

# Persistent Exertional Chest Pain in a Marathon Runner: Exercise-induced, Painful, Left Bundle Branch Block Syndrome Treated With His-Bundle Pacing

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## Abstract

A 49-year-old woman presented with exercise-induced chest discomfort during long-distance running that was occasionally present during rest. Significant coronary artery disease was excluded and a diagnosis of “painful left bundle branch block (LBBB) syndrome” was made after correlation of LBBB aberrancy with symptoms during Holter monitoring. The patient underwent confirmatory testing consisting of rapid atrial pacing below and above 130 beats per minute, the rate cut-off for LBBB manifestation. His bundle pacing implantation was performed resulting in both non-selective and selective morphologies depending on output, both of which manifested with a painless narrow QRS regardless of rate. She was rendered completely pain free during long-distance running and remains so 6-months later. Her pain at rest, now thought to be due to severe anxiety secondary to her painful LBBB, has also subsided. Exercise-induced, painful LBBB is a rare phenomenon that manifests as chest discomfort when LBBB is present. This disease is frequently misdiagnosed as coronary angina, has limited medical treatment options, and can be disabling. HBP is an attractive treatment for this syndrome in an effort to avoid electromechanical dyssynchrony, the presumed mechanism of discomfort. This case report adds to the growing literature of painful LBBB syndrome and its effective treatment with HBP, with the added caveat that it can present with persistent symptoms at rest, in the setting of enhanced anxiety. HBP should be considered early on in the treatment of such patients.

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Exercise-induced left bundle branch block (LBBB) is a rare phenomenon found in 0.5% of patients undergoing exercise stress testing.<sup>1</sup> An uncommon variant that results in chest discomfort coinciding with the development of LBBB has been coined “painful LBBB syndrome” and can occur in patients with or without underlying structural heart disease.<sup>2-4</sup> The prevalence of this specific entity is unclear because of common comorbidities with similar clinical manifestations.<sup>1,5-8</sup> Painful LBBB syndrome can cause incapacitating symptoms with even modest exertion and lifestyle, and medicinal therapies<sup>5,9,10</sup> have had limited efficacy.<sup>3</sup>

Permanent His-bundle pacing (HBP) serves to maintain or reestablish normal cardiac conduction by stimulating the proximal ventricular conduction system. Because of the focal nature of most LBBB frequently correct LBBB aberrancy, resulting in a relatively narrow QRS complex and early activation of the lateral left ventricle, avoiding electromechanical dyssynchrony.<sup>11-14</sup> His-bundle pacing remains an attractive treatment option for patients with painful LBBB syndrome.

