular block.

dyspnea on exertion, palpitations, cough, unilateral facial numbness, slurred speech, gait disturbance, and confusion.

He was afebrile and other vital signs were notable for a blood pressure of 106 over 56 mmHg and heart rate of 60 beats/min. Cardiovascular examination demonstrated an irregular rhythm and bradycardic rate without murmurs, rubs, or gallops. His lungs were clear to auscultation bilaterally and extremities were warm and well perfused. Neurologic and musculoskeletal examinations showed normal pupillary responses, normal neck range of motion, grossly normal cranial nerves, and the absence of large joint effusions. Skin examination showed multifocal truncal annular rashes without peripheral scaling or palmar-solar involvement.

Given the high incidence of Lyme disease in Northeastern United States, as well as the patient's presenting symptoms, Lyme disease was suspected. Serologies were obtained and the results became available while the patient was in the ED and were notable for positive Lyme antibodies (IgM and IgG). The Western blot resulted after admission, with positive IgM and negative IgG. Electrolyte levels, thyroid stimulating hormone, and brain natriuretic peptide levels were all within normal limits and *SARS-CoV-2* testing was negative. Cardiac troponin I was trended to peak at 0.074 ng/ml (reference range less than 0.034 ng/ml).

Imaging findings were notable for a single-view chest X-ray without hilar fullness, mediastinal widening, cardiomegaly, or interstitial markings. His admission ECG demonstrated AV block with an infrahisian escape rhythm with a right bundle branch and left anterior fascicular pattern suggesting a left posterior fascicular origin of escape (Figure 1). He was initiated on empiric high-dose ceftriaxone 2 g daily and admitted to the medical intensive care unit (MICU) for further monitoring. Upon arrival to the MICU, his rhythm quickly degenerated into polymorphic ventricular tachycardia leading to cardiac arrest (Figure 2).

