Transbrachial Intra-Aortic Balloon Pumping for High-Risk Percutaneous Coronary Intervention

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Abstract: The beneficial effect of placement of intra-aortic balloon (IAB) pump before revascularization in patients with high-risk coronary anatomy and impaired left ventricular systolic function is documented. However, the conventional insertion of IAB pump via the common femoral artery may be contraindicated or may be even impossible in patients with severe vascular disease. Recently, the percutaneous insertion of IAB via the brachial artery has been shown to be effective and safe in small series of patients with vascular disease undergoing coronary artery bypass surgery. The authors report their experience with a patient with aortobifemoral bypass grafts who underwent successful stenting of a trifurcating distal left main stenosis after placement of a 7.5-Fr IAB pump via the left brachial artery.

Key Indexing Terms: Brachial artery; High-risk angioplasty; Intra-aortic balloon pump; Left main coronary artery. **[Am J Med Sci 2011; 341(2):153–156.]**

There is general agreement regarding the beneficial effects of placement of intra-aortic balloon (IAB) pump before revascularization in patients with high-risk coronary anatomy and impaired left ventricular (LV) systolic function.[1,2] However, the conventional insertion of IAB pump via the common femoral artery may be contraindicated or impossible in patients with vascular comorbid conditions, including severe atherosclerotic disease of the iliac arteries or abdominal aorta.

The development of smaller IAB pump catheter sizes allows the use of alternative arterial approaches for IAB placement. Recently, the percutaneous insertion of IAB pump via the brachial approach has been proposed as an effective and safe alternative in patients with peripheral vascular disease undergoing coronary artery bypass surgery.[3–6] Herein, we report our experience of IAB pump insertion via the left brachial artery in a patient with severe unprotected trifurcating distal left main coronary artery stenosis, severely impaired LV function and bilateral aortofemoral bypass grafts, who underwent successful percutaneous coronary intervention.

CASE REPORTS

A 64-year-old man with hypertension, dyslipidemia, type-2 diabetes, active tobacco use, obesity, chronic obstructive pulmonary disease and peripheral arterial disease was referred to our hospital for cardiac catheterization and selective coronary angiography. He had initially presented to another hospital with an episode of chest pain, hypotension and decompensated heart failure. He had a history of bilateral aortofemoral bypass graft surgery and nonobstructive coronary artery disease by angiography 10 years ago.

Laboratory results showed an increased troponin-I (7.3 ng/mL), creatine kinase isoenzyme MB (72 ng/mL) and B-type natriuretic peptide (1070 pg/mL). The electrocardiogram (ECG) demonstrated left axis deviation, right bundle branch block and low voltage. Transthoracic echocardiography showed LV ejection fraction of 15% to 20% with anterior wall and apical akinesis and moderate to severe hypokinesis of the other wall segments, LV and right ventricular dilatation and moderate to severe tricuspid regurgitation. The patient received intravenous inotropic agents, diuresis and heparin and was brought to the catheterization laboratory.

Right heart catheterization revealed a high pulmonary wedge pressure (45 mm Hg). Coronary angiography was performed through a 5-Fr sheath placed into the right aortofemoral graft. The trifurcating left main had a 95% diameter stenosis distally, involving the ostium and the proximal segment of the left anterior descending (LAD) coronary artery. Competitive flow was noted in the LAD. The left circumflex (LCX) and the large ramus intermedius coronary arteries had mild luminal irregularities (Figure 1A). The dominant right coronary artery had luminal irregularities and was providing collaterals to the distal LAD (Figure 1B). The LV end-diastolic pressure was 44 mm Hg.

Given the high-risk nature of the patient's coronary anatomy, the severely impaired LV function and the borderline hemodynamic condition (brachial blood pressure of 85–95/55–65 mm Hg), an IAB pump was placed. Because the patient had bilateral aortofemoral bypass grafts, percutaneous insertion of an IAB via the brachial artery was pursued. To screen for subclavian stenosis, blood pressure was measured in both arms. Interarm systolic pressure difference was <5 mm Hg.

