Temporary Dual-Chamber Pacing Can Stabilize Hemodynamics During Noncardiac Surgery in a Patient With Left Ventricular Hypertrophy and Outflow Obstruction

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HYPERTROPHIC CARDIOMYOPATHY (HCM) often includes asymmetric (or nonphysiologic) massive left ventricular hypertrophy, which can be diagnosed by electrocardiography and echocardiography. In patients with HCM, hypertrophy is more common in the ventricular septum below the aortic valve, leading to left ventricular outflow tract (LVOT) obstruction.[1-3] There have been many reports of anesthetic management for noncardiac surgery of patients with ischemic heart disease. However, there have been only a few reports concerning the anesthetic management of patients with HCM undergoing noncardiac surgery.[4-7] Hreybe et al reported that the presence of HCM significantly increased the risk of death and myocardial infarction associated with noncardiac surgery.[8] Patients with HCM undergoing elective procedures may require more careful preoperative assessment and perioperative monitoring. However, it is not known exactly what factors associated with HCM have harmful effects on the perioperative condition of a patient. Left ventricular hypertrophy and LVOT, which induce left ventricular diastolic dysfunction and a pressure gradient, may be involved. In addition, better ways for decreasing the risks have not yet been established.

Permanent dual-chamber pacing has been proposed as an adjunct treatment to lessen symptoms in markedly symptomatic patients with obstructive HCM refractory to drugs.[9] This approach is based on the concept that pre-excitation of the interventricular septum by right ventricular pacing would cause the septum to move away from the left ventricular wall during systole and artificially make dyssynchrony, resulting in an increase in LVOT dimensions and, hence, a decrease in LVOT blood velocities. This would, in turn, decrease the systolic anterior motion of the mitral valve, resulting in further relief of the LVOT obstruction and less severe mitral regurgitation. However, the application of this procedure in perioperative management has been rare. Here, the authors describe a case of noncardiac surgery with left ventricular hypertrophy and LVOT obstruction. The surgery included resection of a catecholamine-secreting endocrine tumor that was having a harmful effect on the patient's hypertrophic heart. After assessing the effect with temporary pacing, the authors performed temporary dual-chamber pacing to decrease the perioperative risks. Noncardiac surgery then was performed successfully without any adverse cardiac events. The clinical course of left ventricular hypertrophy and LVOT obstruction complicated with a catecholamine-secreting tumor involves significant implications in clinical practice.

CASE REPORT

A 42-year-old woman was referred for perioperative cardiac assessment and management. She already had hypertension in her 30s. She had palpitations and excessive diaphoresis. When she was 40 years old, she underwent clinical evaluation in a hospital because of abdominal pain. Computed tomography visualized an irregularly shaped 35-mm tumor mass in her left adrenal gland. A high urinary metanephrine level of 1.51 mg/day was detected, leading the authors to suspect pheochromocytoma. Clonidine administration did not suppress her plasma catecholamine level, suggesting the presence of a catecholamine-secreting tumor. Scintigraphy showed that iodine-123-labeled metaiodobenzylguanidine had not accumulated in the tumor mass, whereas positron emission tomography with fluorodeoxyglucose depicted its accumulation in the tumor. These data strongly suggested pheochromocytoma. Surgical intervention was proposed for the diagnosis and treatment of the tumor.

This patient had dizziness and shortness of breath with effort. On physical examination, a Levine 5/6 grade systolic ejection murmur was audible at the left upper sternal border. The serum B-type natriuretic peptide level was 289 pg/mL. Left ventricular hypertrophy with a strain pattern was present on the electrocardiogram. An echocardiogram with continuous-wave Doppler showed remarkable left ventricular hypertrophy and a high pressure gradient of 105 mmHg in the LVOT (Fig 1). To lower the high pressure gradient, the authors administrated bisoprolol, 10 mg, cibenzoline, 300 mg, and doxazosin, 8 mg, at the maximum doses possible in Japan to decrease the high pressure gradient. However, they were not effective against the high pressure gradient.

Cardiac catheterization was performed for perioperative risk stratification. There was no significant stenosis in any coronary artery. However, left ventriculography indicated the obstruction from the mid-ventricle to the outflow tract. Even high-dose medications were not effective for it. Therefore, the authors evaluated the effects of cardiac pacing on the left ventricular pressure gradient. Dual-chamber sequential pacing at the right atrial appendage and at the right ventricular apex caused the widest QRS complex, indicative of significant ventricular dyssynchrony, and markedly decreased the left ventricular pressure gradient from 80−100 mmHg to 20.5 mmHg in the cardiac catheter and echocardiographic measurements (Table 1). At the same time, systolic anterior motion on the echocardiogram had disappeared (Fig 2). Moreover, this study indicated that not only right ventricular pacing but also select-site pacing in an adequate position were essential to decrease the pressure gradient effectively. The authors discussed whether a permanent pacemaker was indicated for this patient because

