CASE REPORT

Prolonged duration of transbrachial intra-aortic balloon pump as bridge to heart transplantation

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Accepted 19 January 2015

SUMMARY

We describe a case demonstrating the quality of life (QOL) benefit and safety of using a transbrachial approach for insertion of an intra-aortic balloon pump (IABP) in a patient awaiting cardiac transplantation. A 68-year-old man with ischaemic cardiomyopathy was admitted to our cardiac intensive care unit to await the availability of a suitable donor organ for orthotopic heart transplant. An IABP was needed for haemodynamic support due to cardiogenic shock. Since the patient did not want to be committed to lying supine in bed for multiple days, as would have been the case had the IABP been placed using the conventional femoral route, we inserted a 7.5 Fr 'sheathless' IABP via the transbrachial approach. The patient's haemodynamics improved and the device was left in place for 240 h without vascular compromise. He was subsequently successfully transplanted and is doing well on follow-up.

BACKGROUND

Intra-aortic balloon counterpulsation is commonly used to help stabilise the haemodynamic parameters and improve end-organ function in patients with advanced heart failure awaiting cardiac transplantation.¹ The transfemoral route has traditionally been used for an intra-aortic balloon pump (IABP) placement, necessitating ambulatory restriction. This restriction greatly affects the quality of life (QOL) of the patient in the immediate pretransplant period, since patients have to be bed-bound for the duration of their 1A status. Alternative routes for IABP placement have been sought in order to improve the patient's (QOL) while maintaining the necessary haemodynamic support. The axillary and transaortic routes have been cited as alternatives in case reports, but these frequently require surgical intervention.^{2,3} A case of percutaneously placed axillary IABP has been described.⁴ We describe a case of a percutaneously placed IABP via the brachial approach. This device was left in place for 240 h without vascular compromise. We believe that with the necessary expertise this approach can be a viable alternative to the transfemoral route in this subset of patients.

CASE PRESENTATION

A 68-year-old man with a history of end-stage ischaemic cardiomyopathy ACC/AHA stage D, New York Heart Association (NYHA) functional class IV heart failure was admitted to our cardiac intensive care unit for haemodynamic stabilisation and support while awaiting cardiac transplantation. His left ventricular ejection fraction was 15%. His medical history was

also positive for pulmonary hypertension secondary to left heart disease (WHO group II), atrial fibrillation, severe mitral regurgitation, essential hypertension and hyperlipidaemia. He had previously undergone automatic implantable cardioverter-defibrillator placement and radiofrequency ablations for recurrent ventricular tachycardia. Prior to this admission he was being treated as an outpatient with continuous Dobutamine infusion at 10 µg/kg/min. His clinical status continued to decline and his physical examination as well as a right heart catheterisation revealed a persistent low-output state.

The patient was made status 1 A on the heart transplant list and admitted to our care.

IABP support was deemed necessary by the heart transplant team to help improve the patient's haemodynamic profile. The anticipated duration of support was at least 7–10 days. The patient expressly stated his wish to be ambulatory to chair while awaiting heart transplantation. This precluded use of the femoral approach. The cardiothoracic surgeons entertained the idea of placing the IABP via the axillary or transaortic routes. However, the need for general anaesthesia and the invasive nature of these procedures made them less appealing. The decision was made to proceed via the transbrachial route.

TREATMENT

The left brachial artery diameter measured 4.8 mm by ultrasound. The plan was made to insert a 'sheathless' 7.5 Fr (2.47 mm outer diameter) 40 cc volume (Sensation Plus, Maquet Medical, Germany) IABP with a shaft length of 72.3 cm and balloon membrane length of 22.9 cm. Estimated measurements were made outside the body to ensure adequate balloon and shaft lengths.

Percutaneous brachial arterial access was obtained using a Cook 21G, 4 cm needle and a Merritt MAK 0.018" Guide Wire under ultrasound guidance. This was followed by insertion of a 4 Fr sheath (Terumo Radial Sheath, Terumo Medical Corp, New Jersey, USA) into the left brachial artery. A Judkins Right4 4 (JR4) diagnostic catheter 100 cm (Infiniti Catheter, Johnson and Johnson/Cordis, New Jersey, USA) was inserted over 0.035" standard J tip wire (GuideRight, St Jude Medical, Minnesota, USA) and guided into the descending aorta. The J tip wire was exchanged for a 0.018" 300 cm guidewire (Steelcore, Abbott Vascular, California, USA) through the JR4 catheter, which was subsequently removed along with the 4F sheath. The 7.5 Fr IABP was successfully advanced under fluoroscopy over the Steelcore wire to the descending aorta via a sheathless technique.