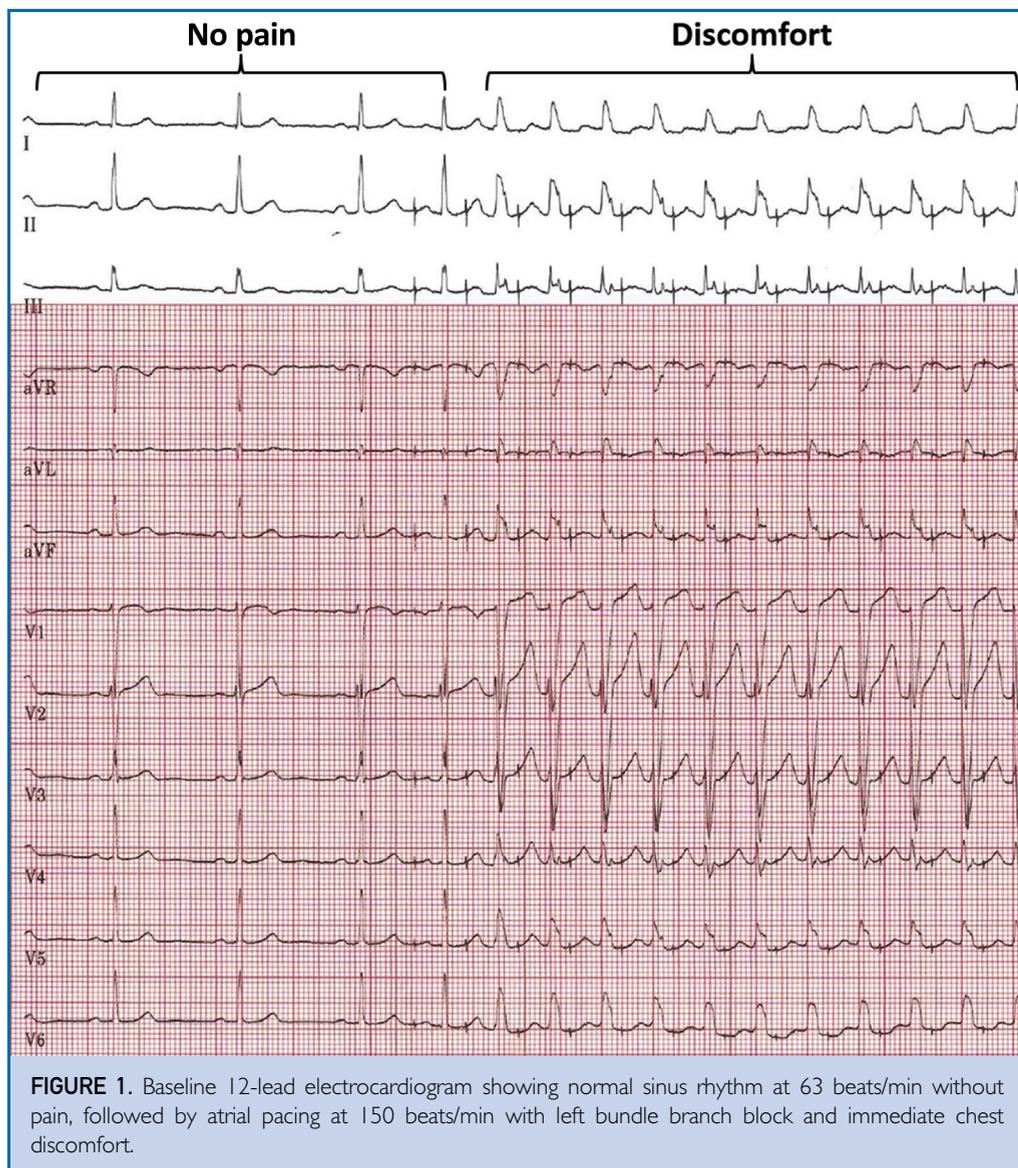
## CASE REPORT

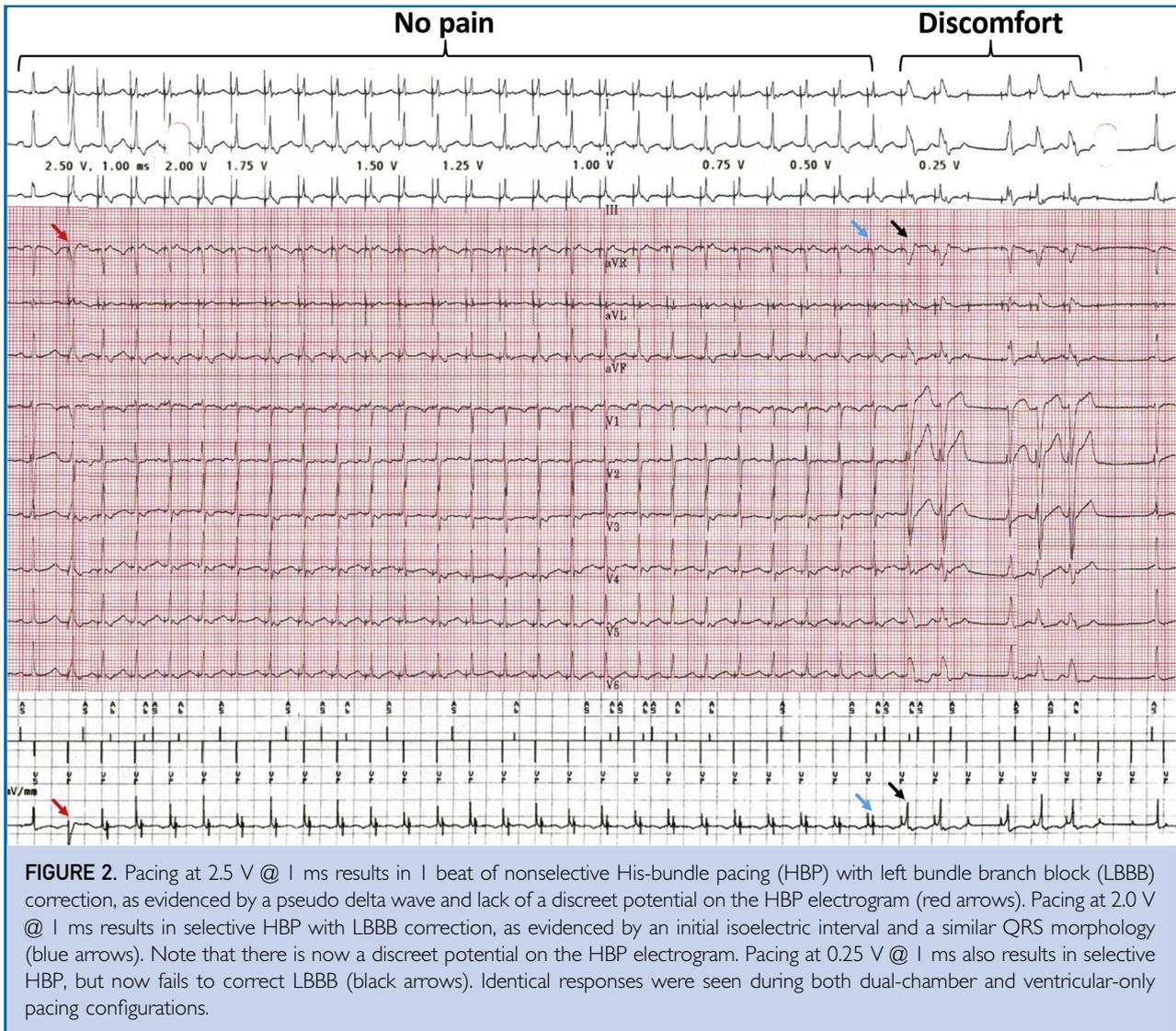
A 49-year-old woman with a medical history of mild intermittent asthma presented to the

