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Intraoperative Transesophageal Echocardiography-Guided Avoidance of Mitral Valvuloplasty During Left Ventricular Aneurysmectomy

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Abstract **Case Report**

Left ventricular (LV) aneurysm formation after myocardial infarction frequently leads to secondary functional mitral regurgitation (MR) through geometric distortion of the left ventricle. Although severe functional MR generally warrants surgical correction, the management of moderate functional MR during LV reconstruction remains controversial. We present the case of a 74-year-old male scheduled for coronary artery bypass grafting (CABG), LV aneurysmectomy, and mitral valvuloplasty for a large inferior LV aneurysm and moderate functional MR. Intraoperative transesophageal echocardiography (TEE) performed immediately after LV aneurysmectomy demonstrated a marked qualitative reduction in MR severity. Recognizing that restoring LV geometry effectively corrected the functional subvalvular tethering mechanism, the surgical team avoided the planned mitral valvuloplasty and right coronary artery bypass grafting. The patient was successfully weaned from cardiopulmonary bypass (CPB) without complications, and follow-up transthoracic echocardiography (TTE) at 5 months demonstrated only mild residual MR. This case highlights the pivotal role of real-time intraoperative TEE in guiding dynamic surgical decisions and preventing redundant valvular interventions by directly assessing immediate geometric restoration.

Keywords: Transesophageal echocardiography, Left ventricular aneurysm, Mitral regurgitation, Mitral valvuloplasty, Cardiopulmonary bypass.

INTRODUCTION

Left ventricular remodeling following myocardial infarction can progress to severe structural complications, including true LV aneurysms and pseudoaneurysms. Both conditions significantly distort LV geometry. This structural distortion often induces secondary or ischemic functional MR, driven by progressive changes in ventricular sphericity and regional wall stress (Gaudron *et al.,* 1993). In functional MR, the mitral valve leaflets and chordae tendineae are anatomically normal; however, displacement of the papillary muscles, local tethering, and annular dilatation restrict proper leaflet coaptation (Levine & Schwammenthal, 2005). While severe functional MR warrants surgical correction, managing moderate functional MR during geometric LV reconstruction remains controversial, as remodeling the ventricle may intrinsically restore subvalvular alignment (Song *et al.,* 2020). This case report highlights the utility of real-time intraoperative TEE in evaluating immediate geometric alterations, which ultimately prevented an unnecessary mitral valvuloplasty.

CASE REPORT

A 74-year-old male (height 160 cm, weight 59 kg, BMI 23.0 kg/m²) presented with ischemic cardiomyopathy and a large inferior LV aneurysm measuring 4.9 × 4.9 cm (Figure 1). Preoperative transthoracic echocardiography (TTE) demonstrated a left ventricular ejection fraction (LVEF) of 52% alongside regional wall motion abnormalities in the right coronary artery (RCA) territory. Coronary angiography revealed total occlusion of the mid-RCA with collaterals from the left circumflex (LCx) artery, combined with significant stenosis in the proximal-to-mid left anterior descending (LAD) artery and the proximal-to-distal LCx artery. The initial surgical plan included RCA CABG, LV aneurysmectomy, and mitral valvuloplasty to address moderate functional MR.

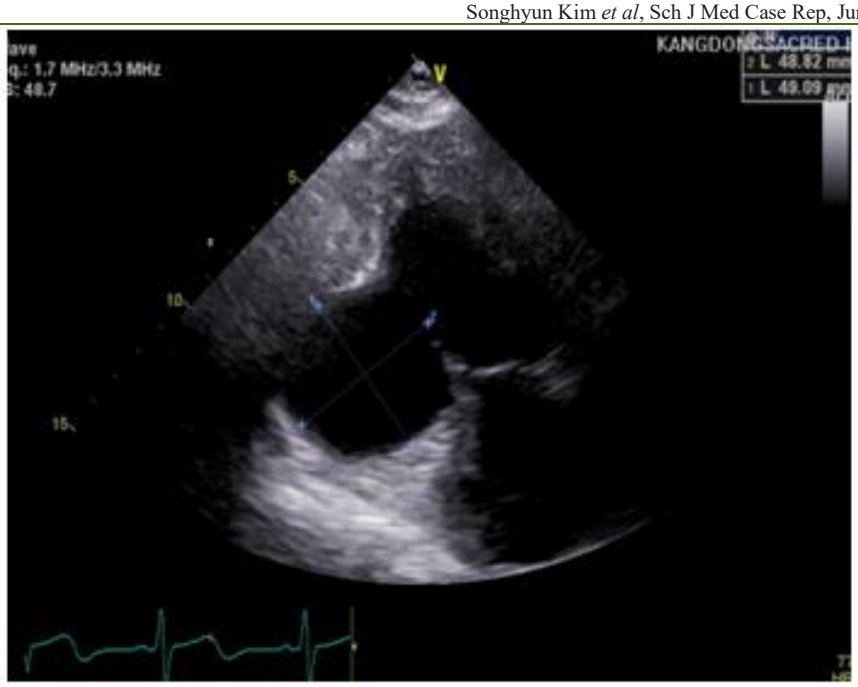

Figure 1: Preoperative transthoracic echocardiography demonstrating an inferior left ventricular aneurysm measuring 4.9 x 4.9 cm

