intravenous heparin to an aPTT target of 50–70 s or no anticoagulation at all whilst on IABP. Patient groups were well matched in preceeding the procedure, demographics and comorbidities with no significant differences between the two. There was a significantly higher incidence of bleeding in the heparinized vs non-heparinized group, 14.1 vs 2.4% ($P < 0.05$), but no difference in incidence of limb ischaemia, with minor ischaemic complications, occurring in both groups, 4.2 vs 2.4% (*P*, not significant). No major ischaemic events occurred. Blood results (platelet count, d-dimer, plasminogen activator inhibitor-1 and fibrin degradation products concentrations) were also compared between the groups with no significant difference at IABP commencement, 24 or 48 h of continued therapy, or 24 h post-discontinuation of IABP. No macroscopic thrombus was seen on the catheter after the removal. The time of IABP support was not significantly different between the groups: 46.9 ± 19.4 h vs 45.1 ± 22.4 h. It is worth noting that 56 patients also underwent angiography of iliac and femoral vessels prior to catheterization of the less diseased side, which may help reduce the risk of limb ischaemia.

Cooper *et al.* [3] reported a 'before and after' cohort study in which they compared two different management strategies of anticoagulation in patients with IABP for 252 consecutive patients. The first 102 patients in the 'universal heparin' group all received heparin. The following 150 consecutive patients were managed with a selective strategy and given heparin only if indicated by an underlying condition (including unresolved acute coronary syndrome, anterior myocardial infarction, intracardiac thrombus, mechanical prosthetic heart valve and atrial fibrillation). Of this 'selective' group, 47% did not meet indication criteria for heparin and were not anticoagulated. There was a greater incidence of bleeding in the universal group, 39.2 vs 31.8% ($P = 0.049$), but no significant difference in ischaemic events, 1.0 vs 0%, or overall major IABP-related complications (major ischaemia, major bleeding or balloon leak), 2.9 vs 4.6%. A single major ischaemic event occurred in a patient in the 'universal heparin' strategy group. There was no difference in the length of stay in CCU, the total length of stay or in-hospital mortality rates. Groups were also well matched for demographics and comorbidities, except that there was lower incidence of hypertension in the universal group, 51 vs 65% ($P = 0.02$). There was no difference between groups in terms of the use of aspirin, clopidogrel or glycoprotein IIb/IIIa inhibitors. The mean duration of IABP support was similar in both groups with a mean of 43 ± 37 h. *Post hoc* analysis of those patients who received heparin (regardless of allotted group) against those who did not revealed any significant difference in major or minor limb ischaemia. However, major non-access-site bleeding was significantly more common among patients who received heparin than among those who did not (8.2 vs 1.4%, $P = 0.047$).

Laish-Farkash *et al.* [4] reported data from a cohort study of 97 patients following PCI with IABP *in situ*. Patients were treated with only a glycoprotein (GP) IIb/IIIa antagonist following a single heparin bolus at the start of PCI. Patients were only further heparinized if IABP was still required after the GP antagonist was discontinued (after 12–24 h for most patients, with the length of treatment determined by the hospital protocol). Minor bleeding (9.3%), major bleeding (15.5%), in-hospital mortality (13.4%) and limb ischaemia (2%) incidence were within the range of other published results for IABP with heparinization, suggesting no increase in ischaemic events or other complications with omission of heparin. Interpretation of these results is complicated by a wide variation in administration times of GP antagonists that were not standardized across the cohort. Following initial heparin bolus, some patients received a single bolus of GP antagonist before being recommenced on heparin, in which case the time 'off heparin' is likely to have been minimal, whereas others received GP antagonists for up to 48 h, without heparin.

Lazar *et al.* [5] conducted a trial in which 25 pigs were randomized to receive either IABP with heparinization, without heparinisztion, or a heparin-coated IABP without heparinization. After 9 h of counterpulsation, the pigs were sacrificed and the balloon catheters were analysed. There was no thrombus detected in either the heparinized group or the heparin-coated IABP group; however, thrombus was detected in the non-heparinized group at the insertion site, on the catheter itself, as well as in the distal femoral artery.

