



# Early Disseminated Lyme Carditis: Long-Term Follow-Up

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## Abstract

Lyme carditis commonly presents with high degree atrioventricular block, but most conduction abnormalities will resolve with appropriate antibiotic therapy. Most patients with treated Lyme carditis remain symptom-free without lasting or recurrent conduction abnormalities in long term follow-up of greater than 12 months after initial presentation.

## Keywords

Long-term follow-up • Lyme carditis • Lyme disease • Heart block • Atrioventricular block

## 1 Introduction

Lyme disease is a tick-born bacterial infection caused by *Borrelia burgdorferi*. It is the most reported vector-born disease in North America, and its incidence has risen dramatically in recent years. In up to 10% of cases, dissemination of LD may lead to cardiac tissue inflammation and Lyme carditis (LC) [1]. The most common presentation of LC is high-degree atrioventricular block (AVB) which can fluctuate rapidly over minutes, hours, or days. Most AVB in LC resolve with appropriate antibiotic treatment without requirement of a permanent pacemaker [1–3].

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The diagnosis and management of early disseminated LC is now well-established, with the use of the SILC (Suspicious Index in Lyme Carditis) score to assess for risk of LC in patients presenting with AVB [2], hospitalization with appropriate cardiac monitoring, targeted antibiotic therapy, and treadmill ECG stress testing to assess atrioventricular conduction stability prior to discharge [3]. Temporary pacing with an endocardial lead connected to an external permanent pacemaker allows early patient mobility for those with symptomatic bradycardia [4]. Follow-up of patients who do not require permanent pacing at 4–6 weeks after initial discharge is recommended to ensure resolution of conduction abnormalities [1]. However, studies on the long-term outcomes of treated LC are scarce, and there is currently no clinical precedence for ongoing monitoring of patients after discharge from hospital.

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## 2 Appropriate Treatment of Lyme Carditis

The diagnosis and management of LC is explored in detail in Chap. 8. In brief, patients presenting with high degree atrioventricular block should be assessed for risk of LC using the SILC score, and all patients should be hospitalized with continuous cardiac monitoring. Those determined to be high risk for LC should have empiric intravenous antibiotic therapy initiated while waiting for serology. Appropriate antibiotic regimens include intravenous antibiotics for 10–14 days (ceftriaxone is first line) followed by oral antibiotics (doxycycline, amoxicillin, cefuroxime) to complete a 14–21 day course [1, 5].

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## 3 Long-Term Follow-Up of Lyme Carditis—Existing Literature

To better gauge the documentation and length of long-term follow up of LC patients after receiving antibiotic treatment in current literature, we performed an informal systematic review. The review was completed on September 28, 2022 using the databases Embase and Medline. The search terms utilized were inspired by a systematic review completed on October 3, 2017 of all published cases of LC with high-degree AVB [2]. Specifically, the search term used was as follows: (“Lyme” OR “Lyme disease”) AND (“carditis,” “myocarditis,” “heart block,” “heart muscle conduction disturbance,” “heart conduction system,” “sick sinus syndrome,” “heart arrest,” “conduction,” “AV block,” “atrioventricular block,” “asystole,” “sinus pause,” OR “bundle branch block”). All papers with greater than 1 month follow-up of patients with confirmed LC, published in the English language were reviewed independently by authors C. Wang and R. Al Rawi.

A total of 19 articles were retrieved from the review, giving 31 patients; results are summarised in Table 1 and Fig. 1. Fourteen (73.7%) articles documented only 1 patient, one (5.26%) documented 2 patients, one (5.26%) documented 3 patients, two (10.5%) documented 4 patients, and one (5.26%) documented 6 patients. The

mean length of long-term follow up was 8.70 months. Of the patients who received appropriate therapy for early disseminated Lyme disease, all had complete resolution of symptoms and conduction abnormalities. However, the diagnosis of Lyme disease was often delayed, and seven patients received insertion of a permanent pacemaker before diagnosis of LC was made. In four cases, subsequent follow-up also revealed resolution of symptoms and conduction abnormalities. Three patients showed persistence of complete AV block 7 weeks with pacemaker dependency, though this was after sub-optimal IV antibiotic treatment [6–8].

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## 4 Long-Term Follow-Up of Lyme Carditis—New Insights

Recognizing the absence of high-quality data on the long-term follow-up of patients with treated LC, Wang et al. published a prospective single center series on the outcomes of patient diagnosed with LC who received appropriate antibiotic therapy without permanent pacing for high-degree AVB [9]. All patients were asymptomatic and free of conduction abnormalities at a mean follow-up of 20 months with no residual defects.

