Echocardiographic Evidence of the Brockenbrough–Braunwald–Morrow Sign After Mitral Valve Repair

Joshua D. Stearns, MD
Wilson Y. Szeto, MD
Albert T. Cheung, MD

The Brockenbrough–Braunwald–Morrow sign was first described in 1961 (1) in individuals with hypertrophic cardiomyopathy and dynamic left ventricular (LV) outflow tract (LVOT) obstruction worsened by conditions associated with increased myocardial contractility. The sign was characterized by an increase in peak-systolic gradient combined with a decrease in pulse pressure after an extrasystolic beat (2). The increased contractile performance in the postextrasystolic beat was explained by postextrasystolic potentiation from 1) persistence of the positive inotropic effect and 2) rest potentiation from an increased strength of contractility immediately after a period of rest (3). The pathophysiology underscoring the Brockenbrough–Braunwald–Morrow sign was demonstrated echocardiographically after repair of the mitral valve.

A 58-yr-old female patient with severe mitral regurgitation from myxomatous degeneration underwent mitral valve repair that included a sliding quadrangular resection of the P2 (middle) segment of the posterior mitral valve leaflet and a 34-mm mitral ring annuloplasty (Model 4450, Edwards Life Sciences). Preprocedural transesophageal echocardiography (TEE) revealed a mitral valve with advanced myxomatous degeneration, redundant tissue of both leaflets and severe, central mitral regurgitation. After repair, color flow Doppler in the TEE midesophageal-aortic valve-long axis view demonstrated turbulent flow in the LVOT and mild mitral regurgitation consistent with systolic anterior motion (SAM) of the mitral valve (Fig. 1; also please see video loop available at www.anesthesia-analgesia.org). Continuous-wave Doppler examination in the TEE transgastric mid-LV-long axis view measured a LVOT peak gradient of 60 mm Hg in the absence of aortic stenosis or septal hypertrophy. The presence of SAM ultimately led to a return to cardiopulmonary bypass and revision of the mitral valve repair (please see video loop available at www.anesthesia-analgesia.org).

In addition to SAM, further evidence for dynamic LVOT obstruction was captured on continuous-wave Doppler examination (Fig. 2). In this image, a premature complex led to a poor ejection and a reduced gradient. However, the postextrasystolic beat led to an increased LVOT gradient ($V_{\text{MAX}} = 4.2$ m/s; peak gradient = 67.2 mm Hg; mean gradient = 33.2 mm Hg). Continuous-wave Doppler-derived measurements, taken immediately before the premature complex, demonstrated a consistent

Figure 1. Transesophageal echocardiography midesophageal long-axis image at a multiplane angle of 123° at mid-to-late systole immediately after sliding quadrangular resection of the P2 (middle) segment of the posterior leaflet and 34 mm mitral ring annuloplasty. The tip of the anterior mitral valve leaflet (A) was displaced into the LV outflow tract (LVOT) producing systolic anterior motion (SAM) and LVOT obstruction. Ao = aortic root; LA = left atrium; LV = left ventricle.
LVOT peak gradient of 40–45 mm Hg. The increased LVOT gradient after a postextrasystolic beat is consistent with the Brockenbrough–Braunwald–Morrow sign.

The Brockenbrough–Braunwald–Morrow sign was originally described in the setting of hypertrophic obstructive cardiomyopathy; however, this image (Fig. 2) supports the notion that any condition producing LVOT obstruction, in this case SAM, that is worsened by increased contractility should also exhibit this sign. Although the Brockenbrough–Braunwald–Morrow sign was traditionally demonstrated using simultaneous intraaortic and intraventricular pressure measurements, the sign was also detected by physical examination as a decreased pulse pressure after a premature ventricular contraction. Likewise, the use of intraoperative TEE may also demonstrate the Brockenbrough–Braunwald–Morrow sign and its associated pathophysiology, as evidenced by the presented images after repair of the mitral valve.

REFERENCES

Figure 2. Continuous-wave Doppler examination of the LV outflow tract (LVOT) in the transesophageal echocardiography transgastric midventricular long-axis image at a multipane angle of 118° immediately after mitral valve repair. Simultaneous recording of the electrocardiogram demonstrated an isolated increase in LVOT blood flow velocity ($V_{\text{MAX}} = 4.2$ m/s; peak gradient = 67.2 mm Hg; mean gradient = 33.2 mm Hg) corresponding to a postextrasystolic beat (3) immediately after a premature complex (2). The LVOT blood flow velocity and pressure gradient associated with the fourth QRS complex (4) returned to baseline ($V_{\text{MAX}} = 3.4$ m/s; peak gradient = 46.2 mm Hg; mean gradient = 18.6 mm Hg).