Lyme carditis manifesting with sinoatrial exit block: a case report

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Background

Lyme disease is the most common vector-borne disease in North America and Europe. Infection with the spirochete Borrelia burgdorferi complex can involve cardiac tissue causing Lyme carditis (LC). Due to the infection of conductive tissue, LC typically presents with varying degrees of atrioventricular conduction block. Here, we provide the first evidence that conductive tissue of the sinus node can be involved in LC resulting in higher degree sinoatrial (SA) block with concomitant syncope.

Case summary

We report the case of an otherwise healthy 31-year-old female presenting with LC manifesting with SA exit block causing asystole over 12 s with concomitant syncope. Signs of SA block completely resolved with antibiotic treatment with a third-generation cephalosporin. The patient did not require permanent pacemaker implantation and had no sinus pauses after 12 months of follow-up as confirmed via implantable loop recorder.

Conclusion

The possibility of LC in patients with sinus node dysfunction should be considered, as adequate antibiotic therapy can spare patients from potentially unnecessary pacemaker implantation.

Keywords

Lyme disease • Lyme carditis • Sinoatrial exit block • SA block • Syncope • Case report

ESC Curriculum

5.7 Bradycardia • 5.2 Transient loss of consciousness • 5.9 Pacemakers

Learning points

• Infection with the spirochete Borrelia burgdorferi complex can involve cardiac tissue causing Lyme carditis (LC) that typically affects conductive tissue.
• Lyme carditis mostly presents with varying degrees of atrioventricular conduction block but may also involve the sinus node resulting in higher degree sinoatrial block and syncope.
• The possibility of LC in young individuals with sinus node dysfunction should be considered, as antibiotic therapy can be an effective treatment and spare patients from potentially unnecessary pacemaker implantation.

Introduction

Lyme disease (LD) is the most common vector-borne disease in North America and Europe with an increasing incidence. It is mainly caused by the gram-negative spirochete bacteria Borrelia burgdorferi complex that is transmitted by the Ixodes tick. Patients with LD can present with arthralgia, erythema migrans (EM) rash, fatigue, or unspeciﬁc neurologic symptoms. Haematogenous spread can lead to direct myocardial invasion by the bacteria, referred to as Lyme carditis (LC). The incidence of cardiac involvement in LD is reported between 0.3% and 4%. All layers of the heart can be involved by spirochete invasion of cardiac tissue with a marked tropism to
Conductive tissue. Consequently, patients with LC typically present with some degree of atrioventricular nodal conduction block (AVB) in 80–90% of cases with LC. Here, we provide the first evidence that LC may present with solely sinoatrial (SA) exit block. We report the case of a young otherwise healthy female who was admitted with recurrent syncope due to sinus pauses associated with *B. burgdorferi* infection that completely resolved under adequate antibiotic treatment.

**Timeline**

| Time          | Events                                                                                                                                                                                                 |
|---------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| June 2020     | - Erythema migrans after a visit in the countryside in western Germany.                                                                                                                                |
|               | - Diagnosis of LD and consequent antibiotic treatment with oral doxycycline for 2 weeks.                                                                                                |
| Late August 2020 | - Two consecutive episodes of syncope:                                                                                                                        |
|               |   - The first while sitting and the second while showering.                                                                                       |
| September 2020 | - Ambulatory neurological evaluation [magnetic resonance imaging (MRI), electroencephalography (EEG)] revealing no abnormalities.                                                                 |
| November 2020 | - Emergency admission due to another syncope after showering.                                                                                                                                       |
|               | - Recurring syncope during the first night in the hospital while sitting.                                                                                                                                  |
|               | - Telemetric electrocardiogram (ECG) Holter revealing a 12-s asystole during that episode.                                                                      |
|               | - Cardiac imaging with echocardiography and cardiac MRI revealing no abnormalities.                                                                                |
|               | - Twelve-lead ECG revealing 2nd degree sinoatrial (SA) exit block with typical Wenckebach periodicity.                                                                                          |
|               | - Repeated in-hospital serological testing confirming Lyme Borreliosis.                                                                                                                                       |
|               | - Initiation of a second antibiotic course with intravenous ceftriaxone over 14 days.                                                                                                                      |
|               | - Signs of SA block on surface ECG resolving after a few days of antibiotic treatment.                                                                                                                       |
|               | - Ergometry stress test confirming stable cardiac conduction times.                                                                                                                                      |
|               | - Implantation of a cardiac loop recorder (ILR) for continuous rhythm monitoring.                                                                                                                       |
|               | - Discharge on oral doxycycline for 21 days without any signs of sinus pauses or bradycardia.                                                                                                               |
| December 2021 | - Asymptomatic patient with no more episodes of asystole documented after 12 months of follow-up.                                                                                                      |