The operation was performed under total intravenous anesthesia (TIVA) using target-controlled infusions of propofol and remifentanil. Baseline vital signs following induction were stable: blood pressure was 138/63 mmHg, heart rate was 57 beats/min, and peripheral oxygen saturation (SpO2) was 96%. For continuous hemodynamic monitoring, an arterial line was placed in the right radial artery, and a Swan-Ganz pulmonary artery catheter was inserted via the right internal jugular vein to measure pulmonary artery pressures and cardiac output. Additionally, a TEE probe was inserted to monitor intraoperative cardiac function.

Following anesthetic induction, pre-CPB TEE suggested at least moderate functional MR characterized by a dense holosystolic regurgitant signal and broad color Doppler jet (Figure 2). The MR was identified as secondary (functional) due to LV distortion and dilatation from the aneurysm, while the mitral leaflets remained structurally intact.

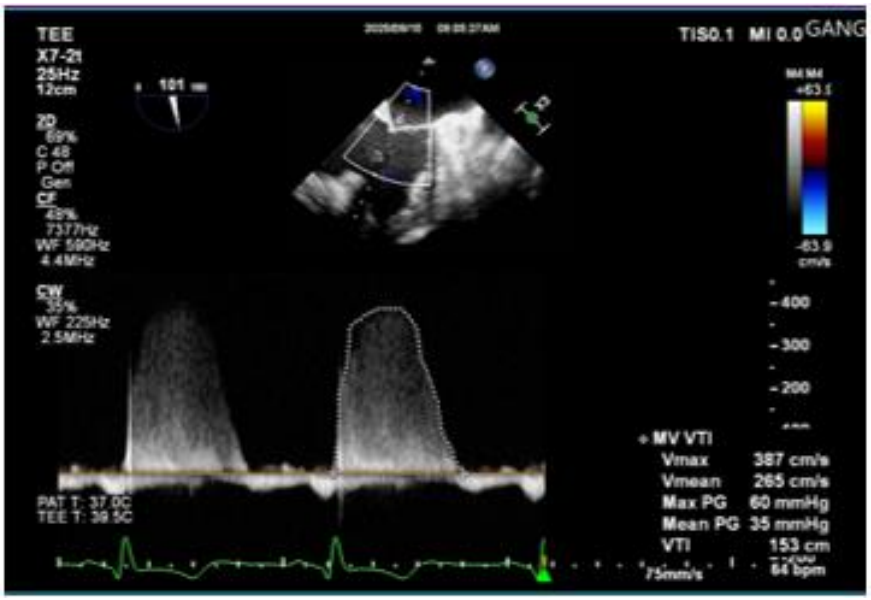

Figure 2: Pre-CBP TEE demonstrating a dense holosystolic continuous-wave Doppler envelope consistent with moderate functional mitral regurgitation

Median sternotomy was performed, and CPB was subsequently initiated. Following cardioplegic arrest, the inferior LV aneurysm was incised, and a geometric endoventricular patch repair was performed

using bovine pericardium. Post-reconstruction multiplane TEE demonstrated a substantial qualitative reduction in functional MR severity, with complete resolution of the dense holosystolic CW Doppler envelope and only a faint residual regurgitant signal (Figure 3). This significant attenuation indicated that restoring a more favorable ventricular geometry successfully relieved subvalvular tethering. The MR severity was assessed using an integrated qualitative multiparametric TEE evaluation including color Doppler and CW Doppler findings.