emergency department with exertional mid-sternal chest pain and shortness of breath. Her chest discomfort was exacerbated by exertion and partially relieved by rest. Her symptoms were now interfering with her training for an upcoming marathon.

The results of laboratory testing including complete blood counts, basic metabolic panel, and cardiac enzymes were normal. Pulmonary embolism and worsening exercise-induced asthma were ruled out by computerized tomography of the chest and pulmonary function tests, respectively. A transthoracic echocardiogram revealed normal systolic and diastolic functions with trace pericardial

effusion. Because of this finding, treatment of presumed pericarditis with nonsteroidal anti-inflammatory medications and colchicine was trialed but resulted in no improvement. Coronary angiography was performed and was negative for obstructive lesions. However, her right coronary artery spasmed at the time of selective engagement, requiring nitroglycerin. Because of this, treatment of coronary spasm with vasodilators was attempted but proved ineffective. A 12-lead electrocardiogram treadmill stress test was performed, which revealed a rate-related LBBB at a heart rate of 134 beats/min correlating with her typical symptoms of chest tightness and shortness of breath. Of



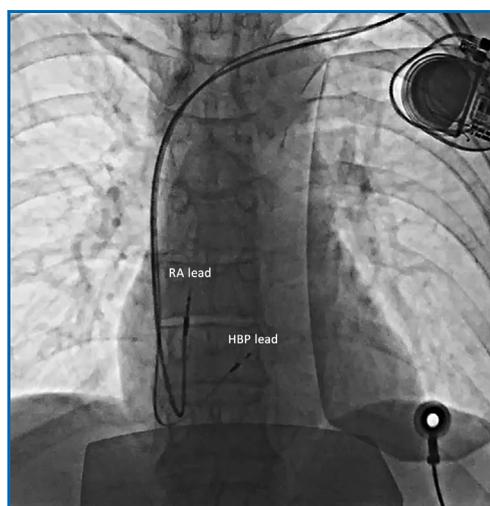


note, similar testing 5 years ago found LBBB at a rate of 150 beats/min without recognition of symptoms.

Because of suspicion that her exercise-induced LBBB was the etiology of her symptoms, a dual-chamber pacemaker with HBP was recommended in an effort to correct LBBB.

