JECT. 2013;45:51–54
The Journal of ExtraCorporeal Technology

Case Reports

Anatomical Advantage to Percutaneous Insertion of the Intra-Aortic Balloon through the Left Brachial Artery over the Right Brachial Artery

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Abstract: Off-label use of the intra-aortic balloon (IAB) is not recommended in ideal situations and certainly not a Food and Drug Administration-approved activity. The instruction-for-use manual for the IAB recommends percutaneous insertion. However, there are certain extreme situations where "thinking outside the box" appears necessary. We have successfully inserted a transthoracic IAB (TIAB) in the operating room where an open sternum is an option. This has been instituted whenever severe peripheral vascular disease (PVD) precludes a percutaneous attempt or when attempted insertion fails. An open chest is not a choice in the catheterization laboratory or the postoperative setting. We have successfully inserted the IAB through the brachial/axillary artery in a patient with bilateral aortofemoral grafts, with a history of severe PVD, in the cardiac catheterization laboratory. A left-sided approach is advisable for brachial artery insertion and an axillary approach is also possible under sedation. This case report details our experience with transbrachial insertion of the IAB and establishes counterpulsation through this route as a viable option, where an open chest is not available and a percutaneous femoral approach has failed. **Keywords:** transthoracic, transbrachial, peripheral vascular disease, intra-aortic balloon, counterpulsation. *JECT. 2013;45:51–54*

Documentation on an extrafemoral, nontransthoracic approach to intra-aortic balloon (IAB) insertion is rare. Although a femoral approach is recommended by the instruction-for-use manual, this is sometimes not possible in the clinical setting. In the cardiac operating room (OR) before or immediately postsurgery, patients with severe peripheral vascular disease (PVD) have an open chest, which enables direct insertion of an IAB (1) down the descending aorta. In the catheterization laboratory, radial arteries are often used for performing an angiogram. However, as a result of the anatomical distance of the radial artery from the descending aorta and the physical length of the IAB, it would be challenging to insert the IAB retrograde down the descending aorta through the radial artery without the proximal portion of the IAB lying in the aortic arch. In the cardiac catheterization laboratory, other routes available for IAB insertion are the axillary and the brachial arteries.

CASE REPORT

A 74-year-old woman with aortobifemoral grafts (placed in 2004) was admitted into the emergency room in December 2010. She had been previously diagnosed with multiple vessel coronary artery disease with an ejection fraction of 28%, turned down for coronary artery bypass surgery, and placed on medical therapy. She had a history of hypertension, type 2 diabetes, treated hyperlipidemia, smoking, and a recent myocardial infarction in 2004. The patient was on Coumadin for past vascular surgery, sulpha, penicillin, and insulin. She presented with ongoing angina, left carotid bruit, moderate mitral regurgitation, and moderate pulmonary artery hypertension. As a result of her extensive comorbidities, she was thought to

Received for publication May 11, 2012; accepted February 6, 2013.
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The senior author has stated that the authors have reported no material, financial, or other relationship with any healthcare-related business or other entity whose products or services are discussed in this paper.

be high risk for surgery. Subsequently she was turned down for surgery and placed on Plavix in the emergency department along with inotropic therapy (milrinone, norepinephrine, and epinephrine). She was found to be unstable despite inotropic therapy and transferred to the catheterization laboratory at approximately 7 PM. An eggshell aorta and severe peripheral vascular disease in the femoroiliac arteries were viewed on fluoroscopy in the catheterization laboratory. At this time, hypotension with respiratory instability was observed. A decision was made to intubate and insert the IAB. The perfusionist was paged at approximately 8 PM for IAB insertion. A transfemoral approach with a 34 mL/7.5-Fr IAB catheter was attempted but quickly abandoned because insertion failed bilaterally. A 25-mL IAB was not used because the French size was higher (8 Fr). At our institution, the available catheter sizes for the IAB are 25 cc, 34 cc, 40 cc, and 50 mL, all manufactured by Datascope.

Angiography performed through the right brachial artery and a 6-Fr sheath revealed a Grade 4 left ventricular (LV) and a 90% stenosis of the left anterior diagonal (LAD), 90% stenosis of the first diagonal (D1), and 90% stenosis of the first obtuse marginal (OM1), and second obtuse marginal (OM2). Bare metal stents were placed in the ostial LAD and OM2. No residual stenosis was observed. The patient was anticoagulated with Bivalirudin during the procedure. Angioplasty of the middle segment of the right coronary artery (RCA) was performed with a Quantum Maverick (Boston Scientific) balloon. Residual stenosis of the RCA was observed to be 25%. The initial plan in the catheterization laboratory was to deploy the stents following up with the insertion of an IAB pump. As a result of a known history of poor LV function, LV angiography was not performed. The cardiologist was unable to cross the circumflex artery and OM2, and stenting or dilatation of these was abandoned. At this time hypotension was again observed with mean arterial pressure (MAP) falling to below 50 mmHg and a decision was made to insert the IAB and start vasopressin in addition to other inotropes already running.

A right brachial artery insertion of IAB was attempted. The perfusionist advised against the procedure and suggested the left brachial artery. This was suggested because of previous experience of the perfusionist with a similar case in which right brachial artery insertion failed to reach the descending aorta. The cardiologist felt that guidewire threading would be easier through the right brachial approach. The IAB inserted through the right arm was found to lie in the transverse arch through fluoroscopy.

The IAB was removed and another IAB was reinserted through the left brachial artery (Figure 1). The CS 100 Intra-Aortic Balloon pump (IABP) console (Maquet) was able to time the IAB accurately in the "auto" mode (Figure 2). A left brachial artery insertion with a 7.5-Fr, 34-mL balloon was successful and the MAP stabilized to above 80 mmHg.