**Case presentation**

In November 2020, a 31-year-old woman presented at the emergency room after recurrent syncope of unknown origin. She reported having lost consciousness after experiencing dizziness under the shower and had regained consciousness shortly after.

On admission, the patient was asymptomatic. Her electrocardiogram (ECG) showed sinus bradycardia with no ST-segment or T-wave abnormalities (Figure 1). She revealed no relevant trauma after syncope and physical exam and initial blood tests were normal. She reported two similar episodes of syncope in late August 2020, the first while sitting and the second while showering. A subsequent ambulatory neurological evaluation including cranial magnetic resonance imaging (MRI) and electroencephalography (EEG) did not reveal any abnormalities. She regularly smoked marijuana (up to 5 g a week) and cigarettes (10 packyears), other drugs or regular alcohol intake were not reported.

During her first night in the hospital, she experienced another syncope while sitting on her bed. Telemetric Holter ECG monitoring revealed a 12-s asystole during that episode (Figure 2A) and she was therefore referred for additional investigation and pacemaker implantation evaluation. The patient’s medical history revealed only substituted hypothyroidism (normal thyroid stimulating hormone (TSH), 2.19 U/mL). The patient’s father had dilative cardiomyopathy of unspecified aetiology. Other than that, there was no history of cardiovascular diseases or sudden cardiac death in the family. Cardiac imaging with echocardiography and cardiac MRI revealed no abnormalities (Figure 3). Orthostatic hypotension was not seen in a Schellong-test.

Twelve-lead ECG revealed 2nd degree SA exit block showing typical Wenckebach periodicity with gradually shortening PP intervals until a pause occurred (Figure 2B). It was concluded that the recurrent syncope was most likely due to asystole resulting from higher degree SA block. The SA block in the absence of any signs of structural, coronary, or infiltrative heart disease raised suspicion towards other rare and potentially reversible inflammatory heart conditions including LC. Indeed, the patient reported several tick bites during a countryside visit in June 2020, after which she noticed a rash on her forehead and left calf with typical morphology of an EM. Her general practitioner diagnosed LD with positive borrelia antibodies (IgG and IgM) and prescribed antibiotic therapy with oral doxycycline. The Suspicious Index in Lyme Carditis (SILC) score proposed by Besant et al. was 9 (outdoor activity, tick bite, age < 50 years, EM), suggesting a high suspicion of LC. Serological testing was repeated at the hospital and confirmed Lyme Borreliosis by a Western blot assay with positive IgM and IgG antibodies against *B. burgdorferi* specific antigens VlLsE, p41 and OspC.

Due to the possibility that the first antibiotic course with oral doxycycline had been insufficient and the intermittent sinus arrest and syncope may have been caused by LC associated with SA block, a second antibiotic course was initiated with 2 g ceftriaxone i.v. once daily over 14 days. Signs of SA block rapidly resolved within a few days (Figure 4) and there were no more episodes of bradycardia or asystole documented. Ergometry stress test documented chronotropic competence and revealed no exercise-induced PQ interval prolongation or widening of QRS complexes. It was therefore opted against the implantation of a pacemaker with consequent possible
complications. Instead, a cardiac loop recorder (ILR) was implanted for continuous rhythm monitoring, and to be able to diagnose any further episodes of sinus pauses or high degree SA block, if they should recur. The patient was discharged on sequential oral antibiotic therapy with doxycycline for another 21 days. She has been completely asymptomatic with no sinus pauses documented in the ILR after 12 months of follow-up.

