Eur J Vasc Endovasc Surg **10**, 327–329 (1995)

Management of Lower Limb Ischaemia Associated with the Use of Intra-aortic Balloon Pumps During Cardiac Surgery

J. S. Jameson[1], R. D. Sayers[1], D. S. Macpherson[1] and T. J. Spyt[2]

Departments of [1]General and [2]Cardiothoracic Surgery, Glenfield Hospital NHS Trust, Groby Road, Leicester LE3 9QP, U.K.

Objective: *To audit the lower limb vascular complications associated with the use of an intraaortic balloon pump (IABP) on a cardiothoracic unit over a 12 month period.*
Design: *Retrospective analysis.*
Setting: *Regional university cardiothoracic unit.*
Patients: *Fifty four IABPs inserted into 51 patients.*
Results: *Seventeen patients (33%) died from cardiogenic shock in the immediate postoperative period. Of the remaining 34 patients (37 IABPs), lower limb vascular complications occurred in nine patients (26%) who underwent 11 IABP insertions (30%). Vascular complications included groin haematomas (n = 2 insertions), compartment syndrome (n = 2 insertions), femoral artery trauma (n = 7 insertions).*
Conclusions: *Prompt management by peripheral vascular surgeons resulted in limb salvage in 10 legs and only one death from a pulmonary embolus.*

Key Words: Intra-aortic balloon pump; Cardiac surgery; Femoral artery; Trauma; Complications.

Introduction

The intra-aortic balloon pump (IABP) is an important adjunct for weaning patients with compromised left ventricular function from cariodpulmonary bypass and is also an effective treatment in some patients with refractory low cardiac output states after cardiac surgery. However, use of the IABP may be associated with significant morbidity due to trauma to the femoral artery in the groin. This paper describes the use of the IABP in a cardiothoracic unit over a 12-month period to audit the lower limb vascular complications associated with its use.

Patients and Methods

Groby Road Hospital is a regional cardiothoracic unit serving a population of around 900000 people. Between March 1989 and February 1990, 1080 patients underwent cardiac surgery with cardiopulmonary bypass. Over this 12-month period 57 intra-aortic balloon pumps were inserted in 54 patients. Three of these patients underwent insertion of the IABP directly into the thoracic aorta through the median sternotomy and have been excluded from the analysis. The case notes, intensive care unit records and cardiopulmonary bypass records of the remaining 51 patients (54 IABPs) were reviewed to obtain details of morbidity and mortality associated with the use of the IABP.

Insertion of the IABP

The IABP was inserted via the femoral artery in the groin either pre, intra or postoperatively. Additional intravenous heparin was not routinely used but all patients were anticoagulated (5000u heparin) during cardiopulmonary bypass and patients who had undergone valve replacement surgery received postoperative anticoagulation with heparin. The IABPs were inserted by surgeons familiar with the technique, either percutaneously or under direct vision after formal exposure of the femoral artery, depending on the preference of the operator. Percutaneous insertion was performed using a Seldinger technique to insert a

Please address all correspondence to: Mr J.S. Jameson, Department of Surgery, The Glenfield Hospital NHS Trust, Groby Road, Leicester LE3 9QP, U.K.

1078–5884/95/070327 + 03 $12·00/0

guidewire which was then replaced with a 10F sheath. A single chamber 9.5F Percor Stat-DL intraaortic balloon with a 40 ml balloon reservoir (Datascope Corporation, Oakland, New Jersey, U.S.A.) was then inserted via the sheath and advanced into the descending thoracic aorta and connected to a Datascope IABP 90T Console. Fluoroscopic screening was not routinely used but the final balloon position was checked by chest radiography. Open insertion was performed by exposure and control of the common femoral artery and introduction of the IABP over a guidewire through a longitudinal arteriotomy. The groin was closed with interrupted skin sutures. All patients were monitored on the intensive therapy unit (ITU) and careful clinical examination of the legs was regularly performed.

Removal of the IABP

The IABP was removed when cardiovascular stability was achieved or if severe lower limb ischaemia was suspected clinically. IABPs which had been inserted percutaneously were removed without exposure of the femoral artery and bleeding controlled by direct pressure. IABPs inserted by the open technique were removed by re-exposure of the femoral artery and direct suture of the arteriotomy using 5.0 polypropylene on the ITU.

Results

During the 12 months from March 1989 to February 1990, 54 IABPs were inserted into 51 patients. One patient underwent insertion of a second IABP in the contralateral groin following ipsilateral femoral artery trauma during attempted insertion. Two other patients required balloon pumps on separate occasions. Seventeen patients (33%) died on ITU from cardiogenic shock in the immediate postoperative period before removal of the IABP. These patients have been excluded from further analysis. Of the remaining 34 patients (37 IABPs), 22 (65%) were male and 12 (35%) were female with a group median age of 57 years (range 25–75). Eighteen (49%) IABPs were inserted percutaneously and 19 (51%) via the open technique.

Lower limb vascular complications

There were lower limb vascular complications in nine patients (26%) who underwent 11 IABP insertions (30%).

Groin haematoma (n = 2 *percutaneous insertions)* Two patients developed large groin haematomas requiring surgical exploration. In these cases no specific bleeding point was found and simple evacuation and drainage of the haematoma performed.

Compartment syndrome (n = 2 *insertions, 1 percutaneous, 1 open)* Compartment syndrome in the calf muscles developed following removal of two balloon catheters (two patients). In one patient, the diagnosis was made 48 h after IABP removal. Foot pulses were present during IABP use and normal ankle systolic pressures were recorded following removal of the IABP. Surgical treatment consisted of decompression of all four compartments and debridement of ischaemic muscle in the anterior compartment. Despite this, the patient died from a pulmonary embolus following a prolonged period of immobility to which the compartment syndrome was a major contributor. In the second patient, successful decompression of a compartment syndrome with fasciotomies was followed by a full recovery.