The left brachial artery was used for access. After conscious sedation with midazolam and fentanyl and local anesthesia with lidocaine, a 7.5-Fr sheath was placed into the left brachial artery. Advancement of a 0.025-in $\times$ 175-cm Teflon-coated 3-mm "J" stiff guide wire (Arrow International, Reading, PA) to the descending aorta was facilitated with a 4-Fr internal mammary artery diagnostic catheter (Infiniti; Cordis, Bridgewater, NJ). Then, a 40-mL 7.5-Fr UltraFlex Flexible IAB catheter (Arrow International) was advanced under fluoroscopy over the wire and placed into the descending thoracic aorta, with the proximal marker of the balloon positioned at the level of the third intercostal space. The IAB pump (Arrow AutoCAT2 Wave; Arrow International) was set on a 1:1 mode and was synchronized with the ECG (Figure 2). Intravenous heparin 4000 IU was given as a bolus, followed by infusion of 1000 IU per hour. Heparin was titrated to maintain an activated clotting time of at least 300 seconds. Cefazolin was given intravenously for prophylaxis. An arterial catheter was placed in the left radial artery, and a pulse oximeter was applied to the left middle finger. Radial pressure waveforms, pulse oximetry waveforms and saturation and hand temperature were

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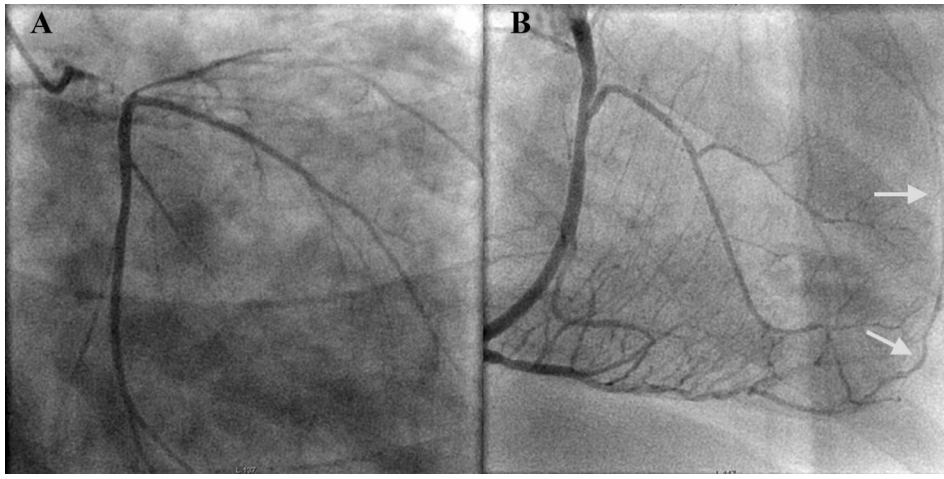

FIGURE 1. (A) Injection of the left coronary artery at the right anterior oblique view with caudal angulation showing a diffusely diseased trifurcating left main coronary artery with a critical stenosis distally, involving the ostium and proximal segment of the left anterior descending coronary artery. The left circumflex and ramus intermedius coronary arteries are free of significant disease. (B) Injection of the right coronary artery at the right anterior oblique view showing collaterals to the distal left anterior descending coronary artery (arrows).

continuously monitored. The brachial insertion site was also checked for bleeding or hematoma at regular intervals.

