



## A Reversible Cause of Complete Heart Block: Lyme Carditis in a Young Athlete

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### Introduction

Lyme disease is an example of a multisystem infection. It may present in the patient as a dermatologic, neurological, musculoskeletal, or heart condition. Cardiac manifestations, together referred to as Lyme carditis, are the ones that happen in about 5% to 10% of the cases and are mostly represented by Atrioventricular (AV) conduction abnormalities. The pathogen reaches myocardium and surrounding tissues, and localized inflammation, edema, and transient conduction blockade follow. The AV node in particular is very sensitive, and the resultant block can vary or progress quickly from first to second and even third-degree blocks. Therefore, if the conduction abnormality is allowed to persist without appropriate intervention (antibiotic therapy), it can extend to complete heart block and, in some instances, sudden cardiac death [1].

Lyme disease, caused by *Borrelia burgdorferi* is a multisystem infection that can manifest as a dermatological, neurological, musculoskeletal, or heart condition. Cardiac involvement, known as Lyme carditis, occurs in about 5% to 10% of cases and most commonly presents with Atrioventricular (AV) conduction abnormalities. The pathogen reaches the myocardial and surrounding tissues, leading to localized inflammation, edema, and conduction block. The AV node is particularly sensitive to blockade, ranging from first-degree to complete heart block. These high degree blocks, in rare cases, can result in sudden cardiac death.

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According to guidelines by the ACC, AHA, and HRS, AV block due to Lyme carditis is typically reversible and thus permanent pacemaker implantation should be avoided unless the conduction blockade persists despite antibiotic therapy. Besides these, the Infectious Diseases Society of America (IDSA), American Academy of Neurology (AAN) [2], and American College of Rheumatology (ACR) recommend that a patient with a PR interval  $\geq 300$  ms or with a high-grade block should be admitted to the hospital and monitored continuously, as they are at risk of developing complete heart block.

### Case Presentation

A 38-year-old male with a medical history of major depressive disorder and attention-deficit/hyperactivity disorder presented to the emergency department with a two-week history of persistent bradycardia. At baseline the patient was highly active, engaging regularly in weightlifting, cycling, and jiu-jitsu. He reported that his resting heart rate, typically in the 60-70s, had fallen to the low 40s and that his heart rate during exercise would not increase beyond the 80-90 range, even with vigorous exercise, whereas before it would rise to the 150s. He denied any associated dizziness, lightheadedness, syncope, chest pain, dyspnea, or weakness [3,4].

Two weeks prior to his admission, he had discontinued compounded medications (Clomiphene citrate (an off-label fertility medicine used to treat hypogonadism in men) and Retatrutide (a GLP-1 analogue in clinical trials)) without improvement of his bradycardia. He reported no family history of cardiac disease, and his social history included only occasional alcohol and cigarette use. Of note, he had recently traveled to New England during the summer, 3 months prior to admission. During his travel, he had developed a viral illness that resolved without treatment. However, following its resolution, the patient reported episodes of orthostasis whenever he would stand up too quickly, and this persisted until his presentation to the hospital.

Upon presentation, his vital signs were notable for a heart rate 48 bpm. Physical examination was unremarkable except for bradycardia on auscultation and a mildly delayed capillary refill time of 2-3 seconds. Laboratory studies revealed an unremarkable complete blood count and metabolic panel, a TSH <0.001  $\mu$ U/mL with T4 of 1.71 ng/dL, BNP of 1,415 pg/mL, and negative troponin. An Electrocardiogram (ECG) demonstrated sinus bradycardia with both a first-degree heart block and a 2:1 AV block, rightward axis, and "camel-hump" T-waves. CT chest angiography was unremarkable.

Upon further cardiac workup, a Transthoracic Echocardiogram (TTE) showed normal Left Ventricular (LV) systolic function with an ejection fraction of 60% to 65%, normal LV strain, and a severely dilated inferior vena cava, consistent with carditis. An exercise stress test revealed impaired chronotropic competence, with the heart rate increasing only to 125 bpm (68% of predicted maximum) and no ischemic changes. Cardiac MRI demonstrated normal biventricular function, no late gadolinium enhancement, and no structural or infiltrative abnormalities. Lyme serologies returned positive for both IgM and IgG, confirming a diagnosis of Lyme carditis with high-grade AV block.

