

# Third-Degree Heart Block Associated With Lyme Carditis: Review of Published Cases

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**Lyme carditis is an uncommon manifestation of Lyme disease that most commonly involves some degree of atrioventricular conduction blockade. Third-degree conduction block is the most severe form and can be fatal if untreated. Systematic review of the medical literature identified 45 published cases of third-degree conduction block associated with Lyme carditis in the United States. Median patient age was 32 years, 84% of patients were male, and 39% required temporary pacing. Recognizing patient groups more likely to develop third-degree heart block associated with Lyme carditis is essential to providing prompt and appropriate therapy.**

**Keywords.** atrioventricular conduction block; heart block; Lyme carditis; Lyme disease.

Lyme disease is a multisystem tickborne illness caused by the spirochete *Borrelia burgdorferi*. Approximately 30 000 cases are reported to the Centers for Disease Control and Prevention (CDC) each year, primarily from high-incidence states located in the northeast and north-central United States [1]. Acute clinical illness is usually characterized by fever and constitutional symptoms combined with a distinctive dermatologic lesion, erythema migrans (EM), which develops at the site of the tick bite. Without early treatment, infection can disseminate to other tissues causing peripheral and central neuropathy, arthritis, and carditis.

Lyme carditis results from direct invasion of heart tissues by spirochetes and can involve all layers of the heart [2]. The most common clinical manifestation is atrioventricular (AV) conduction blockade, which can fluctuate rapidly and progress from first- to third-degree heart block within minutes to hours [2]. Third-degree heart block, or complete heart block, is the most severe

form with complete dissociation of the electrical impulses between the atria and the ventricles. This results in a slow ventricular rhythm that can evolve into life-threatening arrhythmias, including ventricular tachycardia and ventricular fibrillation. Although early case series suggested that some form of carditis occurred in 4%–10% of untreated patients with Lyme disease, surveillance data indicate that approximately 1% of patients with Lyme disease have second- or third-degree AV conduction blockade [2, 3].

In response to a recent report describing 3 cases of sudden cardiac death associated with Lyme carditis in young patients, we conducted a literature review of published cases of third-degree conduction block from Lyme carditis [4]. Our goal was to describe common demographic features of cases with the hope of improving disease recognition and patient care.

## METHODS

We conducted a systematic review of the medical literature to identify published cases of Lyme carditis resulting in third-degree heart block. Relevant studies published in the English-language literature were obtained through a search of PubMed (US National Library of Medicine, Bethesda, Maryland) and Google Scholar (Google Inc, Mountain View, California) using the search terms “Lyme disease, lyme carditis,

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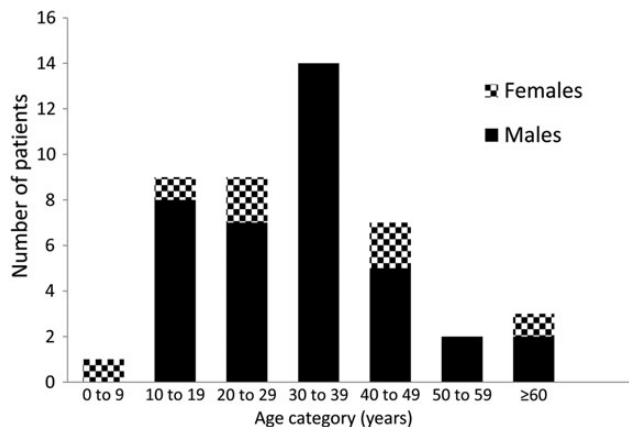
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*Borrelia burgdorferi*, conduction block, heart block, heart, and arrhythmia” both alone and in combination. References in all papers were reviewed to identify additional cases. Inclusion criteria were as follows: any English-language case report or case series published in a peer-reviewed journal of any patient who either had a clinician-documented EM lesion or laboratory evidence of infection, and had electrocardiography (ECG)-documented third-degree conduction block [5]. Manuscripts not written in English, discussing patients not living in the United States, or not including individual patient variables were excluded. Studies were critically evaluated for the following variables: age, sex, state where Lyme disease was acquired, presenting symptoms, month of presentation, degree of heart block on admission, antibiotic therapy given, time to resolution of heart block, whether transvenous pacing was required, and subsequent pacemaker placement, adjuvant steroid therapy, laboratory results, and patient outcome. A medical epidemiologist performed the literature retrieval and evaluation of each report. Whenever possible, data missing from case reports were sought by contacting the authors of the original manuscript. Statistical evaluation of the data was performed using Epi Info, version 7.1.1.14 (CDC, Atlanta, Georgia). Statistical comparisons were performed using the Mann-Whitney *U* test. No institutional review board approval was sought for this review of previously published cases.