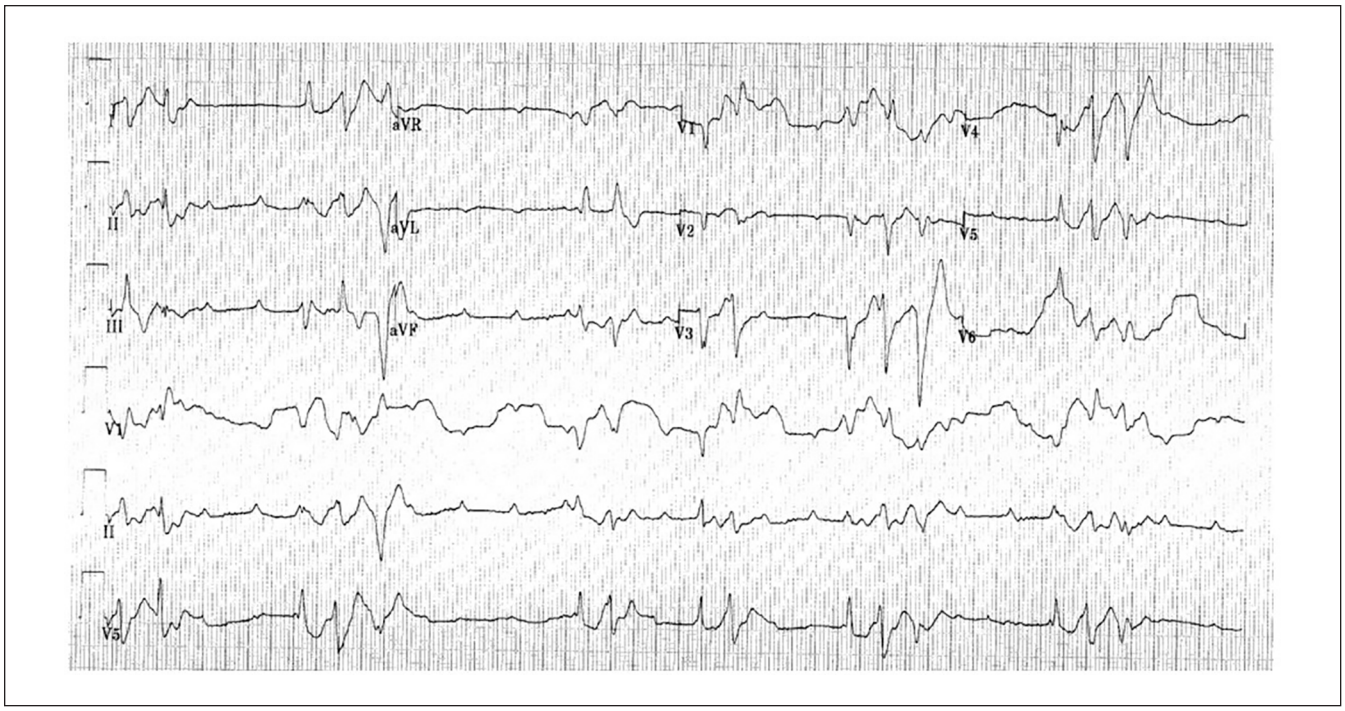


**Figure 3.** Postarrest electrocardiogram demonstrating high-grade atrioventricular block and short-coupled R-on-T premature ventricular contractions triggering non-sustained polymorphic ventricular tachycardia.
Abbreviation: VF, ventricular fibrillation.

He was immediately resuscitated with 1 round of cardiopulmonary resuscitation, a single unsynchronized shock, 1 mg of intravenous epinephrine, and a 1-L normal saline bolus. He was neither intubated nor centrally cannulated for vascular access, as following resuscitation he was alert with a Glasgow Coma Score of 15 and with adequate blood pressure. He was loaded with amiodarone 150 mg intravenously, followed by an amiodarone drip at 1 mg/h, and received magnesium 2 g intravenously. In the immediate post-resuscitation period, his rhythm continued to demonstrate high-grade AV block and short-coupled R-on-T premature ventricular contractions triggering non-sustained polymorphic ventricular tachycardia (Figure 3). He was transferred to a tertiary care center for further management.

Upon arrival to the tertiary care center, he remained in a stable perfusing rhythm, at times in a slower idioventricular rhythm, but without significant pauses, recurrent malignant ventricular arrhythmias, or evidence of evolving circulatory collapse. Inpatient electrophysiology and infectious diseases teams were consulted. Amiodarone was discontinued and he was continued on high-dose ceftriaxone. A transthoracic echocardiogram demonstrated moderately reduced left ventricular systolic function (ejection fraction: 40-45%) with mild diffuse hypokinesis, abnormal septal motion, and a mildly dilated right ventricular cavity with mildly reduced systolic function. Other diagnoses including sarcoidosis and viral myocarditis were strongly considered in the differential diagnosis, especially given his abnormal septal motion and biventricular dysfunction on echocardiogram and wide complex infrahisian escape rhythm with a prior documented malignant ventricular arrhythmia. Temporary venous pacemaker (TVP) implantation was considered but deferred for several important reasons: ongoing hemodynamic stability, absence of symptomatic bradycardia and recurrent ventricular arrhythmias for over 24 hours since transport, patient's refusal of invasive procedures and recurrent threats to leave the hospital against medical advice, ability to expedite advanced cardiac imaging in coordination with the Radiology Department, and given that the presence of a TVP wire would preclude advanced cardiac imaging required to refine the differential diagnosis. Ultimately, he agreed to a gated cardiac MRI which demonstrated a normalized left ventricular ejection fraction and no evidence of late gadolinium enhancement to suggest active myocarditis, myocardial edema, infiltrative disease, or scar.

Given the patient's favorable clinical response to continued parenteral antibiotic therapy and the suspected reversibility of his condition, neither permanent pacemaker nor internal cardiac defibrillator implantation was indicated. On the third day of hospitalization, he insisted on discharging against medical advice. His predischarge ECG showed first-degree AV delay (PR interval: 268 milliseconds), a corrected QT interval of 445 milliseconds, and an incomplete right bundle branch block. He was de-escalated to oral

doxycycline 100 mg twice daily, provided instruction to complete a 21-day course of therapy, and scheduled for close follow-up with his primary care physician and a local cardiologist. After completing his course of doxycycline, his rhythm had normalized on a repeat ECG obtained in routine outpatient follow-up with his primary care physician.

