



A comparison of post-op haemoglobin levels and allogeneic blood transfusion rates following total knee arthroplasty without drainage or with reinfusion drains

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The effects of re-infusion drains on the rate of allogeneic blood transfusion and post-op haemoglobin levels in Total Knee Arthroplasty were examined. A group of 22 patients undergoing primary Total Knee Arthroplasty using a CBCII Constavac Stryker® re-infusion drainage system were compared with a group of 30 patients, matched for age, sex and type of prosthesis but without any drain usage. The re-infusion drain group had a significantly lower day 1 and day 3 post-operative haemoglobin compared to the non-drainage group. The re-infusion drain group had a higher allogeneic transfusion rate compared to the non-drainage group. There were no significant differences between the two groups regarding the rate of wound and transfusion related complications and mean length of post-operative stay. We found that reinfusion drains were ineffective in reducing allogeneic transfusion requirements as compared with non-drainage in total knee arthroplasty.

Keywords : reinfusion drains ; allogeneic blood transfusion ; autologous transfusion ; total knee arthroplasty.

INTRODUCTION

Primary total knee arthroplasty can be associated with significant blood loss and the patient may require a blood transfusion in the postoperative period. Beirbaum *et al* 1999 (2) reported in their multicentre study that although the requirement for blood replacement was less for primary unilateral total knee arthroplasty when compared with bilater-

al procedures and revision joint surgery, 25% of their primary unilateral total knee replacements required a transfusion of predonated blood and 11% required an allogeneic transfusion (2). Alternatives to the transfusion of allogeneic blood have been sought in an attempt to ease the increasing demands on the blood transfusion service, as well as to avoid the associated transfusion related risks such as transmission of blood-borne viruses and immune mediated reactions (2,3,4,6,20). In addition, allogeneic transfusions have been associated with a significant increase in post-op infection, fluid overload and prolonged hospital stay (2). An alternative to bank blood transfusions is blood salvage and reinfusion drains ; they have been recognised as a safe and effective method of blood replacement for patients undergoing total knee arthroplasty (12,18). Numerous published studies are in support of auto-

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transfusion drains reducing the need for allogeneic blood, especially when compared with closed suction drains (5,7,8,10,13,14,16, 21).

Since November 2006, we have been using the CBC II Constavac reinfusion drain (Stryker Instruments, Kalamazoo, Michigan, USA) for all patients undergoing a primary unilateral total knee arthroplasty, under the care of one consultant surgeon. Prior to this, drain insertion was not a routine practice by this orthopaedic surgeon. The objective of this comparative study was to compare blood salvage and reinfusion with the practice of no drain insertion, with respect to post-operative haemoglobin levels, the requirement for allogeneic blood transfusions and complications encountered.

MATERIALS AND METHODS

Fifty two patients who underwent a cemented primary knee replacement (AGC®, Biomet) between November 2005 and November 2007 were involved in this comparative study. Twenty two of the 52 patients who all had a Stryker® CBC II Constavac reinfusion system inserted were matched for age, sex, type of implant and surgeon to 30 patients who had no drain inserted during surgery and were reviewed retrospectively. Transfusion records for each group were cross checked with the blood transfusion database for accuracy. Patients with a coexisting coagulopathy and those on warfarin were not included in the study for analysis.

All patients were operated upon by the same consultant orthopaedic surgeon or by an orthopaedic trainee, under his direct supervision. An above knee tourniquet was inflated to 300 mmHg prior to incision and a medial parapatellar approach to the knee performed. All patients received intravenous antibiotic prophylaxis at anaesthetic induction. The tourniquet was deflated following wound closure and application of sterile wool and crepe bandage outer dressing. The reinfusion drains were opened at 20 minutes post surgery. Salvaged blood was reinfused into the patient within 6-8 hours. As per post-operative instructions, patients had a haemoglobin check on post-operative day one and day three; they all received chemical thromboprophylaxis with low molecular weight heparin plus anti-embolic stockings and were mobile with physiotherapy input as soon as they were able. A departmental agreed protocol for proceeding with an allogeneic blood transfusion was used for all cases. Patients were transfused when their haemoglobin level

was 8 g/dl or below or when the level was between 8-10 g/dl, with the symptoms of anaemia present. This practice is supported by the British Orthopaedic Association Guidelines on blood conservation and transfusion (11).

