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Case Report

Successful treatment of functional mitral regurgitation in severe heart failure with atrial pacing: A case report

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ABSTRACT

Functional mitral regurgitation (MR) is a common complication accompanying left ventricular dysfunction. Increasing resting heart rate (HR) is demonstrated to be associated with increased mortality in heart failure (HF) patients. Thus, lowering HR is recommended by recent HF management guidelines. However, the hemodynamic effect of changing HR on functional MR remains unclear. We present a patient who demonstrated ischemic cardiomyopathy and was admitted to our hospital. Electrocardiogram showed complete left bundle block with QRS interval of 120 ms and HR of 60 beats/min. Temporal pacing study was performed to confirm the efficacy of cardiac resynchronization therapy. Functional MR was unexpectedly improved by increasing HR with atrial pacing rather than biventricular pacing. Brain natriuretic peptide was reduced from 3642 pg/ml to 435 pg/ml after 2 weeks. Our case indicates that in some HF patients with functional MR, a prolonged diastolic interval may lead to deteriorating MR flow.
<**Learning objective**: When a resting HR >70 beats/min is observed in patients with systolic HF in sinus rhythm, lowering the HR below 70 beats/min is recommended according to the recent guidelines. However, in some HF patients with functional MR, it is possible that a prolonged diastolic interval leads to deterioration in regurgitation flow. Increasing the HR by atrial pacing may provide a favorable outcome in such patients.>

Introduction

Functional mitral regurgitation (MR) is a common complication accompanying left ventricular dysfunction [1]. In functional MR, determining heart rate (HR) during heart failure (HF) is crucial because regurgitation flow might be influenced by the diastolic interval time. Resting HR >70 beats/min (bpm) may be associated with increased mortality [2]. Current European guidelines recommend reduction of HR to <70 bpm [3]. However, the hemodynamic effect of changing HR on functional MR remains unclear. In this report, we present a case in which functional MR was unexpectedly improved by increasing HR with atrial pacing rather than biventricular pacing (BVP).

Case report

A 71-year-old male with ischemic cardiomyopathy was admitted to our hospital with deteriorating HF. He had a history of coronary angioplasty 6 years previously. On physical examination, blood pressure was 70/51 mm Hg, HR was 60 bpm, and a II/VI holosystolic murmur was heard at the apex. A 12-lead electrocardiogram revealed a left-bundle branch block and QRS duration of 120 ms (Fig. 1). Echocardiography showed a dilated left ventricle (LV) with an end-diastolic dimension of 60 mm, akinesis in inferior and apical wall and severe hypokinesis in the other LV walls, depressed ejection fraction (EF) estimated at 25% by modified Simpson's method, and severe functional MR (Fig. 2A and B). No significant stenosis was seen upon coronary angiography. Laboratory data revealed a white blood cell count, 14,330 mm^3; C-reactive protein, 11.7 mg/dl; serum sodium, 132 mEq/l; creatinine, 1.74 mg/dl; and brain natriuretic peptide, 3642 pg/ml. Prescribed medications included carvedilol 5 mg twice daily; enalapril 1.25 mg daily; spironolactone 25 mg daily; and furosemide 40 mg daily. After hospitalization, antibiotics and increasing doses of diuretic were initiated. These treatments improved the infection but congestion was not resolved and renal function deteriorated gradually, categorizing his symptoms as New York Heart Association classes III and IV. An acute hemodynamic study with pacing was performed to evaluate the efficacy of biventricular pacing (BVP) on cardiovascular parameters. At baseline, HR ranged from 55 to 65 bpm. Swan–Ganz catheter insertion revealed elevated pulmonary capillary wedge pressure (PCWP) with prominent V wave of 51 mmHg

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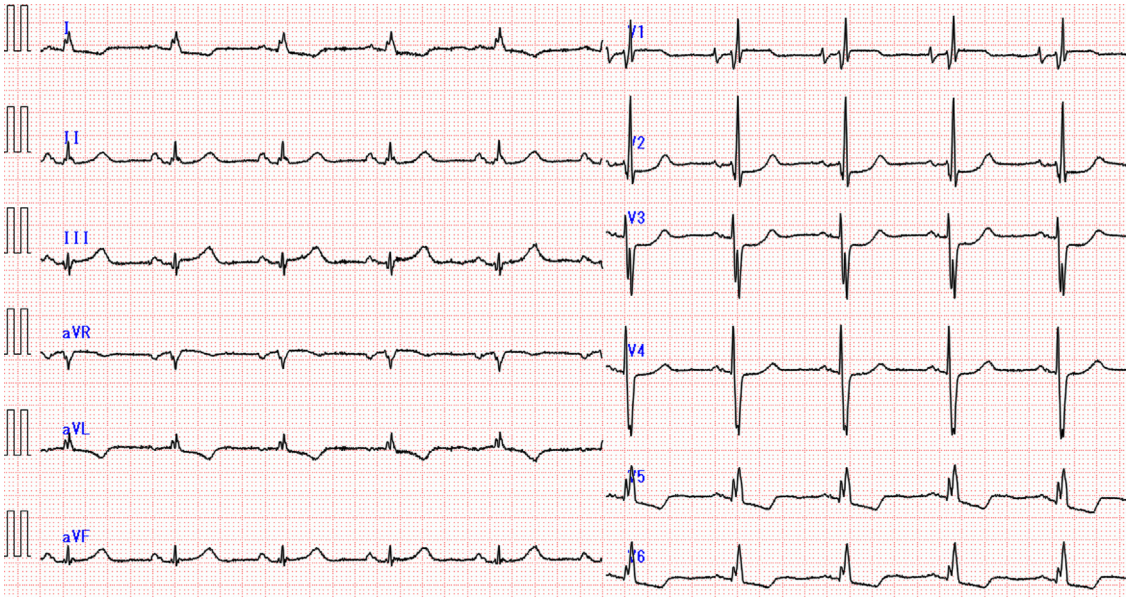