## Discussion

This is a case of a patient presenting with pause-dependent polymorphic ventricular tachycardia leading to cardiac arrest from early disseminated Lyme carditis in the setting of high-grade AV block with an infrahisian escape rhythm with a right bundle branch and left anterior fascicular pattern and QT interval prolongation. Reports of malignant ventricular arrhythmias leading to cardiac arrest from Lyme carditis are exceedingly rare, with only 1 non-English case report from Denmark describing a similar situation,[4] and another describing a previously healthy 16-year-old male presenting with a witnessed cardiac arrest in the setting of acute Lyme perimyocarditis, ventricular fibrillation storm, and underlying Brugada pattern on ECG with an underlying PR interval of 252 milliseconds.[5] Transient acquired QT interval prolongation in patients with Lyme carditis has also been reported in a case series, presumably due to the same pathologic process affecting AV nodal function, though possibly unmasked by some degree of intrinsic genetic susceptibility.[6]

Specific treatment for Lyme disease differs based on the stage and severity of the disease. For Lyme carditis in adults specifically, treatment depends on whether there is mild or severe Lyme carditis and is outlined by the Centers for Disease Control and Prevention as follows. Mild Lyme carditis is defined as first-degree AV block with a PR interval of less than 300 milliseconds and can be treated with oral medications. This includes oral doxycycline 100 mg twice daily for 14 to 21 days; oral amoxicillin 500 mg 3 times daily for 14 to 21 days, or oral cefuroxime 500 mg twice daily for 14 to 21 days. Severe Lyme carditis is defined as first-degree AV block with a PR interval of equal to or greater than 300 milliseconds, second-degree or third-degree AV block, or being symptomatic, and can be treated with intravenous ceftriaxone 2 g once daily for 14 to 21 days.[7]

Our patient was fortunately responsive to immediate resuscitative and ongoing supportive care, including parenteral antibiotics with demonstrable improvement in his cardiac electrical disturbances after a few days. Although a differential diagnosis was considered in this case, empiric therapy for Lyme carditis was appropriately initiated given its high clinical suspicion and potentially fatal consequences if left untreated.[8] His presentation to a smaller community hospital where clinicians frequently encounter Lyme disease ensured early consideration of Lyme carditis in his hospital course. The geographical expansion of Lyme disease proffers greater vigilance among all clinicians working on the front lines of health care to ensure expeditious recognition.

Risk stratification scores, like the Suspicious Index in Lyme Carditis (SILC) score, may be considered in clinical scenarios of unexplained conduction abnormalities or arrhythmias to identify key risk factors, especially given the limitations of Lyme serologies in the acute care setting.[9] The SILC score is composed of 6 patient-specific variables (age less than 50 years old, male gender, outdoor activity or endemic area, constitutional symptoms, tick bite, and erythema migrans) rated on a 12-point scale with 0 to 2 points indicating low probability of Lyme carditis treated as per standard management, and 3 to 6 points and 7 to 12 points indicating intermediate risk and high risk for Lyme carditis, respectively. For intermediate- and high-risk scores, management can include obtaining Lyme serologies, initiation of antibiotic treatment, and use of temporary or temporary-permanent pacing (TPP) if bradycardia is symptomatic. The strategy of TPP has been previously described with the added benefits of lead durability, early patient mobilization, and mitigation of clinical deconditioning.[10] In our case, deterioration of AV conduction was a potential concern, and placement of temporary wire or TPP pacing system would have been a reasonable management strategy but omitted based on other clinical and nonclinical factors as previously mentioned. Finally, given sudden cardiac arrest in younger patients is often secondary to myocarditis, cardiomyopathies, and channelopathies, early clinical follow-up for repeat ECG normalization could help direct further care like obtaining a 3-generation pedigree and/or pursuing genetic testing.

## Conclusion

Malignant arrhythmia-associated cardiac arrest secondary to Lyme carditis is rare. This report describes such a case in an otherwise healthy patient. To our knowledge, this is the first reported case in English of pause-dependent polymorphic ventricular tachycardia leading to cardiac arrest in the setting of Lyme disease. The patient remained asymptomatic after resuscitative efforts and his malignant arrhythmia did not recur with prompt initiation of parenteral antibiotic therapy. Advanced cardiac imaging helped rule out other pathologies. Emergency health care providers should be aware of the SILC score for risk stratification and the possibility for complicating ventricular arrhythmias leading to cardiac arrest in the setting of Lyme carditis.

### Authors' Note

This case will be presented as an abstract at the American College of Cardiology Conference (ACC22), Washington, DC on April 2, 2022 to April 4, 2022.

### Declaration of Conflicting Interests

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## Ethics Approval

The University of Vermont Medical Center does not require IRB approval for case reports.

## Informed Consent

Written and verbal consent was obtained from the patient.

## ORCID iD

Negar Esfandiari https://orcid.org/0000-0001-5485-0199

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