

# Recurrent flash pulmonary edema due to rate-dependent left bundle branch block



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## Introduction

Left bundle branch block (LBBB) is an electrophysiological abnormality that can have profound acute and chronic hemodynamic effects.<sup>1</sup> Intermittent LBBB has been noted to occur with accelerations in heart rate, typically during exercise (known as rate-dependent LBBB). This has been associated with acute deteriorations in cardiac systolic function through the development of left ventricular (LV) dyssynchrony, and also episodic chest pain (“painful LBBB syndrome”).<sup>2–4</sup> We present a case of an acute rate-dependent LBBB-associated cardiomyopathy with recurrent episodes of systolic heart failure and “flash” pulmonary edema that was successfully treated with cardiac resynchronization therapy (CRT).

## Case report

A previously healthy 54-year-old woman was admitted to the intensive care unit with acute, severe dyspnea. An electrocardiogram demonstrated a wide complex tachycardia. This was found to represent a sinus tachycardia with a previously unknown LBBB, which resolved during the hospitalization. No ischemic changes were noted and serum troponin levels were unremarkable. Transthoracic echocardiography (TTE) revealed global LV hypokinesis with an ejection fraction (LVEF) of around 40%; subsequent coronary angiography was negative for coronary artery disease. An acute cardiomyopathy, possibly secondary to a viral myocarditis, was suspected. She achieved rapid clinical recovery with standard heart failure therapy; LVEF improved to 50% on dismissal. Laboratory evaluation for secondary causes of a nonischemic cardiomyopathy returned negative. At 2-month follow-up, the patient was back to her baseline function. Repeat TTE showed complete normalization of LV systolic function (ejection fraction 55%); electrocardiogram revealed

a narrow QRS complex without evidence of interventricular delay.

Three months later, the patient’s exertional dyspnea symptoms recurred. TTE revealed moderate to severe LV enlargement, moderate functional mitral regurgitation (MR), and LVEF of 31%. During that study she was noted to be in LBBB at a heart rate of 90 beats per minute (BPM). A Holter monitor was placed (Figure 1), which showed sinus rhythm with LBBB occurring at rates over 75 BPM. Beta blockade was increased and her symptoms resolved. At a follow-up visit 6 months later she was feeling well and a TTE showed only mild MR with an LVEF of 55% and normal LV synchrony (Figure 2).

Six months after, however, the patient presented again with acutely worsening dyspnea secondary to pulmonary edema. TTE showed LVEF of 25% and abnormal septal motion secondary to LBBB. Telemetry demonstrated a rate-dependent LBBB, with QRS complex narrowing with heart rates below 70 BPM. Beta blockade was again increased to suppress her baseline heart rate and maintain normal conduction. She improved clinically, and her 3-month follow-up TTE showed a significant improvement in LVEF to 42%.

Nine months later, the patient presented with new-onset exertional chest discomfort suspicious for angina. An exercise stress echocardiogram was therefore performed. LBBB with faster heart rates was again observed; concomitantly, LVEF deteriorated from 45% to 30% at peak stress with regional wall motion abnormalities. This prompted a repeat coronary angiogram, which again showed no significant coronary artery disease. Five days later, the patient required intubation and admission to the cardiac intensive care unit for acute pulmonary edema. TTE demonstrated LVEF of 30% with intraventricular mechanical dyssynchrony secondary to LBBB (Figure 3) and moderate functional MR; QRS duration was 198 ms.

Given her repeated episodes of acute systolic heart failure secondary to rate-dependent LBBB despite optimization of beta-blocker therapy, we elected to proceed with CRT. It was felt that an intermediate step, such as further up-titration of her beta blocker or atrial pacing, may provide too little therapy in the setting of her recurrent life-threatening

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**KEY TEACHING POINTS**

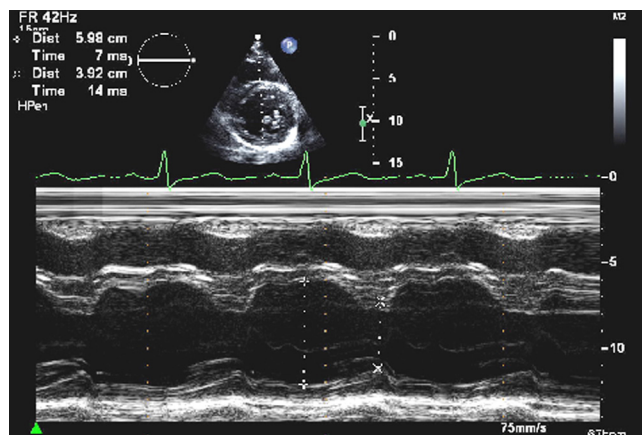
- Rate-dependent left bundle branch block can rarely present with recurrent episodes of acute systolic heart failure.
- Early cardiac resynchronization therapy may be considered in patients with acute heart failure and left ventricular dysfunction secondary to intermittent left bundle branch block.

episodes. She subsequently underwent biventricular implantable cardioverter-defibrillator implantation and was discharged after a full clinical recovery.

Three months following this intervention, her symptoms were completely resolved, and she had an excellent result from her 6-minute walk test (111% predicted based on age and sex). Follow-up TTE revealed improved LVEF to 40% with near-resolution of contractile dyssynchrony and improved MR (from moderate to mild).