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To cite: Smith TBBJ, Shridhar P, Khalil R, et al. *BMJ Case Rep* Published online: [please include Day Month Year] doi:10.1136/bcr-2014-208658

Counterpulsation was initiated with excellent diastolic augmentation. The ECG was used as the trigger signal since we were unsure whether the 'upside down' IABP would adequately sense the central aortic pressure in order to use the arterial pressure waveform as the triggering mechanism. The IABP was secured using the standard protocol.

The patient was started on intravenous unfractionated heparin at 700 U/h with a target partial thromboplastin time of 50–70 s. Dressing changes were performed at the bedside every 48 h using sterile technique with the application of surgical foam around the site to prevent oozing (figure 1). The patient was ambulatory to the chair during the entire hospitalisation (figure 2). Left arm perfusion was monitored by continuous pulse oximetry and the patient's radial pulse was assessed routinely per unit protocol. IABP remained stable and there was no need for repositioning due to patient movement as assessed by daily chest X-rays. No technical issues were encountered during the IABP implantation.

OUTCOME AND FOLLOW-UP

On day 10 of hospitalisation, the heart transplant team decided to cease IABP counter pulsation due to markedly improved haemodynamics. The patient did not receive heart transplantation at that time because a suitable donor organ was not available. IABP was discontinued after 240 h. Heparin was held for 2 h before the removal of the IABP. ACT by the Hemotech analyser was 220 s and 20 mg of protamine was administered. After withdrawal of the device, a haemoband arterial compression device was applied to the left brachial area for 45 min while ensuring patent haemostasis. No immediate vascular complications were observed. Auscultation of the brachial site did not reveal any bruit. Duplex ultrasound performed 2 weeks later showed a brachial artery measuring 5 mm with normal flow velocity and no pseudoaneurysm (figure 3). The patient was transplanted 3 weeks after IABP removal and is doing extremely well on follow-up visits.

DISCUSSION

IABP is currently used for temporary mechanical support in patients with end-stage heart failure. We report the first case of

Figure 2 The patient is ambulatory to the chair and appears comfortable.

IABP insertion via the transbrachial route in a patient awaiting cardiac transplantation. The longest duration of transbrachial IABP support reported so far was 7 days in a patient with fulminant myocarditis.⁵ Percutaneous cardiopulmonary support was also employed in that case. The longest stand alone mechanical support using this technique was 90 h in a patient awaiting coronary artery bypass grafting.⁶

In our case, the total duration of support was 240 h. There were no vascular complications and the IABP performed its function of improving the patient's haemodynamics.

The transbrachial route has been shown to be safe and efficacious for IABP insertion in patients undergoing percutaneous coronary intervention^{7 8} and in patients undergoing coronary bypass surgery.^{9 10} Percutaneous placement of IABP in axillary/subclavian position has been described as a bridge to heart transplantation.⁴ However, this technique requires major

Figure 1 Transbrachial access for intra-aortic balloon pump (IABP) support. Haemoband device in place (white arrow).

Figure 3 Duplex ultrasound showing normal flow in the left brachial artery.

vascular intervention. Transaortic and axillary routes are costly, risky and necessitate the use of general anaesthesia. The recent use of smaller, 7 and 6 Fr catheters via a transbrachial approach has been reported in patients who cannot undergo transfemoral insertion due to aortoiliac and femoral disease.^{6 11–13} However, 6 Fr IABP catheters are not commercially available in the USA.

The brachial artery is superficial, easily accessible and amenable to manual compression to achieve adequate haemostasis. In addition, ultrasound imaging easily provides a reliable measurement of the brachial artery diameter allowing safe and effective access thus minimising the incidence of neurovascular complications. After IABP placement, monitoring can be performed by digital pulse oximetry, palpation of radial pulse and monitoring of hand temperature.

