Intraoperative cell salvage versus postoperative autologous blood transfusion in hip arthroplasty: a retrospective service evaluation

L Mason, C Fitzgerald, J Powell-Tuck, R Rice

Trauma and Orthopaedic Department, Nevill Hall Hospital, Abergavenny, UK

ABSTRACT

INTRODUCTION A number of ways of reducing blood loss in arthroplasty have been explored, including preoperative autologous transfusion, intraoperative cell salvage and postoperative autologous transfusions. Both intraoperative blood salvage and postoperative retransfusion drains have been shown to be effective in reducing blood loss in total hip arthroplasty. In our department there was a change in practice from using postoperative retransfusion drains to intraoperative cell salvage. To our knowledge no study has directly compared using intraoperative blood salvage and postoperative retransfusion drains alone in total hip arthroplasty.

METHODS This was a retrospective service evaluation including all primary hip arthroplasty performed under our care between January 2006 and December 2008. Patients were divided into two groups: Group A used a postoperative autologous blood transfusion (ABT) drain and Group B used intraoperative cell salvage.

RESULTS A total of 144 patients were included in this study: 84 in Group A and 60 in Group B. The mean haemoglobin difference for Group A was 3.96g/dl (standard deviation [SD]: 1.52) and for Group B it was 3.46g/dl (SD: 1.42). The mean haematocrit difference for Group A was 0.12% (SD: 0.05) and for Group B it was 0.10% (SD: 0.04). Using an independent t-test for the comparison of means, a significant difference was found between Group A and B both in regards to haemoglobin difference ($p=0.009$) and haematocrit difference ($p=0.046$).

CONCLUSIONS We feel that intraoperative cell salvage provides a more efficient method of reducing blood loss than postoperative retransfusion in primary total hip replacement. A prospective randomised study would be useful to ascertain any clinical difference between the two methods.

KEYWORDS

Hip arthroplasty – Blood loss – Autologous blood transfusion – Intraoperative cell salvage

Accepted 30 March 2010

CORRESPONDENCE TO

Lyndon Mason, Trauma and Orthopaedic Department, Nevill Hall Hospital, Abergavenny, UK, NP7 7EG
E: mrlyndonmason@me.com

The minimisation of blood loss in orthopaedic surgery is of ongoing concern. About 10% of UK-donated packed red blood cell (RBC) units are used in orthopaedic procedures and about 40% of these are for patients undergoing arthroplasty.¹ Allogenic donated blood has many documented risks including transfusion reactions, infection transmission, immunomodulation and transfusion error.^{1–4} The availability of donated RBC units is also a worry, with 7,000 donations needed daily in the UK to supply demand.⁵ Bearing this in mind, any methods of reducing operative blood loss and postoperative allogenic blood transfusion are increasingly important.

A number of ways of reducing blood loss in arthroplasty have been explored, including preoperative autologous transfusion,⁶ intraoperative cell salvage⁷ and postoperative autologous transfusions.^{1–5,8} Both intraoperative blood salvage and postoperative retransfusion drains have been shown to be effective in reducing blood loss in total hip arthroplasties.^{1–4,7–14}

Intraoperative cell salvage involves collection of blood lost during surgery using a suction device. The blood is centrifuged and washed so that only concentrated red cells are collected and returned to the patient. Blood is usually returned to the patient intraoperatively but this can continue postoperatively.¹⁵ Postoperative collection and retransfusion is typically via a postoperative drain system. This consists of a blood collection suction bellows connected to an autologous transfusion bag with a filter. A drain is inserted into the surgical wound before closure and blood collected up to six hours postoperatively is retransfused.

To our knowledge no study has directly compared using intraoperative blood salvage and postoperative retransfusion drains alone in total hip arthroplasties. In our department we changed practice, from the use of postoperative drain and blood salvage to the use of intraoperative cell salvage. We aimed to examine the two groups of patients who underwent total hip arthroplasties to compare intraoperative blood salvage and postoperative retransfusion.

Methods

This was a retrospective service evaluation including all primary hip arthroplasties performed under our care between January 2006 and December 2008. All patients were operated on by the same consultant or under his supervision. A standard operative technique (the modified Hardinge approach) was used for all patients. All patients received a hybrid total hip replacement, using a cemented Exeter femoral stem (Stryker® Orthopaedics, Mahwah, New Jersey, US) with an uncemented Trident acetabular cup (Stryker® Orthopaedics, Mahwah, New Jersey, US). All patients received standard postoperative rehabilitation. Thromboembolic prophylaxis was accomplished using 40mg of subcutaneous enoxaparin as per hospital protocol.