### Hospital course and management

The patient was admitted for telemetry monitoring and was started on IV ceftriaxone 2 g daily for a patient with significant conduction abnormalities in the hospital secondary to Lyme carditis. Infectious Disease and Cardiology were consulted. Since he was asymptomatic and otherwise hemodynamically stable, a temporary pacemaker was not deemed necessary. Serial ECGs demonstrated a gradual improvement from complete 2:1 AV block on Hospital Day (HD) 1 to intermittent 1:1 conduction with persistent PR prolongation >350 ms on HD 7. Electrolyte optimization was continued with potassium >4.0 mmol/L and magnesium >2.0 mg/dL [5].

The patient showed progressive conduction recovery over 7 days. Myocarditis and myocardial scarring were ruled out by cardiac MRI. As the patient's condition was expected to recover with antibiotics, permanent pacemaker implantation was deferred. Repeat exercise stress test 14 days after admission demonstrated improved chronotropic competence and conduction. Patient's antibiotic course was changed to oral doxycycline 100 mg twice daily to complete a 21-day course. He was discharged with close outpatient follow-up with electrophysiology, infectious disease, and endocrinology for evaluation of subclinical.

### Discussion

This case is a typical instance of Lyme carditis with a high-grade AV block in a young adult who was previously in good health. Lyme disease is a primary reversible cause of conduction abnormalities recognized in the literature, and early antibiotic therapy can restore normal AV conduction very effectively [6]. The diagnostic difficulty lies in detecting the association between an unexplained bradyarrhythmia and recent tick exposure or travel to the areas where the disease is endemic.

When the heart is involved, the inflammation caused by the *B. burgdorferi* spirochetes in the myocardial conduction system is what leads to the fluctuating degrees of AV block. The PR interval is a significant clinical indicator; if a PR interval is  $\geq 300$  ms or there is a high-grade AV block, the patient should be admitted to a hospital and placed on continuous telemetry because the block may progress rapidly, which can lead to significant clinical decompensation and

even death. Here, the patient's ECG showing 2:1 AV block and PR >350 ms was consistent with these known cardiac manifestations of Lyme disease.

Management based on guidelines revolves around antibiotic use and supportive observation. According to the IDSA/AAN/ACR directives, IV ceftriaxone is recommended as the main therapy for inpatients, and a patient can be transitioned to an oral antibiotic such as doxycycline, amoxicillin, cefuroxime axetil, or azithromycin for a total period of 14-21 days after the patient's condition improves. Temporary cardiac pacing is only warranted in patients with symptomatic bradycardia or those who have hemodynamic instability, while permanent pacemakers are typically avoided since the AV block tends to improve or resolve completely within a short period of treatment [7].

Prognoses for Lyme carditis are generally benign. Research indicates that the vast majority of patients' conduction abnormalities normalize within a two-week period, and the likelihood of relapse or progression to chronic cardiomyopathy after eradication of the infection is very low. Our patient received appropriate antibiotic therapy in a timely manner, and his AV block gradually improved over the course of 10 days, without requiring any pacemaker placement. Cardiac MRI and TTE assisted in eliminating myocarditis, infiltrative processes, and ischemia from the differential diagnoses. Factors that can lead to incomplete recovery of conduction usually occurs in elderly patients with pre-existing conduction diseases. After the infection has been eradicated, routine long-term cardiac surveillance is not necessary, but follow-up ECGs may be helpful in confirming ongoing.

### Conclusion

Lymecarditis is an infrequent but dangerous condition that arises from *Borrelia burgdorferi* infection. It is crucial to recognize it early and begin treatment with antibiotic therapy to avoid the development of complete heart block or sudden death. This case is a reminder that an AV block caused by Lyme disease generally has a favorable prognosis with early detection and treatment. After prompt treatment, most patients are discharged without long term cardiac complications or requiring permanent pacemaker. Providers should consider the possibility of Lyme carditis in a patient with an unknown cause of bradycardia or conduction abnormalities, especially if the patient has had geographical exposure where Lyme disease is.

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