CLINICAL BOTTOM LINE

The use of heparinization with IABP is intended to reduce the risk of thrombus, thromboembolus or limb ischaemia whilst generating an increased risk of bleeding as a side-effect. The studies considered demonstrated that omitting or implementing a selective use strategy of heparinization during IABP counterpulsation can significantly decrease the incidence of bleeding without an increase in limb ischaemic events. The decision to heparinize should be weighed in the context of other indications or contraindications rather than being an automatic response to the use of IABP counterpulsation.

Conflict of interest: none declared.

BEST EVIDENCE TOPIC

REFERENCES

[1] Dunning J, Prendergast B, Mackway-Jones K. Towards evidence-based medicine in cardiothoracic surgery: best BETS. Interact CardioVasc Thorac Surg 2003;2:405–9.
[2] Jiang CY, Zhao LL, Wang JA, Mohammod B. Anticoagulation therapy in intra-aortic balloon counterpulsation: does IABP really need anti-coagulation? J Zhejiang Univ Sci 2003;4:607–11.
[3] Cooper HA, Thompson E, Panza JA. The role of heparin anticoagulation during intra-aortic balloon counterpulsation in the coronary care unit. Acute Cardiac Care 2008;10:214–20.
[4] Laish-Farkash A, Hod H, Matetzky S, Guetta V. Safety of intra-aortic balloon pump using glycoprotein IIb/IIIa antagonists. Clin Cardiol 2009; 32:99–103.
[5] Lazar HL, Bao Y, Rivers S, Treanor PR, Shemin RJ. Decreased incidence of arterial thrombosis using heparin-bonded intraaortic balloons. Ann Thorac Surg 1999;67:446–9.

eComment. Sheathless intra-aortic balloon pump insertion

Authors: ***Jamil Hajj-Chahine, Christophe Jayle, Hassan Houmaida and Pierre Corbi***

Department of Cardio-Thoracic Surgery, University Hospital of Poitiers, Poitiers, France

doi:10.1093/icvts/ivs196

We read with great interest the article by Pucher et al. regarding the systematic use of heparinization in patients requiring the insertion of an intra-aortic balloon pump (IABP) [1]. The authors reviewed a vast number of published articles and concluded that the decision-making process concerning the use of heparin in patients with IABP conterpulsation should be weighed in the setting of other indications or contraindications rather than being an automatic response.

The IABP was first used to support the failing heart in 1968 [2]. In the 1990s, the introduction of the percutaneous method of insertion broadened the availability and feasibility of IABP use, and nowadays it represents the most usable tool amongst temporary mechanical circulatory support devices for patients suffering from low cardiac output syndrome. However, the use of IABP is not without complications [3], which include bleeding at the site of insertion, local or systemic infection, stoke, aortic or iliac dissection or rupture (occurring in less than 1% but usually fatal) and entrapment of the balloon (associated with balloon rupture and clot formation). Neuropathy and chronic leg pain occur less frequently.

Acute limb ischaemia is the most common complication of IABP use, occurring in 8-42% of cases. More than 30% of patients with limb ischaemia secondary to balloon insertion required surgical intervention [3]. To reduce morbidity of the IABP, heparinization is generally associated with the use of the balloon. Apart from the reduction of the outer diameter of the balloon (11 Fr), another major step to reduce the incidence of vascular complications is the sheathless insertion technique. This technique was recommended by Erdogan et al. [4] in high-risk patients, particularly female patients with peripheral vascular disease. The sheathless insertion technique reduced the incidence of device-related complications to less than 10 % in a study by Nash et al. [5]. Furthermore this modification could be a useful alternative to the use of heparin in patients with a high risk of bleeding.

A prospective clinical trial is required to address the issue of anticoagulation at a higher level of evidence in patients with IABP with or without a sheath.

