Impella® 2.5 Support During Left Main Coronary Artery Stenting and Transcatheter Occlusion of a Left Internal Mammary Artery Bypass Graft in a Patient with Severe Congestive Heart Failure

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Patient Presentation

A 64-year-old man was admitted with unstable angina and severe congestive heart failure (CHF) three months after an apparently uncomplicated coronary artery bypass graft (CABG) revascularization. The CABG procedure was non-emergent following angiographic evaluation and identification of a 90% ostial stenosis of the left main coronary artery (LMCA) and significant stenotic (90%) disease proximal to the first diagonal branch of the left anterior descending coronary artery (LAD). The patient had a non-dominant right coronary artery (RCA) with the posterior descending coronary artery (PDA) originating from the circumflex coronary artery (CFx). During the CABG, the left internal mammary artery (LIMA) graft was believed to have been placed in the LAD and one reversed saphenous vein graft (SVG) was placed in the obtuse marginal (OM) branch of the CFx and a second SVG was placed in the left PDA.

Transthoracic echocardiography (TTE) and transesophageal echocardiography (TEE) at re-admission revealed depressed left and right ventricular systolic function and right ventricular dilatation compared to the results of TTE and TEE performed prior to CABG. Coronary angiography determined that the LIMA graft had inadvertently been placed on the great cardiac vein, resulting in a left-to-right shunt and biventricular high output failure/CHF. The LAD was devoid of coronary flow, the SVG to the left PDA was occluded, and the SVG to the OM was widely patent.

Renal insufficiency and CHF were considered high-risk factors for complications during a repeat CABG. Therefore, a percutaneous coronary intervention (PCI) was deemed most appropriate. Temporary left ventricular support with the Impella® 2.5 cardiac assist system (Abiomed) was indicated due to the CHF combined with the intention to perform unprotected LMCA stenting and transcatheter occlusion of the LIMA to the cardiac vein.

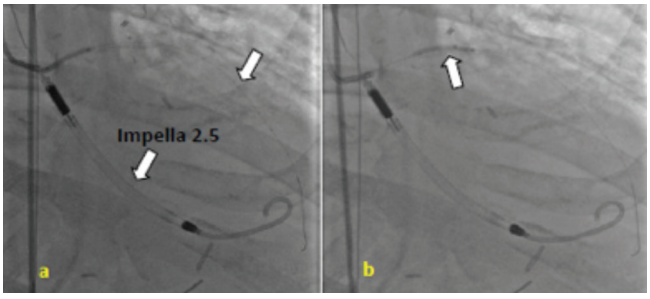

FIGURE 1. Impella 2.5 cardiac assist device positioned across the aortic valve and 0.014" Whisper guidewire in LAD (a); Apex balloon in proximal LAD (b).

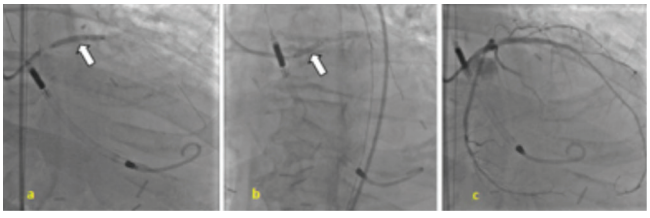

FIGURE 2. Endeavor® (Medtronic) stent deployments in proximal LAD (a) and LMCA (b); excellent angiographic result after DES deployments (c).

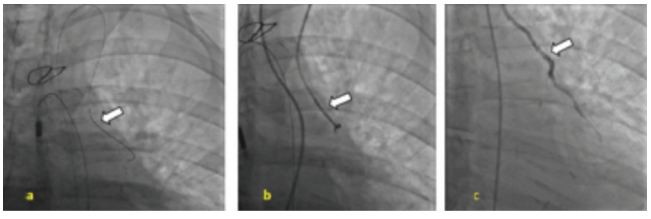

FIGURE 3. Guidewire in LIMA (a); vascular plug delivery (b); negligible antegrade flow into cardiac vein (c).

