Decreasing the blood transfusion rate in elective hip replacement surgery using an autologous drainage system

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ABSTRACT

INTRODUCTION This is a prospective study looking at the effectiveness of autologous postoperative drains in primary un cemented total hip replacement (THR) surgery.

PATIENTS AND METHODS A total of 86 patients were studied, with 43 using standard suction drains (normal drain group) and 43 using autologous drains (autologous drain group).

RESULTS Thirty-seven units of homologous blood were transfused in the normal drain group and 5 units in the autologous drain group. The mean number of units of homologous blood transfused per patient was reduced from 0.86 to 0.12 ($P < 0.01$) with the use of autologous drains and the transfusion rate was reduced from 23% to 6% ($P < 0.02$). The mean length of hospital stay was also reduced by two nights ($P < 0.05$). There were no adverse effects from using the autologous system and it does reduce the need for a homologous blood transfusion.

CONCLUSIONS The system is simple and easy to use and we have also found it to be cost effective. Previously, it has not been reported as being effective in hip arthroplasty surgery, unlike knee arthroplasty surgery. We would recommend using autologous postoperative drains in primary THR surgery.

KEYWORDS

Hip arthroplasty – Blood transfusion – Autologous – Allogenic

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Patients having orthopaedic surgery often require a blood transfusion at some point in their treatment. Orthopaedic patients use 10% of the UK red blood cells, and 40% of these are having elective hip and knee surgery. Of those patients having a total hip replacement (THR), 22–97% required a transfusion of 0.85–3.38 units.^{1,2} There are many recognised complications following homologous blood transfusion. These include disease transmission, transfusion reactions, immunomodulation, and transfusing the wrong blood. Linden *et al.*³ found that a transfusion error occurred in up to 1 in 20,000 transfusions. The risk of contracting HIV from a blood transfusion in the UK is 1 in 8 million, is 1 in 900,000 for hepatitis B, and 1 in 30 million for hepatitis C.⁴ There is a test on the horizon for new variant Creutzfeldt Jacob disease (nvCJD) to determine the carrier status of the donors. From April 2004, anyone who has previously received a blood transfusion is no longer allowed to donate blood because of a theoretical risk of nvCJD transmission. There has, to date, not been any proven cases of nvCJD transmission from a blood

transfusion. All of these issues mean that banked homologous blood is in short supply and its availability will decrease in the future. Blood is, therefore, a valuable product and we need to make every effort to preserve our stocks as suggested by the health service circulars.⁵ There are many ways this can be done such as pre-operative donation, normovolaemic haemodilution (intra-operative pre-donation), intra-operative cell salvage, postoperative cell salvage and re-transfusion.

In our institution, autologous drains have been used successfully in patients having total knee replacement (TKR). The reason for not using the same drainage system in THR has been that a significant amount of the blood loss occurs peri-operatively; therefore, it had been felt that the drains would not be cost effective and would not reduce the transfusion rate in this group of patients, unlike in TKR surgery where the surgery is done with a tourniquet and the blood loss occurs predominantly postoperatively. The purpose of this study was to monitor the blood loss, length of hospital stay, and transfusion requirements of all patients having

THR surgery using an autologous drainage system compared with normal suction drains to decide if the routine use of autologous drains can be justified.

Patients and Methods

All the patients were under the care of one consultant (DJB) and all the surgical procedures were done, or directly supervised, by the consultant. The Zweymuller (Endo Plus, Rotkreuz, Switzerland) uncemented hip prosthesis was used, and a lateral approach to the hip was employed. All cases were done under general anaesthesia. Two drains are used and inserted when closing the anatomical layers. The first drain lies within the hip joint and the second lies in the subcutaneous fat layer. The suction drains used are Bellovac® low-vacuum drains (Astra Tech, Gloucester, UK). These are removed on day 2 postoperatively. For the purposes of this study, these drains are called normal drains. The autologous drainage system used was the Bellovac®A.B.T (Astra Tech). These drains are referred to as autologous drains throughout the rest of this paper. Two drains were used in the same way and they were connected to the collection system via a Y-connector. Blood drained in the first 6 h was used for autotransfusion. After 6 h, the drains function as a normal, low-pressure, wound drain and are also removed on day 2 postoperatively.