The patient underwent dual-chamber pacemaker implantation through the left axillary vein. A right atrial pacing lead was placed (model 5076, Medtronic, Minneapolis, MN), and atrial pacing with rates as low as 130 beats/min replicated LBBB and resulted in acute chest pain (Figure 1). The ventricular lead (SelectSecure 3830, Medtronic) was placed

through a nondeflectable 7-F sheath (C315, Medtronic) and fixated to the basal anteroseptum where a His-bundle deflection was recorded. A large His-bundle current of injury was seen with ventricular sensing of 4.6 mV and an impedance of 550  $\Omega$ . Bipolar threshold testing resulted in painless His-bundle capture with a narrow QRS complex (Figure 2). Nonselective His-bundle capture with LBBB correction was present at a capture threshold of 2.5 V @ 1 ms (red arrows), with transition to selective His-bundle capture with LBBB correction at a threshold of 0.5 V @ 1 ms (blue arrows). Further decrease resulted in continued selective HBP but with loss of LBBB correction



**FIGURE 3.** Anterior-posterior chest radiograph showing a dual-chamber His-bundle pacemaker (HBP). RA = right atrial.

manifesting as a wide QRS complex with immediate chest discomfort (black arrows). These findings were present up to atrial pacing rates of 150 beats/min and were similar in both ventricular-only and dual-chamber pacing modes. The leads were secured, and dual-chamber pacemaker implantation was completed. The postoperative radiograph is displayed in Figure 3. The patient remains pain-free during follow-up and, in fact, just completed her latest marathon.

## DISCUSSION

Left bundle branch block is characterized by a QRS duration of 120 ms or more, QS or RS complex in lead V<sub>1</sub>, and a monophasic R wave in leads I, V<sub>5</sub>, and V<sub>6</sub>.<sup>15</sup> Exercise-induced LBBB is a rare phenomenon estimated to be prevalent in approximately 0.1% to 1.1%<sup>1,6,16-18</sup> and is 6 times more common in women.<sup>15</sup> Manifestation of chest pain during exercise-induced LBBB consistent with painful LBBB syndrome is even less common. Although incompletely understood, it is thought to be due to early septal radial inward thickening followed by late posterior inward thickening, which leads to significant left ventricular dyssynchrony.<sup>5</sup> Unfamiliarity with this syndrome has resulted in the frequent misdiagnosis of acute coronary syndrome, particularly because of a strong association between exercise-induced LBBB and coronary artery disease.<sup>1,7,8</sup>

No defined treatment protocols are available for patients with painful LBBB syndrome,<sup>19</sup> but some studies have reported benefits with exercise training, cardiac resynchronization therapy by way of biventricular pacing, nonselective  $\beta$ -blocker therapy, and long-acting nitrates.<sup>5,9,10,20,21</sup> More recently, Suryanarayana et al<sup>22</sup> reported His-bundle pacing as an effective management for painful LBBB syndrome in a patient with coexisting coronary artery disease. Likewise, Viles-Gonzalez et al<sup>23</sup> reported similar management in a patient with normal coronary angiography results, suggesting that this therapy remains promising. Importantly, HBP appears to be effective with the *selective* type, resulting in pure His-bundle stimulation and a QRS complex identical to normal conduction (Figure 2, red arrow), as well as the *nonselective* type, resulting in His-bundle stimulation with concomitant local right ventricular stimulation, resulting in a pseudo delta wave (Figure 2, blue arrow). The physiology of HBP has been well described, and the interested reader is referred to an excellent review for a complete discussion.<sup>24</sup>

More than 10,000 new cases of exercise-induced LBBB are seen annually during exercise stress testing in the United States.<sup>25</sup> In patients experiencing chest discomfort, consideration for painful LBBB should be entertained if significant coronary artery disease is first ruled out. As seen in our patient, development of exercise-induced LBBB and subsequent symptoms can be dynamic and progressive over time. Evolving symptoms likely warrants repeated testing, with special attention paid to correlating the timing of LBBB with symptom onset to establish a firm diagnosis. Interestingly, our patient appreciated only partial symptom relief during rest, despite a lack of aberrancy. We believe that the patient's severe anxiety due to her painful LBBB syndrome led to the persistent nature of her symptoms, worsening her quality of life. Initiation of HBP with subsequent acute symptom resolution allowed her to confidently increase her level of exertion, leading to a decrease in anxiety and, ultimately, complete freedom from pain.

Some studies have reported that exercise-induced LBBB is predictive of higher mortality rates and major adverse cardiac events.<sup>6,26</sup> Whether HBP has a role in patients who do

not have painful LBBB is unknown and requires further study.

This case report adds to the growing literature of painful LBBB syndrome and its effective treatment with HBP with the added caveat that it can present with persistent symptoms in the setting of enhanced anxiety. His-bundle pacing should be considered early on in the treatment of such patients.

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Drs R.D. Schaller and A. Licata contributed equally to this work.

**Abbreviations and Acronyms:** HBP = His-bundle pacing; LBBB = left bundle branch block

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