Femoral artery trauma (n = *seven insertions, five patients)* One attempted insertion of the IABP via the open method resulted in severe femoral artery trauma with tearing of the artery and intimal damage which was immediately recognised. The IABP was removed and successfully inserted into the contralateral groin. The intimal flap was sutured with a 6.0 polypropylene suture and the arterial laceration repaired directly with 5.0 polypropylene sutures. No long-term ischaemic sequelae ensued.

Acute lower limb ischaemia occurred following a further six insertions in four patients (two patients had balloon pumps inserted on separate admissions and had complications on each occasion). Despite removal of the IABP, clinical improvement did not occur and surgical intervention was required in all six cases. Thrombectomy alone was satisfactory in one, and thrombectomy with closure of the arteriotomy site with a vein patch was successful in another. Both of these cases occurred following percutaneous balloon insertions. The other four ischaemic episodes required a more complicated vascular procedure. One patient developed a femoral artery thrombosis following an open insertion of the IABP into the superficial femoral artery. In addition to thrombectomy, this required excision of a short segment of damaged superficial femoral artery, vascular continuity being restored with an end to end anastomosis following mobilisation of

the remaining artery. Another patient developed bilateral lower limb ischaemia consequent upon aortic thrombosis following a percutaneous balloon insertion. This was treated by thrombectomy via a bilateral femoral artery approach with closure of the right femoral artery with a vein patch profundaplasty, excision of the contralateral proximal superficial femoral artery and restoration of continuity with a short segment reversed saphenous vein graft together with a vein patch. In another case, (open insertion) a popliteal intimal flap lesion was caused by attempted Fogarty thrombectomy through the balloon puncture site for a femoral artery thrombosis and this required a further exploration of the groin, together with popliteal artery exploration and repair of the intimal flap. Both the femoral and popliteal arteriotomy sites were closed with vein patches. The final case of lower limb ischaemia resulted from an injury to an atheromatous plaque at the balloon puncture site (open insertion) and this required exploration and repair and closure of the arteriotomy with a vein patch. Limb salvage and patient survival was achieved in all six cases.

Discussion

This study has demonstrated a high rate of vascular complications associated with the use of the IABP, confirming the findings of other authors.[1–4] The most frequently quoted risk factors for the development of complications are female sex, coexisting peripheral vascular disease and diabetes.[5,6]

Compartment syndrome is well recognised as a complication of the IABP[7] and it has been suggested that this can be avoided by the use of continual monitoring of the lower limb compartment pressures with a slit catheter.[7] This type of monitoring is, however, cumbersome and not widely available. A high index of clinical suspicion needs to be maintained in order not to miss these cases.

Balloon catheters make large holes in the femoral artery; two of the ischaemic complications in this series were due, at least in part, to inadvertent puncture of the superficial femoral artery with consequent thrombosis. This is perhaps understandable when it is considered that balloons are often inserted percutaneously with much haste in patients with failing cardiovascular systems with an almost impalpable femoral pulsation. Indeed damaging punctures of the superficial femoral artery may occur during the initial search for the artery, even when the final site of insertion is the common femoral.

Underlying dissection of an atheromatous plaque is common, wherever the puncture site, and it is rarely possible to restore flow solely with a Fogarty catheter. The use of the Fogarty catheter through the puncture site (as is occasionally done by cardiac surgeons) is not recommended; the artery should be opened to check for intimal damage and usually closed with a vein patch. Prosthetic materials in the groin should be avoided because of the risk of infection.

The diagnosis of lower limb ischaemia in an unconscious, ventilated, cardiovascularly compromised patient can be difficult and it is stressed that this requires diligent observation of the limb together with prompt, early referral and close liaison with a peripheral vascular surgeon as these cases often require more than a simple thrombectomy. An aggressive approach to management is required if amputation is to be avoided.

References

1 Kantrowitz A, Wasfie T, Freed PS, Rubenfire M, Wajszczuk W, Shork MA. Intra-aortic balloon pumping 1967 through 1982: analysis of complications in 733 patients. *Am J Cardiol* 1986; **57**: 976–983.

2 Macoviak J, Stephenson LW, Edmunds LH, Harken A, Macvaugh H. The intra-aortic balloon pump: analysis of 5 years' experience. *Ann Thorac Surg* 1980; **29**: 451–458.

3 Hedenmark J, Ahn H, Henze A, Nystrom SO, Svadjeholm R, Tyden H. Complications of intra-aortic balloon counterpulsation, with special reference to limb ischaemia. *Scand J Thor Cardiovasc Surg* 1988; **22**: 123–125.

4 Alpert J, Bhaktan EK, Gielchinsky I *et al.* Vascular complications of intra-aortic balloon pumping. *Arch Surg* 1976; **111**: 1190–1195.

5 Gottlieb SO, Brinker JA, Borkon AM *et al.* Identification of patients at high risk for complications of intra-aortic balloon counterpulsation: A multivariate analysis. *Am J Cardiol* 1984; **53**: 1135–1139.

6 Wasfie T, Freed PS, Rubenfire M *et al.* Risks associated with intra-aortic balloon pumping in patients with and without diabetes mellitus. *Am J Cardiol* 1988; **61**: 558–562.

7 Glenville B, Crockett JR, Bennett JG. Compartment syndrome and intra-aortic balloon. *Thorac Cardiovasc Surgeon* 1986; **34**: 292–294.

Accepted 18 January 1995