Fig. 1. A 12-lead electrocardiogram revealed a left-bundle branch block and QRS duration of 120 ms.

induced by severe functional MR (Fig. 3A). Right atrium pacing at 80 bpm unexpectedly decreased V wave by 19 mmHg and elevated systolic pressure from 76 to 90 mmHg (Fig. 3B and D). BVP with paced AV delay of 130 ms and VV delay of 0 ms also showed an improved hemodynamic effect on the V wave and mean PCWP. However, right atrium pacing alone was superior (Fig. 3C and E). Echocardiography showed remarkable improvements in MR flow and reduced tethering force, as estimated by incomplete mitral leaflet closure area [4] from 1.1 to 0.5 cm^2, an anterior papillary muscle tethering distance of 38.9–34.4 mm and an LV end-diastolic volume of 214–186 cm^3 (Fig. 2C and D), which was attributed to the shortened diastolic interval with increasing atrial pacing rate. We selected cardiac resynchronization therapy (CRT) with defibrillation, programmed with atrial pacing at 80 bpm. Clinical symptoms improved dramatically and BNP was reduced to 435 pg/ml after 2 weeks. We ultimately programmed DDD mode with a fixed atrio-ventricular delay of 350 ms to avoid ventricular pacing. The patient's pacing rate at discharge was 70 bpm, following the European Society of Cardiology guideline that under 70 bpm is recommended [3], with rate-adaptive pacing to induce

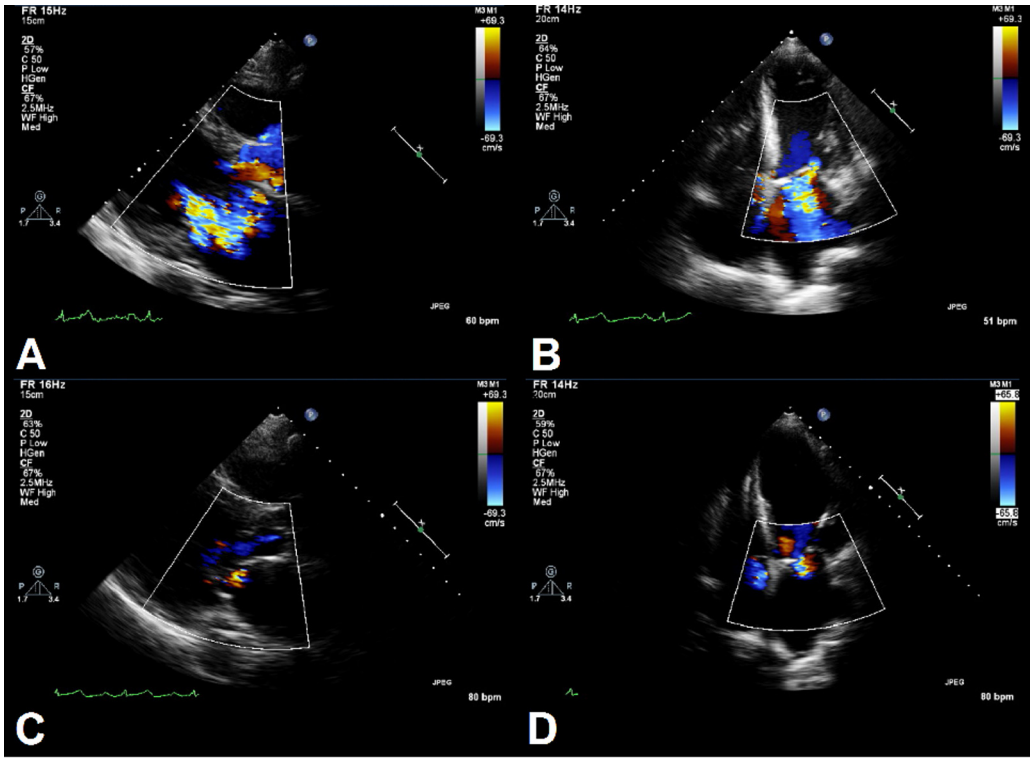

Fig. 2. (A) The parasternal long-axis view (B) and apical four-chamber view, transthoracic echocardiography showed severe left ventricular systolic dysfunction and functional mitral regurgitation. No organic change in mitral leaflet and/or mitral tendon rupture was found. (C and D) Functional mitral regurgitation dramatically improved with right-atrium-only pacing at 80 bpm.