The patients were divided into two groups. Group A used a postoperative autologous blood transfusion (ABT) drain (Bellovac®, Astra Tech Ltd, Stonehouse, Gloucestershire). For these patients a surgical drain was inserted into the wound before closure of the fascia lata. This drain was attached to a blood suction bellows, which in turn was attached to a blood transfusion bag. Blood collected up to six hours postoperatively was retransfused to the patient.

The patients in Group B underwent intraoperative cell salvage (Cell Saver® 5+ system, Haemonetics Corporation, Braintree, Massachusetts, US). Blood collected intraoperatively was centrifuged and washed so that red cells only were retransfused to the patient. No drain was used postoperatively.

The pre and postoperative haemoglobin (Hb) and haematocrit (Hct) levels were recorded. Postoperative transfusion requirements were not analysed as this was dependent on the prescribing physician's preference and other patient factors. Statistical analysis was done using SPSS® 12.0.1 (SPSS Inc, Chicago, Illinois, US). Descriptive statistics were used to confirm that the data were normally distributed and independent t-tests were used to test the differences between the groups.

Results

A total of 144 patients were included in this study. The overall mean preoperative Hb was 13.43g/dl (standard deviation [SD]: 1.53) and the mean postoperative Hb was 9.68g/dl (SD: 1.66). The overall mean preoperative Hct was 0.41% (SD: 0.04) and the mean postoperative Hct was 0.30% (SD: 0.05). The analysis of the anaesthetics given in each group showed similar ratios of general and regional anaesthesia. In Group A 17 patients (20.2%) had general anaesthesia and 67 (79.8%) had regional anaesthesia. In Group B 11 patients (18.5%) had general anaesthesia and 49 (81.7%) had regional anaesthesia.

In Group A there were 84 patients (43 female, 41 male), with a mean age of 71 years (range: 34–90 years). The mean preoperative Hb was 13.50g/dl (SD: 1.54) and the mean postoperative Hb was 9.54g/dl (SD: 1.75). The mean preoperative Hct was 0.41% (SD: 0.04) and the mean postoperative Hct was 0.29% (SD: 0.05).

In Group B there were 60 patients (38 female, 22 male), with a mean age of 66 years (range: 26–89 years). The mean

preoperative Hb was 13.34g/dl (SD: 1.54) and the mean postoperative Hb was 9.88g/dl (SD: 1.52). The mean preoperative Hct was 0.40% (SD: 0.04) and the mean postoperative Hct was 0.30% (SD: 0.04).

The Hb and Hct difference was calculated by subtracting preoperative from postoperative values. The mean Hb difference for Group A was 3.96g/dl (SD: 1.52) and for Group B it was 3.46g/dl (SD: 1.42). The mean Hct difference for Group A was 0.12% (SD: 0.05) and for Group B it was 0.10% (SD: 0.04). Using an independent t-test for the comparison of means, a significant difference was found between Group A and B in regards to both Hb difference ($p=0.009$) and Hct difference ($p=0.046$).

Discussion

Both postoperative ABT and intraoperative cell salvage have been shown to be effective in reducing blood loss during orthopaedic surgery.^{1–4,7–15} To date there has been no direct comparison between post- and intraoperative blood salvage. In 1995 Huo *et al* showed intraoperative blood salvage to be more efficient in reducing blood loss in total hip replacements than ABT drains.⁴ However, in that study they looked at the cumulative effects of three methods of blood loss reduction rather than direct comparison of single methods. Our service evaluation found intraoperative cell salvage to be statistically more effective in reducing blood loss than ABT drains.

Intraoperative blood salvage has often been thought to be more costly than postoperative retransfusion drains. However, although we have not performed a full cost analysis for each method, the cost of the disposable aspects of each method in our institution is comparable. At the time of writing, the disposable aspects of cell salvage in our hospital cost £100 per patient compared with £108 per ABT drain. In addition, the use of intraoperative cell salvage in our institution is subsidised by the National Blood Service. Nevertheless, this does not take into account the initial outlay costs for the intraoperative cell salvage equipment and the training of theatre staff to use it.

Our service evaluation has not directly looked at the clinical effect of each of these blood saving methods, the outcome measure of our study being haematological parameters. We did not analyse postoperative allogenic transfusion requirements in this study as we find this a very unreliable outcome in a retrospective study where no transfusion trigger has been agreed and transfusions have been dependent on the prescribing physician's preference¹¹ and other patient factors.¹⁶

Being retrospective is a clear limitation to this service evaluation as bias is possible. However, a prospective randomised study is difficult to undertake due to the obvious benefits of both blood salvage systems. Nevertheless, some surgeons have decreased the use of postoperative drainage systems due to the increased risk of infection,¹⁷ complication of continued wound drainage, impeding mobilisation and complicating nursing.¹⁸ Furthermore, autologous transfusions are not completely without complications, with a small risk of anaphylactoid-like reactions.¹⁹ We have not in-

licated the volumes of blood collected in each group in this study as we believe this to be clinically irrelevant due to the concentration of Hb in the blood collected being unknown.