Cardiothoracic surgery was consulted. Given the borderline hemodynamics, the severely impaired LV function and decompensated heart failure, right ventricular dilatation, chronic obstructive pulmonary disease and obesity, the patient was considered a poor candidate for urgent coronary artery bypass surgery. The calculated Society of Thoracic Surgeons risk[7] of operative mortality was 10.6%, and the calculated risk for major perioperative outcomes was 69.1%. The patient was stabilized overnight on the IAB pump, and high-risk stenting of the left main coronary artery was pursued the next morning, using the right aortofemoral graft. After engaging the left main coronary artery with a 7-Fr EBU 3.5 guide catheter with side holes (Launcher; Medtronic, Santa Rosa, CA), we advanced 3 Choice PT Extra Support wires (Boston Scientific, Natick, MA) to the LAD, ramus and LCX. Balloon angioplasty of the distal left main and LCX was first performed with a balloon Maverick 2.5 × 15 mm (Boston Scientific, Natick, MA), followed by deployment of a drug-eluting stent, Xience V, 3.0 × 23 mm (Abbott Laboratories, Abbott Park, IL), across the left main and LCX arteries. The proximal stent segment was postdilated with a 3.5 × 15 mm Maverick balloon. The final angiographic result was excellent, with TIMI 3 flow in the LCX and the ramus intermedius (Figure 3). The ostium of the ramus was free of disease poststenting. The ostium and proximal segment of the LAD remained severely stenotic, but considering the collateralization from the right coronary artery, the akinesis of the anterior wall and the apex and the borderline hemodynamic condition of the patient, we decided to end the procedure. The whole procedure was performed with the IAB pumping at 1:1; the patient tolerated the entire procedure with mild hypotension during balloon inflations only.

He remained hemodynamically stable postprocedure, and this was confirmed by switching the pump to the 2:1 mode and by temporarily discontinuing the pumping. The 7-Fr arterial sheath was removed from the right aortofemoral graft 3 hours after the end of the procedure, when the active clotting time fell below 180 seconds. Hemostasis was obtained with manual compression for 15 minutes. The patient denied pain, numbness or paresthesias in his left hand and the pressure waveform of the left radial artery, as well as pulse oximetry waveforms and saturation and hand temperature, were normal. Pumping was discontinued, and the IAB catheter was removed 4 hours after the end of the procedure.

The duration of IAB pumping was 20 hours. The patient was discharged 6 days later, being hemodynamically stable, euvolemic, and without chest pain or shortness of breath. No symptoms or signs of limb ischemia or infection were recorded until his discharge. At a follow-up visit 3 months later, the

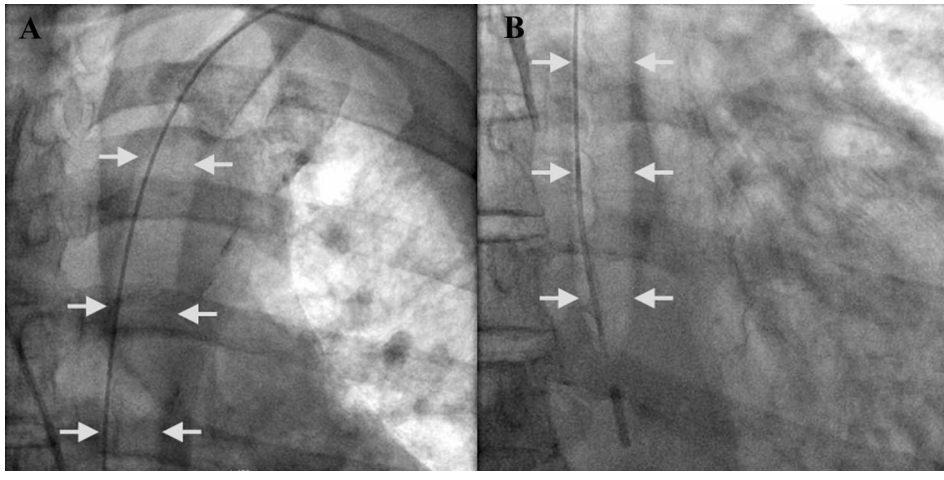

FIGURE 2. The inflated intra-aortic balloon (IAB) (highlighted with arrows) is positioned in the descending thoracic aorta. (A) IAB catheter in the left subclavian artery and descending aorta. (B) The tip of the IAB catheter points caudally.