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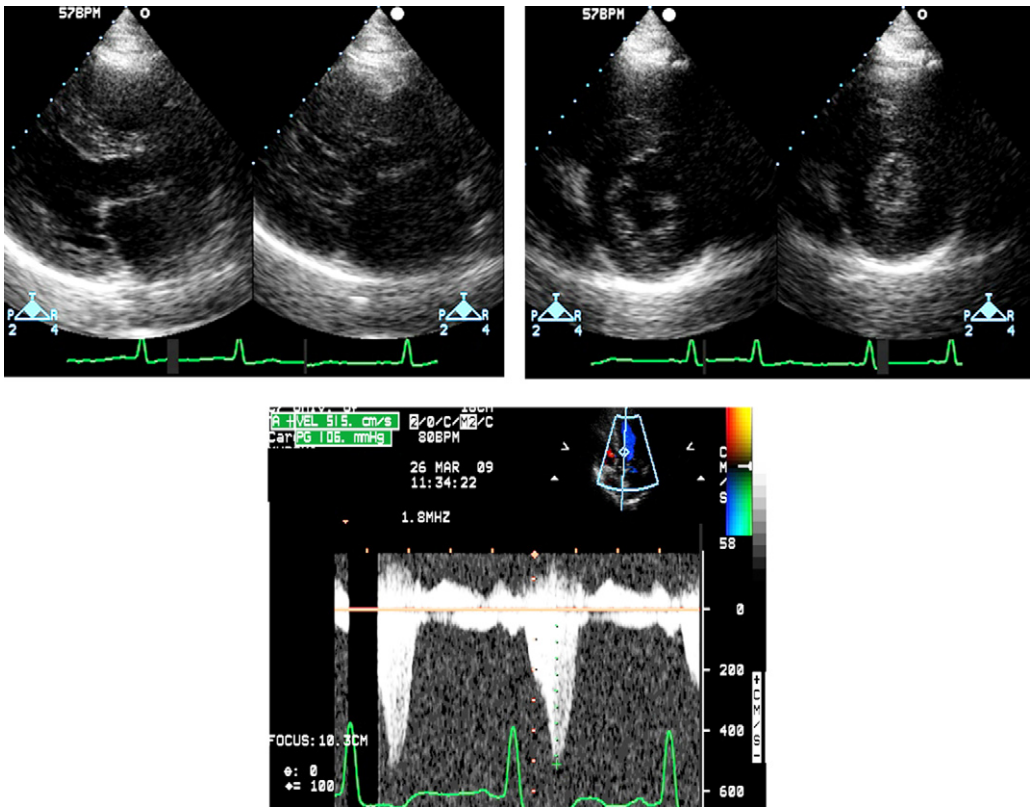

Fig 1. Echocardiographic findings indicating concentric left ventricular hypertrophy and preserved left ventricular ejection fraction in parasternal long-axis (top left) and short-axis (top right) views and the pressure gradient in the left ventricular outflow tract (bottom). The patient had a high pressure gradient of 105 mmHg in the left ventricular outflow tract: intraventricular septum 14 mm, left ventricular posterior wall thickness 17 mm, diastolic left ventricular diameter 43 mm, systolic left ventricular diameter 22 mm, aortic diameter 28 mm, left atrial diameter 48 mm, ejection fraction (Teichholz) 80%, left ventricular outflow obstruction pressure gradient 105 mmHg. (Color version of figure is available online.)

a chronic hemodynamic effect of a permanent pacemaker for HCM has not been established and the patient's cardiac hypertrophy and outflow tract pressure gradient were exaggerated by catecholamine overproduction by the endocrine tumor. Excision of the tumor might have resulted in possible improvement in her hypertrophy and hemodynamics. Therefore, the authors concluded a permanent pacemaker was unnecessary at this time and that temporary pacing might be able to stabilize her hemodynamics during resection of the endocrine tumor. Thus, the authors performed perioperative temporary dual-chamber pacing with electrode catheters that usually are used for electrophysiologic testing. The usual heart rate of this patient was 60 to 70 beats/min. It was assumed that her heart rate changed depending on the intraoperative hemodynamics. During the catheter study, the authors changed the pacing rate and there was little difference among 70, 80, and 90

Table 1. List of Studies with Temporary Pacing

Mode	HR (beats/min or pulses/min)	Position of RV Lead	AV Delay (ms)	LV Pressure (mmHg)*	AO Pressure (mmHg)*	Transcatheter PG (mmHg)	TTE PG (mm Hg)	CO (CI)	QRS Duration in Lead II (ms)
Baseline	71	—	—	187/−7/8	108/63/80	79.8	88.8	3.49	110
AAI	80	—	—	204/−6/8	114/70/86	90.5	95.4	4.85 (2.88)	110
VVI	80	apex	—	183/−2/8	98/68/77	84.9	—	—	170
DDI	80	inf (base)	150	215/−5/12	118/71/89	97.5	108.7	—	130
DDI	80	inf (mid)	150	197/−3/11	113/66/83	84.1	—	—	140
DDI	80	inf (septal)	150	202/−2/14	95/57/73	107.1	95.4	—	150
DDI	80	free wall	150	203/0/14	112/64/83	91.0	86.3	—	160
DDI	80	apex	150	149/−4/10	129/84/99	20.5	39.8 SAM ↓	4.65 (2.76)	170

Abbreviations: AAI, for single chamber, atrial pacing in the inhibited mode; AO, aortic; AV, atrioventricular; CI, cardiac index (L/min/m^2); CO, cardiac output (L/min); DDI, dual chamber pacing and sensing, but inhibited mode only; HR, heart rate; inf, inferior; LV, left ventricular; PG, pressure gradient; RV, right ventricular; SAM, systolic anterior movement; TTE, transthoracic echocardiographic; VVI, for single chamber, ventricular pacing in the inhibited mode.

*Data are presented as systolic/diastolic/mean.