Discussion

This case provides the first evidence that conductive tissue of the sinus node may be involved in spirochete infection which may lead to high degree SA block resulting in asystole with concomitant syncope. Although LC mostly presents with AVB, there are six case reports published that describe patients with sinus pauses associated with LC.\textsuperscript{7–12} Mechanistic explanations of sinus node dysfunction in LC have not yet been provided. However, the observation that LC mainly manifests with conduction abnormalities had already led to the hypothesis that sinus pauses in LC may result rather from SA exit block than from disturbances of the intranodal electrical automaticity.\textsuperscript{9}

Interestingly, cardiac MRI did not reveal any signs of wall oedema corresponding to myocardial inflammatory processes or pericarditis-induced irritation that has been reported in cases of LC with concomitant AVB.\textsuperscript{13,14} Our patient may have had spirochete invasion that was restricted to the atrium and therefore not sufficiently assessable by cardiac MRI due to the thin atrial wall. This could also explain the absence of any atrioventricular conduction delay.

Evidence regarding the correct diagnosis and management of suspected LC is scarce and largely based on case reports. As proposed

\begin{figure}
\centering
\includegraphics[width=\textwidth]{figure1.png}
\caption{Twelve-lead electrocardiogram on admission. This electrocardiogram on admission showing arrhythmic sinus bradycardia with a ventricular heart rate of 47 beats/min and normal intracardiac conduction times (PR interval, 160 ms; QRS duration, 90 ms; QT interval, 420 ms).}
\end{figure}
intravenous antibiotic treatment with 2 g ceftriaxone once daily for 10–14 days is considered first-line therapy, followed by oral antibiotics (doxycycline, amoxicillin, or cefuroxime) for a total antibiotic course of 14–21 days. Early permanent pacemaker implantation should be avoided as conduction disorders may resolve under antibiotic treatment. Although the SILC score was originally introduced for patients presenting with AVB and is not validated for sinus node dysfunction, it was useful to stratify the need for further diagnostic steps into this direction and therefore led to the following positive serological testing.6 It has to be noted that other possible causes of sinus arrest such as vagal dysregulation or possibly extensive marijuana consumption cannot be completely ruled out in our patient. However, the complete regression of SA block on surface ECG after antibiotic treatment...
Figure 3  Cardiac imaging revealing no abnormal findings. Transthoracic echocardiography showing normal end-diastolic (A) and end-systolic (B) chamber dimensions with normal left ventricular ejection fraction in long-axis four-chamber view. Contrast-enhanced cardiac magnetic resonance imaging showing no late gadolinium enhancement in four- (C), three- (D), and two-chamber view (E).

Figure 4  Twelve-lead electrocardiogram after treatment. Twelve-lead electrocardiogram after 1 week of antibiotic treatment showing no signs of sinoatrial or atrioventricular conduction delay (heart rate, 69 beats/min; PR interval, 150 ms; QRS duration, 86 ms; QT interval, 370 ms).
with intravenous ceftriaxone strongly supports LC as the causal factor, and cannabis has been reported to enhance rather than suppress sinus automaticity and to facilitate SA conduction.\(^{15}\)

**Conclusion**

Although LC is mostly associated with AVB, the possibility of LC particularly in younger patients presenting with sinus node dysfunction and suspicion of LC as per the past clinical history should be considered. Antibiotic therapy can be an effective treatment and spare patients from potentially unnecessary pacemaker implantation. The identification of patients with LC is crucial but may be currently underappreciated and should therefore be subject of further investigations.

**Lead author biography**

Antonius Büscher, MD, is a resident and research associate in Cardiac Electrophysiology at the University Hospital Münster, Germany since 2020. After having graduated from the Medical Faculty at Heidelberg University, Germany in 2018, he started his cardiology training at the University Hospital Heidelberg, where he also conducted basic science research in cellular electrophysiology and atrial fibrillation. His current research focuses on Clinical Electrophysiology and the prevention of sudden cardiac death.

**Supplementary material**

Supplementary material is available at European Heart Journal - Case Reports online.

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