Conclusions

We feel that intraoperative cell salvage provides a more efficient method of reducing blood loss than postoperative retransfusion in primary total hip replacement. A prospective randomised study would be useful to ascertain any clinical differences between the two methods.

References

1. Sturdee SW, Beard DJ, Nandhara G, Sonanis SV. Decreasing the blood transfusion rate in elective hip replacement surgery using an autologous drainage system. *Ann R Coll Surg Engl* 2007; **89**: 136–139.
2. Garvin KL, Feschuk CA, Sekundiak TD, Lyden ER. Blood salvage and allogenic transfusion needs in revision hip arthroplasty. *Clin Orthop Relat Res* 2005; **441**: 205–209.
3. Strümper D, Weber EW, Gielen-Wijffels S et al. Clinical efficacy of postoperative autologous transfusion of filtered shed blood in hip and knee arthroplasty. *Transfusion* 2004; **44**: 1,567–1,571.
4. Huo MH, Paly WL, Keggi KJ. Effect of preoperative autologous blood donation and intraoperative and postoperative blood recovery on homologous blood transfusion requirement in cementless total hip replacement operation. *J Am Coll Surg* 1995; **180**: 561–567.
5. News Release, 26 May 2009: Record donation levels in 2008–09 – but need for donors never stops. NHS Blood and Transplant. http://www.nhsbt.nhs.uk/news/2009/newsrelease260509_1.html (cited April 2011).
6. Seshadri RS, Odell WR, Runciman WB, Morley AA. Effective use of blood in elective surgical procedures. 2. The role of preoperative autologous blood transfusion. *Med J Aust* 1982; **2**: 71–74.
7. Zarin J, Grosvenor D, Schurman D, Goodman S. Efficacy of intraoperative blood collection and reinfusion in revision total hip arthroplasty. *J Bone Joint Surg Am* 2003; **85-A**: 2,147–2,151.
8. Association of Anaesthetists of Great Britain and Ireland. *Blood Transfusion and the Anaesthetist: Rec Cell Transfusion*. London: AAGBI; 2008.
9. Bovill DF, Moulton CW, Jackson WS et al. The efficacy of intraoperative autologous transfusion in major orthopedic surgery: a regression analysis. *Orthopedics* 1986; **9**: 1,403–1,407.
10. Jones HW, Savage L, White C et al. Postoperative autologous blood salvage drains – are they useful in primary uncemented hip and knee arthroplasty? A prospective study of 186 cases. *Acta Orthop Belg* 2004; **70**: 466–473.
11. Moonen AF, Thomassen BJ, van Os JJ et al. Retransfusion of filtered shed blood in everyday orthopaedic practice. *Transfus Med* 2008; **18**: 355–359.
12. Moonen AF, Knoors NT, van Os JJ et al. Retransfusion of filtered shed blood in primary total hip and knee arthroplasty: a prospective randomized clinical trial. *Transfusion* 2007; **47**: 379–384.
13. Muñoz M, García-Vallejo JJ, Ruiz MD et al. Transfusion of post-operative shed blood: laboratory characteristics and clinical utility. *Eur Spine J* 2004; **13 Suppl 1**: S107–113.
14. Moonen AF, Neal TD, Pilot P. Peri-operative blood management in elective orthopaedic surgery. A critical review of the literature. *Injury* 2006; **37 Suppl 5**: S11–16.
15. Semkiw LB, Schurman DJ, Goodman SB, Woolson ST. Postoperative blood salvage using the Cell Saver after total joint arthroplasty. *J Bone Joint Surg Am* 1989; **71**: 823–827.
16. Walsh M, Preston, C, Bong M et al. Relative risk factors for the requirement of blood transfusion after total hip arthroplasty. *J Arthroplasty* 2007; **22**: 1,162–1,167.
17. Seibert DJ. Pathophysiology of surgical site infection in total hip arthroplasty. *Am J Infect Control* 1999; **27**: 536–542.
18. Esler CN, Blakeway C, Fiddian NJ. The use of a closed-suction drain in total knee arthroplasty. A prospective, randomised study. *J Bone Joint Surg Br* 2003; **85**: 215–217.
19. Dich-Nielsen JO, Rajan RM, Jensen JJ. An anaphylactoid-like reaction following infusion of salvaged unwashed drain blood. *Can J Anaesth* 1998; **45**: 189.