The blood loss, length of hospital stay and transfusion requirements were recorded. The transfusion trigger was a haemoglobin concentration of less than 8.0 g/dl. The decision to transfuse was made by the study co-ordinator (SWS). The postoperative haemoglobin was measured on the first day after surgery. Initially, for the first year, all cases were performed using normal suction drains. The practice was then changed to use autologous drains, and the same parameters were again recorded. Both groups (normal drain group and autologous drain group) were of similar age, sex ratio, pre-operative pathology and pre-operative

Table 1 Patient characteristics for the two groups.

	Normal drain group (n = 43)	Autologous drain group (n = 43)
Mean age [yrs] (range)	72 (51–96)	67 (32–85)
Gender		
Men	22	13
Women	21	30
Mean pre-operative haemoglobin [g/dl] (range)	13.20 (10.7–15.5)	13.23 (10–16.1)
Mean postoperative haemoglobin [g/dl] (range)	9.72 (6.9–12.4)	10.15 (7.8–12.3)

haemoglobin. All patients undergoing THR during the study period were included in the study.

Statistical analysis was performed using the statistical package SPSS v. 14 (SPSS, Chicago, IL, USA). The *t*-test for independent groups was used to compare the volume of blood transfused and the length of hospital stay. The chi-squared test was used to compare the transfusion rates between the two groups.

Results

There was a total of 86 patients in the study, 43 in each group. The patient characteristics in both groups are shown in Table 1. Data were collected for all patients and, once entered into the study, no patients were lost. The pathology in all patients was osteoarthritis of the hip. The volume of

Table 2 Drainage volume and transfusion details for both groups

	Normal drain group (n = 43)	Autologous drain group (n = 43)
Mean volume of blood drained [ml] (range)	641 (500–1070)	675 (200–1700)
Mean volume of autologous blood re-transfused (ml)	n/a	441 (50–1050)
Number requiring homologous blood transfusion	10	2
Number of units of homologous blood used	37	5
Mean no. of units transfused per patient	0.86	0.12 <i>P</i> < 0.01
Transfusion rate	23%	6% <i>P</i> < 0.02
Mean number of nights' stay	11	9 <i>P</i> < 0.05)

n/a, not applicable.

blood collected in the drains was similar in both groups; in the autologous drain group, a mean of 441 ml of blood was re-transfused to the patient. This is 65% of the total drainage and this blood would be thrown away when normal drains are used. The drainage volume and transfusion details in both groups are shown in Table 2.

Ten patients in the normal drain group, and two patients in the autologous drain group required an homologous blood transfusion (Fig. 1). This equated to a total of 37 units of blood in the normal drain group and 5 units in the autologous drain group. There was a mean difference of 0.74 units of blood used between the two groups ($P < 0.01$). The transfusion rate was 23% in the normal drain group and 6% in the autologous drain group ($P < 0.02$). The difference in the hospital stay was not very marked between the two groups with the autologous drain group having a mean length of stay two nights less than the normal drain group ($P < 0.05$).

There were no complications in any of the patients receiving an autologous blood retransfusion from the drain. One patient only received 50 ml of drained blood out of the 200 ml available. This was because the cannula tissue and, by the time this was detected by the nursing staff, the remaining 150 ml of blood was too old, and had to be discarded.

Discussion

Arthroplasty surgery of the hip and knee is associated with significant blood loss peri-operatively and postoperatively. In TKR, the blood loss is almost all lost postoperatively due to the use of a tourniquet. The use of autologous drains in TKR has been shown to be effective.^{6,7} Newman *et al.*⁶ showed that an

86% reduction in blood transfusion could be achieved and they also showed a reduction in infective episodes and length of hospital stay. In THR, the blood loss occurs during and after the surgery. Uncemented hips probably bleed more than cemented hips because there is no cement to stop the raw cancellous bone from bleeding. In our institution, autologous drains have been used with good effect for many years in TKR and the reason given for not using them in THR surgery was that there was not enough blood lost into the drains to make the blanket use cost effective. Keating *et al.*⁸ found that intra-operative and postoperative blood salvage was not cost effective in primary revision THR surgery. Slagis *et al.*⁹ did not show a benefit in THR but they used a cell washer that is costly. Our results show similar findings to Newman *et al.*⁶ but in uncemented THR surgery rather than TKR surgery. We did not, however, compare the infective episodes in the two groups.