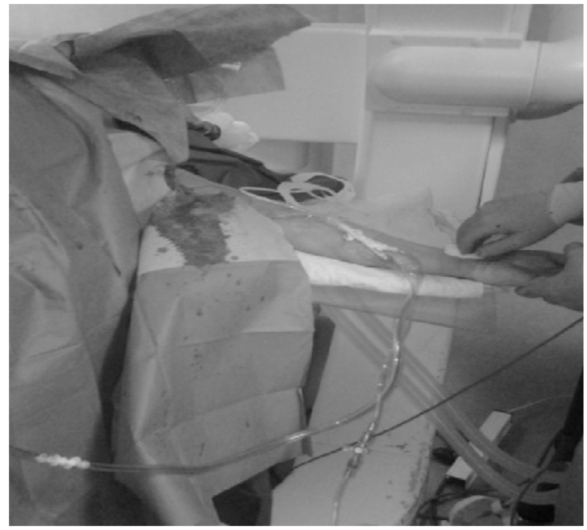

Figure 1. Left brachial artery insertion of the intra-aortic balloon.

Failure to insert the IAB on the right side encouraged the cardiologist to enter higher up in the brachial artery (Figure 3). The patient was transferred to the coronary care unit (CCU) uneventfully. The nursing staff was advised that the IAB insertion was through the left brachial artery. The arm was stabilized to maintain stability. Generally, the IAB is placed at the foot end of the bed. In this instance, the IABP was placed on the left side of the bed and a protective dressing with pads was placed on the left arm.

The IAB was removed on the first postcatheterization day and the patient was extubated on the day of catheterization, later in the evening. She was transferred to the

Figure 2. Intra-aortic balloon console displaying arterial waveform of the left brachial artery.

Figure 3. Left brachial artery insertion higher up in the brachial artery.

Figure 4. Feasibility of brachial artery insertion from the left arm.

cardiology ward on the sixth postoperative day and discharged in 2 weeks.

DISCUSSION

Preoperative insertion of an IAB has been demonstrated to improve hospital and postdischarge outcomes in high-risk coronary surgery (2). The greatest limitation in using peripheral arteries like the brachial artery is the small diameter of the artery. The evolution of the IAB catheter and the downsizing of the French size to 7 and 7.5 mm have enabled the clinical practitioner to overcome this limitation.

Onorati and colleagues (3,4) reported a series of 10 patients, who had transbrachial insertion of the IAB (TBIAB) consecutively over a period of 11 months. These patients had severe peripheral atherosclerosis or distal abdominal aortic aneurysms. The IAB was inserted through the right brachial artery (unlike our experience) and verified through fluoroscopy. The duration of counterpulsation ranged from 18–39 hours with no report of limb complications or mortality. This series adequately demonstrated that TBIAB counterpulsation with a 7.5-Fr catheter (or 7 Fr) in the event of compromised or unavailable femoral artery was as safe and effective as a transfemoral method.

The same author had previously reported their first experience with successful TBIAB insertion in a case report (1). The recipient was a 68-year-old man with ongoing unstable angina and eggshell calcification in the iliac/femoral arteries and the abdominal aorta.

Another study (5) demonstrated safe insertion of a TBIAB in a patient with bilateral aortofemoral grafts undergoing successful stenting of a trifurcating left main stenosis.

The anatomy of the descending aorta and the left brachial artery as well as the length of the IAB provides greater confidence that the IAB inserted through the left arm will lie in the descending aorta (Figure 4). An insertion through the right arm, in our opinion, may not always allow the IAB to lie in the correct position. The IAB inserted through that approach instead would lie in the transverse arch (Figure 5).

The length of the 34-mL Maquet IAB lying in the aorta is 21.9 cm or 8.62 inches. The average length of the brachial artery is 26.29 cm with variations occurring in 26% of cases (6). Inserting from the right side, one would have to deal with a further 10.17 cm of the axillary artery and the aortic arch (6). That amount of variation suggests that physically measuring the length before brachial insertion

Figure 5. Brachial artery insertion from the right arm and its anatomical disadvantage.

of IAB is a wiser choice. This length would not always allow the clinician to insert the IAB from the right approach. Successful right brachial approach would depend on the size of the torso, the anatomical length of the right brachial artery, and the point of entry into the right brachial artery. A safer option would be to use the left brachial artery because its anatomic position allows greater autonomy for successful left-sided insertion retrograde, down the descending aorta.

An axillary approach is certainly possible. However, this would be uncomfortable for the awake patient. In our case, it was certainly a possibility. In patients with brachial artery insertion, one must take care not to allow the IAB to slip backward because that could occlude head vessel branches from the aortic arch.

In conclusion, brachial artery IAB insertion is a safe and viable option in patients in whom the transfemoral approach has failed or is unavailable. An axillary approach is another possibility; however, this technique would be intensely uncomfortable for an extubated or nonventilated patient. Clinical settings like the catheterization laboratories, intensive care unit, and CCU are ideal for TBIAB counterpulsation in candidates with compromised femoral/iliac arteries, in which an open chest is not an immediate option. Technological advancement and downsizing of IAB catheter sizes have enabled insertion in arteries with smaller diameters like the brachial artery. In our opinion, the left brachial artery is a likelier option because it allows the clinician to be independent of the torso size of the patient and the anatomical length of the brachial artery. However, caution should be observed in limiting this technique for patients with severe PVD, extensive vascular surgery, and compromised femoroiliac circulation.

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