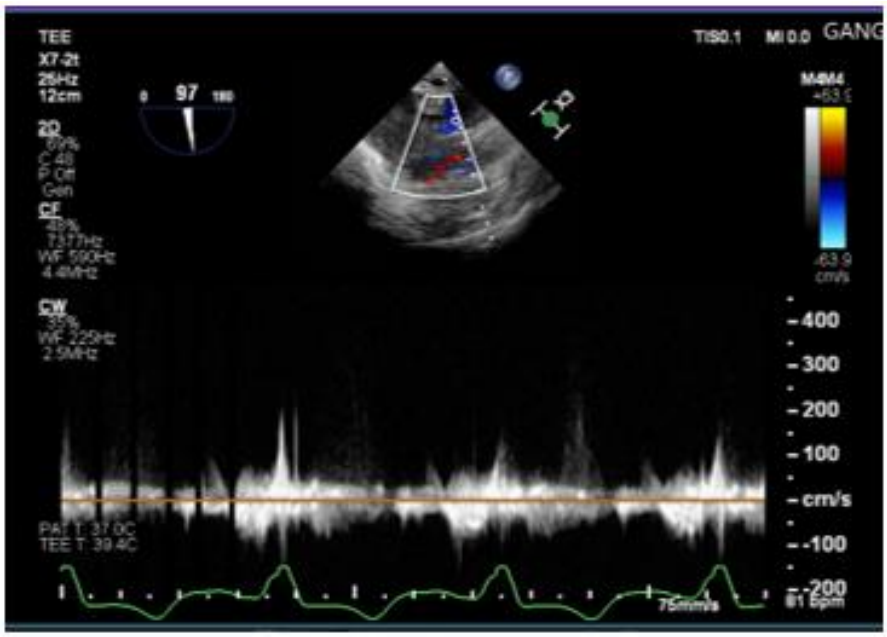

Figure 3: Post-aneurysmectomy TEE demonstrating marked qualitative reduction in functional MR with a faint and incomplete CW Doppler regurgitant signal

Given the immediate reduction in MR severity, the chronic nature of the RCA occlusion with collaterals from the LCx, and the poor quality of the harvested saphenous vein conduit, the surgical team elected to defer RCA revascularization in favor of staged percutaneous coronary intervention (PCI). The total surgical duration was 4.5 hours, with an estimated blood loss of 300 mL. At the 5-month postoperative follow-up, a surveillance TTE demonstrated sustained therapeutic success, revealing only mild functional MR with a quantified effective regurgitant orifice area (EROA) of 0.17 cm^2. To address the residual ischemia of the RCA territory safely, the patient underwent staged PCI with drug-eluting stent implantation to the RCA without any procedural complications.

DISCUSSION

Differentiating a true LV aneurysm from a pseudoaneurysm is critical due to divergent clinical behaviors. A true aneurysm involves all three intact layers—endocardium, myocardium, and epicardium—occurring in 10–15% of transmural myocardial infarctions, primarily at the anterior wall or apex, presenting a broad neck with low rupture risk (<10%) (Flam & Albåge, 2018; Tikiz *et al.,* 2001). In contrast, a pseudoaneurysm results from a cardiac free-wall rupture contained by adherent pericardium or scar tissue (Hulten & Blankstein, 2012; Inayat *et al.,* 2018). It typically occurs in under 2% of post-myocardial infarction cases, predominantly involves the posterior or inferior walls, and carries a high risk of catastrophic rupture (30–45%) demanding urgent closure (Frances *et al.,* 1998; Inayat *et al.,* 2018; Reyaldeen *et al.,* 2018).

Ischemic functional MR is fundamentally driven by progressive changes in ventricular sphericity and regional wall stress following myocardial infarction (Gaudron *et al.,* 1993), which subsequently precipitate localized left ventricular distortion rather than intrinsic valvular pathology (Levine & Schwammenthal, 2005). Although true postinfarction aneurysms classically develop within the apical or anterior walls (Flam & Albåge, 2018), our case presented a rare variant located along the inferior wall due to right coronary artery occlusion. This specific anatomical location has profound functional implications; the inferior wall aneurysm causes disproportionate geometric shifting by directly displacing the posteromedial papillary muscle outward and apically (Flam & Albåge, 2018; Levine & Schwammenthal, 2005). This dynamic vector pulls the chordae tendineae taut and restricts the systolic closure of anatomically normal leaflets (Levine & Schwammenthal, 2005).

While many centers historically combined left ventricular reconstruction (LVR) with routine ring annuloplasty or valvuloplasty for moderate functional

MR, emerging evidence has questioned the routine addition of mitral valve surgery during LVR (Song *et al.,* 2020). Propensity-matched data from the Fuwai Hospital cohort showed that adding mitral valve surgery to LVR offers no midterm survival or major adverse cardiovascular and cerebrovascular event (MACCE) benefit over LVR alone (Song *et al.,* 2020). By directly correcting ventricular geometry, surgical repair by either endoventricular patch plasty or linear closure reduces global wall tension via Laplace's Law, realigning the subvalvular apparatus and naturally relieving the underlying tethering forces (Raja *et al.,* 2009).

In this case report, real-time intraoperative TEE directly validated this geometric principle. The immediate qualitative reduction of the regurgitant CW Doppler signal demonstrated that patch plasty successfully neutralized the subvalvular tethering forces. Quantitative assessment of MR severity was limited intraoperatively because of dynamic loading conditions under general anesthesia and CPB; therefore, surgical decision-making relied on integrated qualitative TEE findings. This real-time feedback allowed the team to avoid a redundant valvuloplasty, potentially minimizing CPB-related morbidity. The clinical durability of this geometric correction was confirmed at 5 months postoperatively, with follow-up TTE demonstrating stable, mild functional MR (EROA 0.17 cm^2). Furthermore, deferred management of the totally occluded RCA via staged postoperative PCI provided a safer, hybrid alternative to prolonged intraoperative grafting in the setting of suboptimal conduits.

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