Procedure Description

The Impella® 2.5 catheter was positioned in the left ventricle and actuated to provide antegrade flow throughout the various phases of the PCI and transcatheter embolization procedure (Figure 1). The mid and proximal LAD and the LMCA were sequentially stented with drug-eluting stents, with an excellent angiographic result (Figure 2). A 6 mm Amplatzer® Vascular Plug II (St. Jude Medical) was deployed in the distal LIMA (Figure 3). Antegrade flow was significantly less and the procedure was ended assuming throm-

bosis of the vascular plug would result in total occlusion of the LIMA.

Case Outcome

The patient remained hemodynamically stable and angina-free during balloon pre- and post-dilatations, stent deployments, and the transcatheter occlusion (Figure 4). The Impella® catheter was removed without complication and the femoral access site was closed. The patient was discharged from the hospital on the following day.

Repeat angiography performed one week later showed persistent antegrade LIMA flow. Biventricular function had improved significantly with a left ventricular ejection fraction estimated at 70%. A second embolization procedure was indicated, however cardiac support for the second procedure was not warranted based on the satisfactory hemodynamic status of the patient. A Proxis™ Embolic Protection System (St. Jude Medical) catheter was used to occlude the LIMA graft while a second 4 mm Amplatzer Vascular Plug II was deployed proximal to the previously placed 6 mm plug. Antegrade flow into the coronary sinus was minimal. The patient had an uneventful recovery with subsequent complete resolution of CHF symptoms and return of normal renal function.

Device Description

The Impella® 2.5 microaxial blood pump is percutaneously placed in the left ventricle to provide up to 2.5 liters/minute of non-pulsatile blood flow into the aorta. The pump configuration is unique in that it is inserted through a 13 Fr sheath placed in the femoral artery with a 9 Fr steering catheter passed across the aortic valve to position the inflow port within the left ventricle, while the outflow port and axial flow pump are positioned within the ascending aorta (Figure 5). The catheter is attached to the Automated Impella® Controller (Figure 6), which provides continuous output and performance data on a display panel.

Discussion

This unusual and exceptionally challenging case illustrates the use of the Impella® 2.5 cardiac assist system to provide critical left ventricular support during a high-risk PCI in a patient with comorbidities of CHF, renal insufficiency, and critical stenoses of the LMCA and LAD.

The Impella® 2.5 device maintained a mean arterial blood pressure of 80-90 mmHg throughout the one-hour PCI procedures that included unprotected LMCA stenting, LAD stenting, and transcatheter occlusion of the LIMA graft. Cardiac output was augmented by 2.0-2.25 liters/minute during the interval of Impella® support and the procedure was completed without complication.

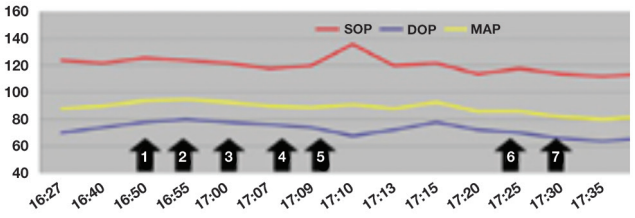

FIGURE 4. Hemodynamics during support with the Impella® 2.5 system. Balloon angioplasty to mid LAD (1), DES in the mid LAD (2), proximal LAD (3), LMCA (4), and DES post-dilatations (5), Amplatzer Plug deployment (6), and start of weaning procedure from Impella® LV support (7).

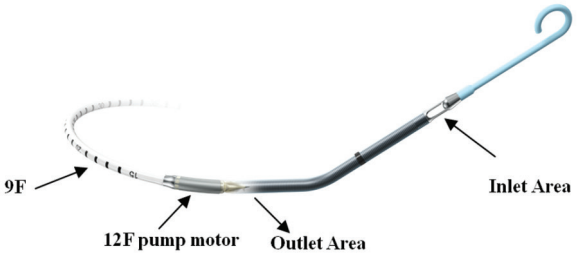

FIGURE 5. The Impella® 2.5 Circulatory Support System catheter.

FIGURE 6. The Automated Impella® Controller.