**Discussion**

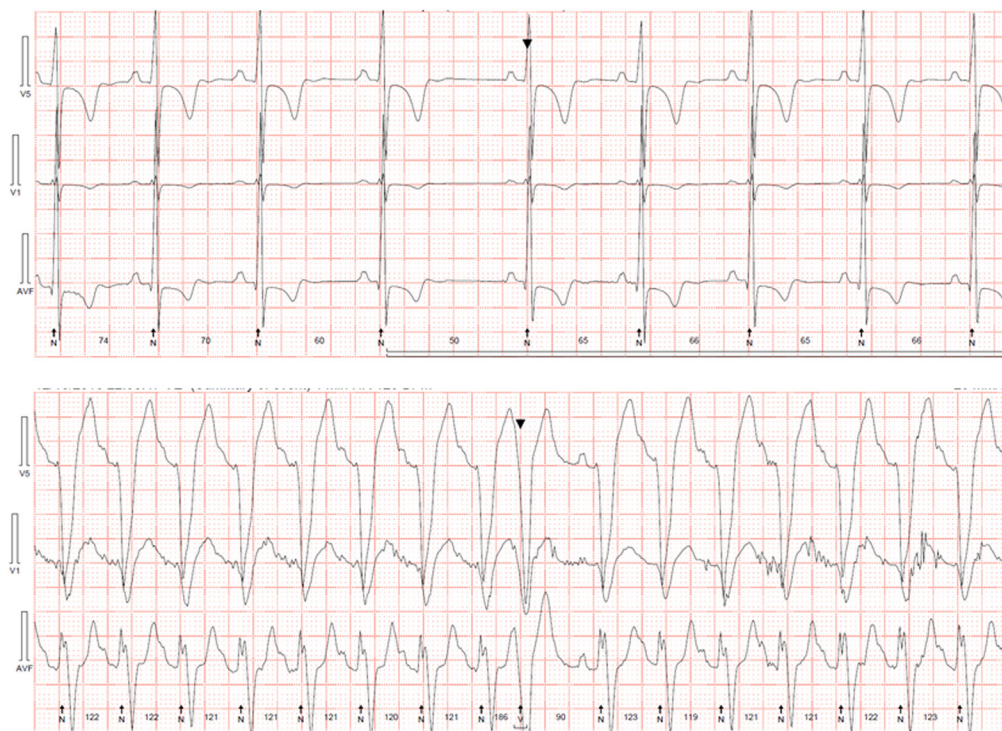
Patients with rate-dependent LBBB can have an abrupt decrease in LVEF with the onset of dyssynchronous contraction.<sup>2</sup> Chest pain associated with rate-dependent LBBB in the absence of myocardial ischemia (termed the “painful LBBB syndrome”) has also been described. Although the mechanism for LBBB-induced chest pain is unknown, investigators have attributed the abnormal systolic motion of the septum as a potential trigger.<sup>4,5</sup> The clinical



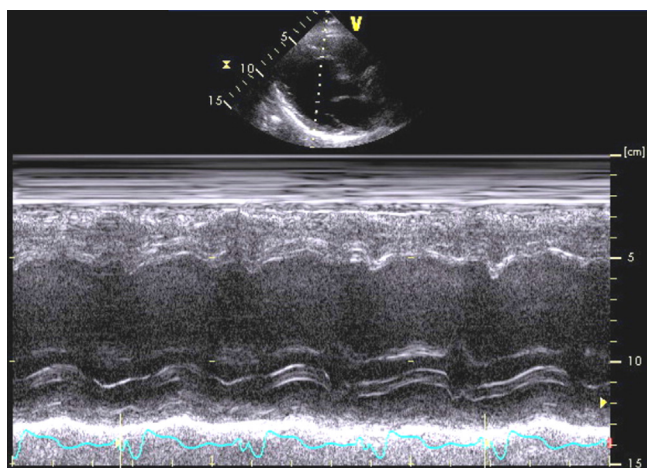
**Figure 2** Transthoracic echocardiogram M-mode through the left ventricle showing synchronous contraction.

significance of rate-dependent LBBB remains unclear. However, a retrospective study revealed a 2.78-fold increase in the odds of death or major adverse cardiovascular events among patients with rate-dependent LBBB compared with matched controls.<sup>6</sup> Hence, the presence of rate-dependent LBBB warrants attention by providers when seen in clinical practice.

Acute systolic heart failure is an uncommon manifestation of rate-dependent LBBB. One case described a 44-year-old woman who developed severe shortness of breath and near-syncope following minimal exercise.<sup>7</sup> An electrophysiologic study confirmed the development of LBBB only with pacing greater than 140 BPM. In another case report, a 75-year-old woman experienced 2 episodes of respiratory arrest and



**Figure 1** Holter monitor tracings demonstrating a narrow QRS complex rhythm at lower heart rates (Top) and emergence of left bundle branch block at heart rates above 75 beats per minute (Bottom).



**Figure 3** Transthoracic echocardiogram M-mode through the left ventricle showing significant abnormal delay between the anteroseptal and inferolateral wall motion.

pulseless electrical activity in the setting of “flash” pulmonary edema.<sup>8</sup> Imaging studies revealed preserved systolic function; exercise testing eventually induced sinus tachycardia with LBBB and recurrent pulmonary edema. In both cases, the patients underwent CRT device implantation with resolution of heart failure symptoms. Our patient showed marked improvement in clinical symptoms and LV function following CRT as well; however, we did not see complete normalization of her LVEF after 3 months, indicating the possibility of an underlying cardiomyopathy that was exacerbated by the rate-dependent LBBB.

In summary, recurrent episodes of acute heart failure and chest pain is a rare presentation of rate-dependent LBBB. CRT proved effective in treating our patient’s symptoms. CRT should therefore be considered early in the clinical course of patients with recurrent episodes of acute heart failure, significantly decreased LVEF, and/or intractable chest pain secondary to LBBB emergence.

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