Several studies have shown that using unwashed drained blood as an autologous transfusion is safe.^{6,7,10} Some studies have attributed side-effects such as hypotension, hyperthermia and febrile reactions to the transfusion of filtered salvaged blood,^{11,12} although the reasons behind these changes is not totally clear. It has been shown that the complement levels¹³ and cytokine levels¹⁴ are higher in salvaged blood compared to the circulating blood. This may explain the reduction in infective episodes shown in TKR by Newman *et al.*⁶ and an increase in spinal surgery when homologous blood is transfused.¹⁵ This is another potential advantage of autologous drainage, although the exact mechanism has still to be proven. We did not have any side-effects from transfusing unwashed drained blood, and we did not see any significant changes in the basic observations performed postoperatively.

We do appreciate that not everyone uses drains postoperatively although the literature supports both actions. In America, studies have shown that it is not necessary to use drains in THR surgery and that, compared to surgery done with drains, the transfusion rate is lower.¹⁶⁻¹⁸ Ritter *et al.*¹⁹ showed, however, that there was no difference in transfusion rate or haemoglobin decrease between patients with or without drains in THR. In the UK, however, it is common practice to use drains and we accept that we could extend our study to look at this issue in more detail.

There are many potential approaches to avoid the need for homologous blood transfusion in orthopaedic surgery. Earnshaw²⁰ showed that, if the pre-operative haemoglobin is greater than 14 g/dl, the risk of needing a transfusion is less than 10%. Earnshaw's patients with a low haemoglobin were optimised with 4 weeks of epoetin alfa before the surgery. There have been various algorithms published in the literature recently that help in reducing the blood transfusion rate.^{21,22} These are based on careful fluid balance and specific transfusion triggers. Our trigger for transfusion was a haemoglobin less than 8.0 g/dl. These algorithms have to be commended but, in isolation, they may not be enough to reduce the transfusion rate significantly.

The annual cost of provision and transfusion of blood products in the UK is £900 million; of this, £635 million is the cost to the national health service (NHS). The estimated cost to the NHS for 1 unit of red blood cells is £635.23. This is a significant amount and will vary from hospital to hospital. It is, however, much greater than the cost of the autologous drains. At the time of writing this paper, the Bellovac® A.B.T system was £45 per patient. The use of drains in our institution has reduced the costs involved in transfusing patients. Our patients now only have a group-and-save blood test on admission to hospital rather than a cross-match. This is cheaper and it also means that there is less cross-matched blood required on hold in the pathology laboratory.

This study has many limitations. The sample size is small and it is not randomised; however, the results do show a good reduction in the transfusion rate and, thus, the number of units of homologous blood that is transfused. The reduction in length of hospital stay may not be totally attributable to the use of the autologous drains but there is a potential reduction in hospital stay if patients do not require a blood transfusion. We feel that the limitations of this study do not completely invalidate our findings.

Conclusions

The autologous drainage system is simple and easy to use when compared with some of the other methods available to reduce the need for blood transfusion, such as pre-operative donation, normovolaemic haemodilution (intra-operative pre-donation), and intra-operative cell salvage. It requires a basic understanding of the technique and nursing staff in theatre and on the ward can easily be trained to use it. The results clearly show that it reduces the need for blood transfusion in uncemented hip replacement surgery. This also means that patients only require a group-and-save sample pre-operatively and do not need cross-matching. There is also a small reduction in hospital stay and there are financial savings. With a national shortage of bloodstocks that is predicted to get worse, we would recommend the use of autologous drains in hip replacement surgery.

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