## RESULTS

A total of 34 manuscripts were reviewed in which 45 cases were reported [6–39]. Males were most commonly affected (84%), yielding a male to female ratio of 5.4:1 (Figure 1). The median age of all patients was 32 years and did not vary significantly between males and females ( $P = .94$ ). All patients with



**Figure 1.** Age and sex distribution of reviewed published cases of Lyme carditis with third-degree atrioventricular blockade, United States, 1980–2013.

geographic information available were from states with historically high rates of reported Lyme disease (Table 1) [1]. More than 40% of patients presented after a syncopal episode, and only 44% of patients had associated EM. Median time from symptom onset to development of AV block was 14 days (range, 2–24 days). Eighty percent of patients had third-degree heart block when first evaluated. Among patients who developed third-degree heart block later, median time from

**Table 1. Clinical Course and Treatment of Patients With Third-Degree Heart Block From Lyme Carditis**

Variable	% of Patients (n = 45)
State where Lyme disease was acquired	
Missing	49
New York	18
Connecticut	9
Massachusetts	7
Minnesota	4
Wisconsin	4
Virginia	4
Maryland	2
Pennsylvania	2
Presentation location	
Hospital	71
Outpatient clinic	25
Missing	4
Associated presenting symptoms	
Erythema migrans rash	44
Syncope	40
Fever	36
Lightheadedness/dizziness	33
Dyspnea	33
Lethargy or weakness	24
Palpitations	22
Chest pain	20
Headache	18
Myalgia	11
Arthralgia	6
Antibiotic therapy	
Ceftriaxone	47
Penicillin	18
Ceftriaxone followed by a tetracycline	13
Tetracycline class alone	13
Other	4
Steroids used as adjunct therapy	
Yes	31
No/missing	69
Transvenous pacing required	
Yes	40
Permanent pacer placed	4
No/missing	60
Fatalities (none reported)	0

presentation to development of third-degree heart block was 3 hours (range, 0.5–24 hours).

The majority of patients were treated with ceftriaxone or penicillin; 32% were given steroids as an adjunct to care. Eighteen (40%) patients required transvenous pacing for management of heart block; however, only 2 patients had permanent pacemaker placement, both treated in the 1980s. In all other cases, heart block resolved, with the median time to improvement to first-degree block or normal sinus rhythm of 6 days (range, 1–42 days). There was no statistically significant difference between the time to resolution of heart block and use of either ceftriaxone or penicillin ( $P = .33$ ) or the use of steroids ( $P = .79$ ). More than 30% of reports had no available laboratory information, all of these had clinician-documented EM. When present, specific serologic test variables were infrequent and inconsistently reported. Month of presentation was similarly reported infrequently with only 7 reports providing this information.

## DISCUSSION

Carditis is an uncommon manifestation of disseminated Lyme disease, and third-degree AV block is rarer still. Nevertheless, third-degree AV block can result in fatal arrhythmias if not managed and treated appropriately. AV block associated with Lyme carditis is due to effects of the host inflammatory response directed at the spirochetes in cardiac tissue [2]. On histopathologic exam, a lymphoplasmacytic linear perivascular and interstitial “roadmap” or “band-like” pattern is commonly observed often involving all heart layers [2, 4]. Spirochetes can be seen in the interstitial space on Warthin-Starry stain [2, 4]. With appropriate antibiotic therapy, AV block from Lyme carditis typically improves, with third-degree block resolving within 1 week and lesser disturbances taking up to 6 weeks to resolve [2].