Transbrachial access allows for some ambulation, thus limiting pretransplant deconditioning. This in our opinion might help to facilitate an easier transition to postoperative rehabilitation and potentially might contribute to earlier post-transplant discharge.

Learning points

- In select patients the transbrachial route for insertion of intra-aortic balloon pump (IABP) appears to be safe.
- Long-term (240 h) haemodynamic management using transbrachial IABP is feasible.
- Monitoring of the IABP while inserted via the brachial artery is relatively simple.
- Transbrachial IABP allows a better quality of life for hospitalised patients awaiting cardiac transplantation and can help to decrease preoperative deconditioning.
- With the recent improvements in IABP profile, a transbrachial approach could be used more routinely as a bridge to cardiac transplantation. Nevertheless, larger studies are required to compare the safety and efficacy of the transbrachial versus transfemoral route for IABP support.

Competing interests None.

Patient consent Obtained.

Provenance and peer review Not commissioned; externally peer reviewed.

REFERENCES

- 1 Cheng JM, den Uil CA, Hoeks SE, *et al.* Percutaneous left ventricular assist devices vs. intra-aortic balloon pump counterpulsation for treatment of cardiogenic shock: a meta-analysis of controlled trials. *Eur Heart J* 2009;30:2102–8.
- 2 Burack JH, Uceda P, Cunningham JN Jr. Transthoracic intraaortic balloon pump: a simplified technique. *Ann Thorac Surg* 1996;62:299–301.
- 3 H'Doubler PB Jr, H'Doubler WZ, Bien RC, *et al.* A novel technique for intraaortic balloon pump placement via the left axillary artery in patients awaiting cardiac transplantation. *Cardiovasc Surg* 2000;8:463–5.
- 4 Estep JD, Cordero-Reyes AM, Bhimaraj A, *et al.* Percutaneous placement of an intra-aortic balloon pump in the left axillary/subclavian position provides safe, ambulatory long-term support as bridge to heart transplantation. *JACC Heart Fail* 2013;1:382–8.
- 5 Okai I, Inoue K, Maruyama M, *et al.* Transbrachial intra-aortic balloon pumping for a patient with fulminant myocarditis. *Heart Vessels* 2012;27:639–42.
- 6 Rubino AS, Onorati F, Serraino F, *et al.* Safety and efficacy of transbrachial intra-aortic balloon pumping with the use of 7-Fr catheters in patients undergoing coronary bypass surgery. *Interact Cardiovasc Thorac Surg* 2009;9:135–7.
- 7 Aznaouridis K, Kacharava AG, Consolini M, *et al.* Transbrachial intra-aortic balloon pumping for high-risk percutaneous coronary intervention. *Am J Med Sci* 2011;341:153–6.
- 8 Simard T, Hibbert B, Parfrey B, *et al.* Transbrachial insertion of an intra-aortic balloon pump for high-risk percutaneous coronary intervention. *Clin Res Cardiol* 2012;101:857–60.
- 9 Onorati F, Impiombato B, Ferraro A, *et al.* Transbrachial intraaortic balloon pumping in severe peripheral atherosclerosis. *Ann Thorac Surg* 2007;84:264–6.
- 10 Bundhoo S, O'Keefe PA, Luckraz H, *et al.* Extended duration of brachially inserted intra-aortic balloon pump for myocardial protection in two patients undergoing urgent coronary artery bypass grafting. *Interact Cardiovasc Thorac Surg* 2008;7:42–4.
- 11 Fujii T, Masuda N, Ijichi T, *et al.* Feasibility of 6 Fr intra-aortic balloon pumping via the femoral or brachial approach. *J Invasive Cardiol* 2012;24:641–4.
- 12 Takahashi A, Taniguchi N. Supported percutaneous coronary intervention using a novel 6-Fr intra-aortic balloon pump catheter via the brachial artery in a nonagenarian patient with an abdominal aortic aneurysm. *Catheter Cardiovasc Interv* 2011;77:1045–8.
- 13 Yamada T, Mizuguchi Y, Sakamoto S, *et al.* Use of novel 6 French intra-aortic balloon pump catheter for patients undergoing percutaneous coronary intervention. *ASAIO J* 2013;59:493–6.

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