

# E-CHALLENGES & CLINICAL DECISIONS

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## Assessment of Coronary Blood Flow by Transesophageal Echocardiography

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### CASE HISTORY

**A** 49-YEAR-OLD MALE presented in extremis after 3 weeks of malaise. Preoperative transthoracic echocardiography showed mild mitral regurgitation, mild pulmonic valve insufficiency (PI), and severe aortic insufficiency (AI) with a large mobile target on the aortic valve. Left heart catheterization confirmed the presence of severe AI and showed the presence of left-dominant circulation and the proximal occlusion of the left circumflex coronary artery (LCx) by a pseudoaneurysm of the aortic annulus lateral to the left coronary sinus of Valsalva (Fig 1). The patient was taken to the operating room for aortic valve conduit root replacement with coronary reconstruction (Bentall procedure) and possible coronary artery bypass graft (CABG) of the LCx. The prebypass intraoperative transesophageal echocardiographic (TEE) examination confirmed the findings of the preoperative studies but also showed severe PI and wall motion abnormalities in the inferior and lateral walls, consistent with left-dominant coronary circulation and LCx ischemia (Video 1).

The patient underwent a Bentall procedure with a 21-mm Medtronic Freestyle porcine root (Medtronic, Minneapolis, MN), pulmonic valve replacement with a 27-mm Carpentier-Edwards Perimount Magna pericardial valve (Edwards Lifesciences, Irvine CA), and saphenous vein harvest in anticipation of possible CABG. After excision of the aortic root pseudoaneurysm, the LCx artery looked normal during surgical inspection. Therefore, the decision was made to forego grafting of the LCx. The patient was successfully weaned from cardiopulmonary bypass (CPB). After the patient was weaned from CPB, TEE showed well-positioned and well-functioning aortic and pulmonic prosthetic valves but persistence of wall motion abnormalities in the LCx territory.

Should CABG of the LCx be performed at this time due to the possibility of damage to the LCx after prolonged compression?

### ECHOCARDIOGRAPHIC FINDINGS AND CHALLENGE

Clinically the determination of whether CABG of the LCx should be performed at the time of surgery depended on TEE evaluation. It was unclear whether irreversible damage had been done to the LCx after prolonged compression. CABG of the LCx would require multiple grafts to the obtuse marginal branches and prolonged cross-clamp and CPB time. In addition, any residual flow in the functional native artery may increase the likelihood of bypass graft failure.

The left main coronary artery can be seen in the midesophageal (ME) aortic valve short-axis view (~45° omniplane) just superior to the left coronary cusp of the aortic valve. Slight changes in depth, probe rotation, and omniplane can allow an echocardiographer to follow its course to the bifurcation of the left anterior descending artery and the LCx. This technique has been used to describe the identification of proximal coronary artery lesions with high sensitivity and specificity; however, distal lesions can be seen less reliably.<sup>1</sup> The LCx is often seen in short axis in the ME mitral commissural view (~60° omniplane) and ME 2-chamber view (~90° omniplane), adjacent to the left atrial appendage and the anterior mitral leaflet. Adequate flow may be difficult to assess by color flow Doppler (CFD) due to the unfavorable angle of insonation. A lower CFD scale allows better visualization of the flow; however, the same CFD scale should be used for coronary flow assessment throughout the examination. In the ME long-axis view (~120° omniplane), a slight increase in depth with retroflexion can bring the LCx into view traveling in the atrioventricular (AV) groove; in this view the larger and more posterior coronary sinus also may be visible. This view allows for visualization of flow in the LCx several centimeters distal to the bifurcation of the left anterior descending artery as well as assessment for rare pathology such as LCx aneurysm, pseudoaneurysm, or fistula.<sup>2</sup> Non-standard views may be necessary due to patient anatomic variability.

### CLINICAL COURSE

In this case, while reinstatement of CPB was being discussed, further assessment of the LCx was accomplished as previously described (Fig 2, Video 2). Of note, the presence of left dominant circulation allowed for good visualization of the LCx in the posterior AV groove with evidence of flow by CFD. The decision was made to not reinstate CPB, and an intra-aortic

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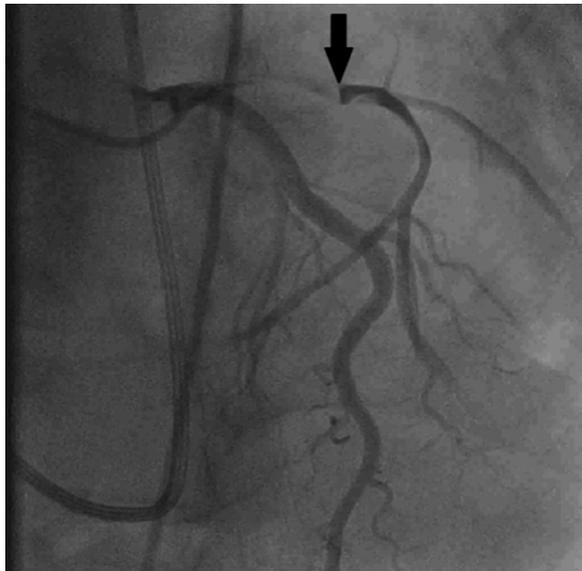


Fig 1. Left heart cardiac catheterization demonstrating a significant filling defect in the left circumflex artery consistent with external compression (black arrow).

counterpulsation balloon pump was placed with resolution of the wall motion abnormalities before the end of the procedure (see Video 2).