A notable feature of Lyme carditis is an apparent predilection for young male patients, which is more pronounced among patients with third-degree AV block. Males account for a little more than 50% of all patients with Lyme disease, and previous studies have shown a male to female ratio of 3:1 among all Lyme carditis patients [2, 3]. However, in reviewed cases with third-degree heart block, there is an even greater proportion of male patients (5.4:1). Additionally, whereas the age distribution of patients with Lyme disease is typically bimodal, with the highest incidence in children aged 5–9 years and adults aged 45–59 years, patients with third-degree AV block from Lyme carditis are predominantly aged 10–45 years [40].

The cause for the greater proportion of young male patients with heart block, and third-degree heart block in particular, remains to be elucidated. There are several possible explanations. It may be that young males are simply less likely to seek care early and therefore more likely to develop advanced forms of disease, including carditis. Alternately, there may be a biologic

predilection for infection of the heart in male patients. A recent study in Europe found a disparity by sex in the proportion of patients with cutaneous and noncutaneous forms of Lyme disease [41]. Patients with cutaneous forms of disease, including acrodermatitis chronica atrophicans, were more likely to be female, whereas those with arthritis and neuroborreliosis were more likely to be male.

Another notable feature of Lyme carditis is the lower frequency of associated EM. EM occurs in approximately 70%–80% of reported Lyme disease cases [40], but in this series only 44% of patients with third-degree heart block had identified EM. Here, too, selection bias may contribute in that patients with EM may be more likely to receive early treatment for Lyme disease and therefore less likely to develop carditis. Recall bias may also contribute, given that third-degree block from carditis presented a median of 14 days after symptom onset. Thorough dermatologic examination may be delayed when patients present in extremis. Finally, it is possible that different *B. burgdorferi* sensu stricto strain types are more likely to disseminate with particular tropism for cardiac tissue, and less likely to manifest with EM, a trait demonstrated between *B. burgdorferi* sensu lato genospecies [42]. Regardless, EM when present can help solidify a diagnosis of Lyme carditis. Absence of an EM lesion should not rule out Lyme carditis in an otherwise appropriate clinical scenario, although recommended serologic evidence of Lyme disease infection should be obtained to ensure correct diagnosis [43].

Reassuringly, in reviewed published case reports, there were no fatalities reported. In the 7 previously reported deaths due to Lyme carditis, no patients had ECG-documented third-degree heart block, so these deaths were not included in this review [4, 44–47]. However, given the potential for transition from third-degree heart block to lethal arrhythmia, it is a possible etiology for death in those 7 patients. The majority of patients who developed third-degree heart block presented with that rhythm. The most common antibiotic used was ceftriaxone, in accordance with published guidelines [43]. Transvenous pacing was utilized in a little more than one-third of patients, highlighting the importance of having this treatment modality available for patients with Lyme carditis. Temporary transvenous pacing should be the modality of choice, and permanent pacing only considered if symptoms do not resolve.

There are several limitations to this study. First, this is a retrospective review of published cases describing patients with third-degree AV conduction block resulting from Lyme carditis; thus, all cases represent a convenience sample. It is likely that more severe and more unusual cases are reported, thus potentially overemphasizing the severity of the disease. Second, because only published cases were reviewed, it is likely that the number of cases reported underestimates the true number of patients with third-degree heart block from Lyme disease. Third, conduction

block from Lyme disease is known to fluctuate, and generally improves quickly with appropriate therapy. Therefore, patients who might have had brief episodes of third-degree block not captured on ECG would not have been recorded.

## CONCLUSIONS

Lyme carditis is an uncommon manifestation of Lyme disease, but also one of the most serious. Progression to third-degree AV block can be rapid, and potentially fatal if untreated. Males, particularly those in their teens through their 40s are disproportionately affected by third-degree AV block associated with Lyme carditis. Although one-third of patients may need supportive transvenous pacing, after appropriate antibiotic therapy is initiated, third-degree AV block from Lyme carditis typically resolves. Healthcare practitioners should maintain a high level of suspicion for Lyme carditis in young male patients from high-incidence Lyme disease locations presenting with flu-like or cardiac symptoms, in addition to the more common symptoms of Lyme disease.

## Notes

**Disclaimer.** The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.

**Potential conflicts of interest.** Both authors: No potential conflicts of interest.

Both authors have submitted the ICMJE Form for Disclosure of Potential Conflicts of Interest. Conflicts that the editors consider relevant to the content of the manuscript have been disclosed.

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