This new data in addition to existing literature on management of LC supports avoidance of permanent pacing and the associated long-term consequences if conduction is stable at discharge. It is possible that adequate antibiotic therapy may resolve inflammation of the conduction system [10, 11], both normalizing and preserving conduction during long-term follow-up. Since patients presenting with LC are often young and otherwise healthy [1], avoiding unnecessary pacemaker implantation is of the utmost importance to avoid exposure to pacemaker-related complications and long-term consequences [12]. Chapter 13 explores the safe explantation of permanent pacemakers in patients subsequently diagnosed with and appropriately treated for LC.

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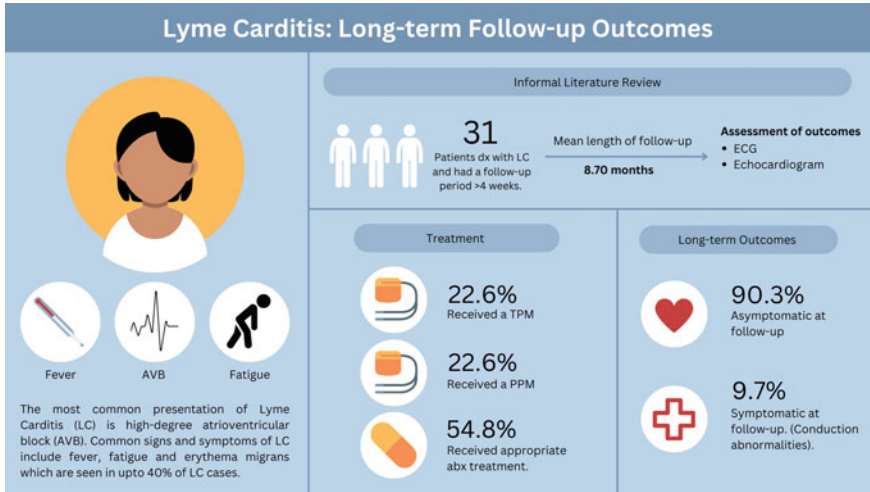
## 5 Conclusions

Though data on the long-term follow-up outcomes of patients with treated LC are largely limited to case reports and case series, all available literature supports the avoidance of permanent pacing in appropriately treated early disseminated LC if AV node conduction is stable at discharge. Further prospective studies are necessary to develop evidence-based guidelines for the long-term management of patients with treated LC.

**Table 1** Previous literature on follow-up of treated Lyme carditis (>1 month)

Paper	# of Pts	Pacemaker Placed (TPM or PPM)	Adequate abx treatment (Y/N)	Average Length of Follow-up	Symptomatic or Asymptomatic at Follow-up
Isath, A 2018 (6)	1	TPM then leadless PPM	N	1 year	Asymptomatic
Sangha [7]	1	N/A	Y	30 days	Asymptomatic
Afari [8]	1	N/A	Y	1 month	Asymptomatic
Brownstein [9]	1	PPM	Y	3 months	Asymptomatic
Oktay [10]	1	N/A	Y	7 weeks	Asymptomatic
Mannava [11]	1	N/A	Y	2 months	Asymptomatic
Shenthathar [12]	1	N/A	Y	2 months	Asymptomatic
Brunner [13]	1	N/A	Y	1 month	Asymptomatic
Wong [14]	1	PPM	Y	1 month	Asymptomatic
Silver [15]	2	N/A	Y	9.5 months	Asymptomatic
Seslar [16]	3	N/A	Y	24 months, 2 patients loss to follow-up	Asymptomatic
Rosenfeld [17]	1	PPM	N	3 months	Asymptomatic
Midttun [18]	6	33% TPM	66% Y	3.84 years	Asymptomatic
Artigao [19]	1	PPM	N	1 year	Symptomatic*
Van der Linde [20]	4	25% TPM, 25% PPM	25% Y	7.25 weeks	25% symptomatic*
McAlister [21]	4	75% TPM, 25% PPM	25% Y	18.75 months	25% symptomatic*
Lorincz [22]	1	TPM	N	18 months	Asymptomatic
Kimball [23]	1	N/A	N	6 weeks	Asymptomatic
Bedell [24]	1	N/A	N	6 months	Asymptomatic

Abbreviations pt = patient, TPM = temporary pacemaker, PPM = temporary permanent pacemaker



**Fig. 1** Summary of existing literature on the long-term follow-up of Lyme carditis (> 4 weeks). \*Created Using Canva. Abbreviations: *AVB* = atrioventricular block; *ECG* = electrocardiogram; *LC* = Lyme carditis; *PPM* = permanent pacemaker; *TPM* = temporary permanent pacemaker

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