## DISCUSSION

In the past, the use of TEE for imaging of the coronary arteries has been limited mostly due to equipment factors, with the left main coronary artery seen in up to 90% of examinations, but the LCx and right coronary arteries visualized in less than 50% of examinations.<sup>3</sup> With improvements in TEE imaging technology, the diagnosis of coronary artery anomalies, identification of proximal coronary artery disease, and measurement of coronary flow reserve has become feasible.<sup>4</sup> In the intraoperative setting, the visualization of coronary artery blood flow in conjunction with wall motion assessment can be useful in the assessment of coronary artery patency after any cardiac surgical procedure with the potential for injury of the coronary arteries.

The use of coronary flow assessment has been reported in mitral valve surgery and transcatheter aortic valve replacement.<sup>5,6</sup> This case is an example in which visualization of

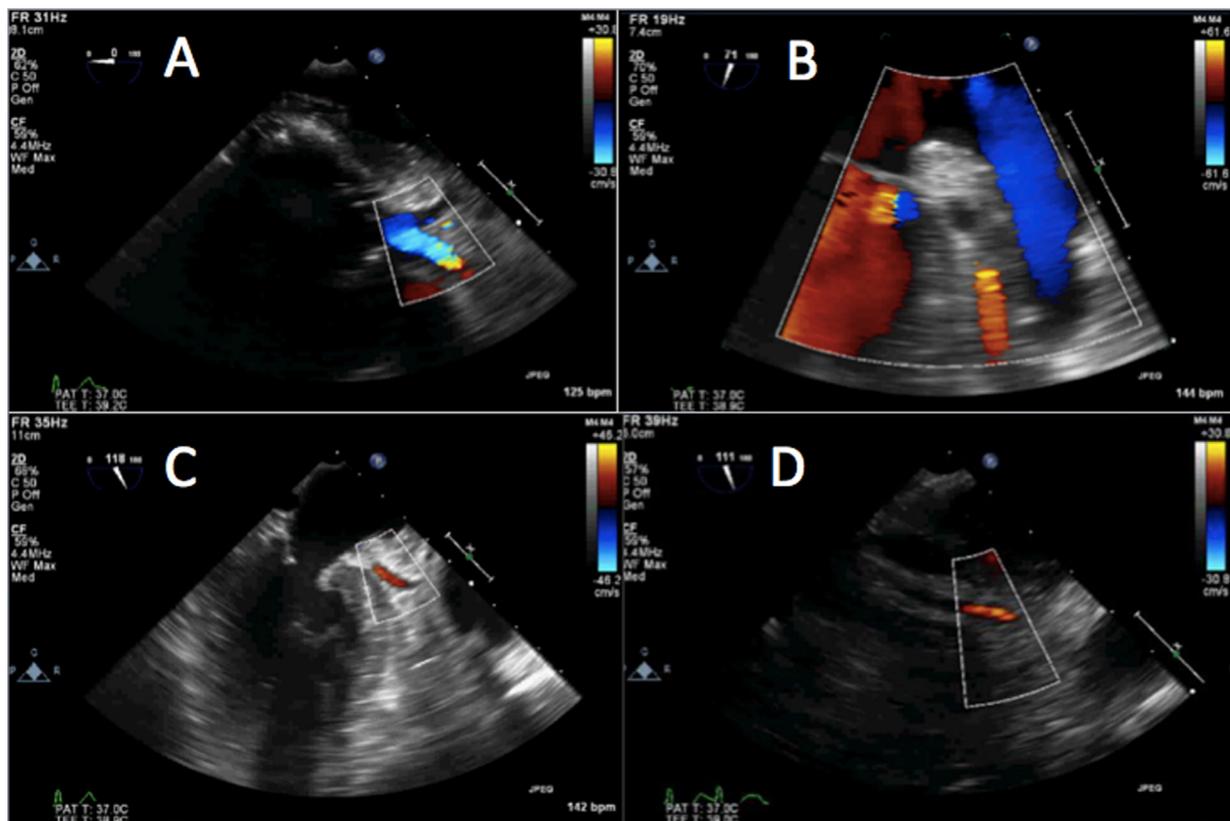


Fig 2. (A) Midesophageal ascending aorta short-axis view showing the bifurcation of the left main coronary artery. Color flow Doppler demonstrates flow through the left anterior descending artery. The left circumflex artery is perpendicular to the Doppler interrogation; therefore, no flow is visualized. (B) Midesophageal mitral commissural zoom view showing flow in an obtuse marginal artery branch. (C) Midesophageal long-axis view with flow in the mid left circumflex artery. (D) Modified long-axis view with distal left circumflex flow in the posterior atrioventricular groove.

coronary artery flow after aortic root replacement allowed the patient to avoid unnecessary CABG surgery and the associated morbidity of increased CPB time. The proximity of the coronary arteries to the TEE probe at the midesophageal level and excellent spatial resolution of the high-frequency transducer allow for good visualization of the coronary arteries, especially in procedures associated with potential injury, such

as mitral valve surgery or surgical or transcatheter aortic valve replacement.

#### APPENDIX A. SUPPLEMENTARY MATERIAL

Supplementary data associated with this article can be found in the online version at <http://dx.doi.org/10.1053/j.jvca.2015.08.030>.

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