Conflict of Interest: None declared

References

[1] Pucher P, Cummings I, Shipolini A, McCormack D. Is heparin needed for patients with an intra-aortic balloon pump? Interact CardioVasc Thorac Surg 2012;15:136–40.
[2] Kantrowitz A, Tjonneland S, Freed PS, Phillips SJ, Butner AN, Sherman JLJr. Initial clinical experience with intraaortic balloon pumping in cardiogenic shock. JAMA 1968;203:113–8.
[3] Baskett RJ, Ghali WA, Maitland A, Hirsch GM. The intraaortic balloon pump in cardiac surgery. Ann Thorac Surg 2002;74:1276–87.
[4] Erdogan HB, Goksedef D, Erentug V, Polat A, Bozbuga N, Mansuroglu D, Guler M, Akinci E, Yakut C. In which patients should sheathless IABP be used? An analysis of vascular complications in 1211 cases. J Card Surg 2006;21:342–6.
[5] Nash IS, Lorell BH, Fishman RF, Baim DS, Donahue C, Diver DJ. A new technique for sheathless percutaneous intraaortic balloon catheter insertion. Cathet Cardiovasc Diagn 1991;23:57–60.

eComment. Re: Is heparin needed for patients with an intra-aortic balloon pump?

Authors: ***Kelechi E. Okonta, Umar Abubakar, Emeka B. Kesieme and Peter O. Adeoye***

Division of Cardiothoracic Surgery, University College Hospital Ibadan, Ibadan, Nigeria

doi:10.1093/icvts/ivs197

The article by Pucher et al. [1] showed the expected results of heparin need for patients with an intra-aortic balloon pump (IABP). At the same time, they observed that the use of heparinization with IABP, which was intended to reduce the risk of thrombus, thromboembolus or limb ischaemia, will concomitantly increase the risk of bleeding as a side-effect. They therefore concluded from the studies that omitting or implementing a selective use strategy of heparinization during IABP counterpulsation could significantly decrease the incidence of bleeding without an increase in limb ischaemic events[1].

It is important to state that the use of IABP showed be holistic, especially when considering ischaemic complications such as limb ischaemia. While it is true that judicious use of an adjunct like heparin should be seriously considered in light of the attendant complications, the physical properties of the IAPB should also be seriously considered vis a vie the size of the balloon/catheter and sheathless technique. In particular, the height/ body surface area of the patients should be taken into account to avoid the occlusive effect of the balloon/catheter, which can lead to an increased effect of limb ischaemia. Scholz et al. observed that using thinner catheters for percutaneous placement was associated with a reduction in the rate of complications, from 20.7 % (17 of 82 patients) for 12 French catheters to 9.9 % (10 of 101 patients) for 10.5 French catheters (P= 0.04), and 8.4 % (14 of 167 patients) for 9.5 French catheters (P = 0.006) and with multivariate logistic regression analysis identified catheter size (odds ratio 3.4 for 12 French catheters) and other factors were independent risk factors for counterpulsation-associated complications[2]. Nash et al., whilst stating that IABP was helpful for controlling myocardial ischaemia and providing haemodynamic support, pointed out that its applicability was limited by lower extremity ischemic complications in a significant percentage of patients. They developed a new sheathless technique for percutaneous intra-aortic balloon catheter insertion, which reduced the effective catheter size. A pilot study conducted using this new technique resulted in a 10% rate of limb ischemia, without compromise of balloon function. They concluded that the technique was useful in reducing the incidence of limb ischaemia associated with IAPB [3].

Thus in the use of IAPB, especially when heparinization is to be discouraged or omitted for fear of bleeding, the balloon/catheter size, and possibly the avoidance of a sheath should be considered.

Conflict of Interest: None declared

References

[1] Pucher PH, Cummings IG, Shipolini AR, McCormack DJ. Is heparin needed for patients with an intra-aortic balloon pump? Interact CardioVasc Thorac Surg 2012;15:136–40.
[2] Scholz KH, Ragab S, von zur Muhlen F, Schroder T, Werner GS, Mindel L *et al*. Complications of intra-aortic balloon counterpulsation The role of catheter size and duration of support in a multivariate analysis of risk. Eur Heart J 1998;19:458–465.
[3] Nash IS, Lorell BH, Fishman RF, Baim DS, Donahue C, Diver DJ. A new technique for sheathless percutaneous intraaortic balloon catheter insertion. Cathet Cardiovasc Diagn 1991;23:57.