Outcome measures compared included mean pre-op, day one and day three haemoglobin levels; the mean difference in haemoglobin levels between pre-op and day one post-op and day one and day three were also calculated. Mean length of hospital stay was also recorded for both groups as well as the incidence of transfusion and significant wound related complications in the post-operative period. Statistical analysis was performed with use of t-tests and chi square tests, using SPSS software (version 11; SPSS, Chicago, Illinois). A p value of below 0.05 was considered significant.

RESULTS

The non-drainage group comprised of 30 subjects, 9 of which were female and 21 male; the mean age was 69.3 years (range: 50-85 years); the reinfusion drain group comprised of 22 subjects of which 8 were female and 14 male; the mean age was 69.2 years (range: 55-87 years), p value 0.66. There was no significant difference in pre-operative haemoglobin levels between the two groups (table I).

In the reinfusion drain group the mean volume of blood drained from the knee was 645.5 ml (range: 100-1250 ml) and on average 76.9% (513.6 ml, range 150-1000 ml) of the reclaimed blood in the reinfusion drain group was transfused back. The drain stopped functioning in one case where the total output drained was 150 ml. The reason for this was not documented in the patient's record. All reinfusions of drained blood were done within 6-8 hours of surgery.

The mean Haemoglobin levels on day one and three post-op were significantly higher in the non-drainage group than in the reinfusion drain group. There was a significantly greater difference in haemoglobin levels observed between pre-op and day one post-op in the reinfusion group. A greater difference was also seen for haemoglobin levels between day one and three post-op for the reinfusion group, but this difference did not reach statistical significance (table I).

Table I. — Comparison of mean values between both groups

	Age (yrs)	pre-op Hb (g/dl)	Hb Day 1 (g/dl)	Hb Diff pre-op – Day 1 (g/dl)	Hb 3 (g/dl)	Hb Diff Day 1-3 (g/dl)	length of stay (days)
Non-drainage group	69.27	14.23	11.27	2.95	10.54	0.69	8.53
Reinfusion drain group	69.15	14.15	10.40	3.75	9.31	1.09	8.05
p value	0.66	0.93	0.03	0.029	0.006	0.266	0.71

In the non-drainage group, one patient required an allogeneic blood transfusion for Haemoglobin of 7.9 g/dl on day 3 post-op. In the reinfusion group, 9 patients received an allogeneic blood transfusion of 2 units within the first 72 hours following surgery. The Haemoglobin range was 7.7-9.4 g/dl. They had all received reinfusion of reclaimed blood within 6-8 hours post-op. In all patients who received an allogeneic transfusion, symptoms and signs of anaemia were present, which resolved following blood replacement. The difference between the two groups for allogeneic transfusion was statistically significant ($p = 0.003$). There were no reported complications following the allogeneic blood transfusions.

No significant wound complications, such as infection, wound breakdown or dehiscence and haematoma requiring a secondary procedure under general anaesthesia were encountered in either group. There was no significant difference in mean hospital length of stay post-op observed between the two groups.

DISCUSSION

We observed that this reinfusion system (CBCII Constavac) was operated with relative ease by the theatre recovery and ward nursing staff caring for the patient following surgery, with minimal technical issues. The transition from the practice of no drain insertion to routine use of a reinfusion drain was in an effort to seek a safe, reproducible and effective alternative to allogeneic blood transfusion should the patient require it. Our study highlighted that we have a relatively low requirement for blood transfusions following unilateral primary total knee arthroplasty and using a reinfusion drain did not

further reduce this need. In fact, our findings demonstrated a significantly higher rate of allogeneic transfusions, over and above the reclaimed blood in the reinfusion group. Reasons for this are not fully understood but it may be related to an increased volume of blood loss from the knee following surgery due to the negative pressure within the autotransfusion and closed suction drains. Parker *et al* 2004 (17) reported in their meta-analysis that drained wounds were associated with a significantly greater need for blood transfusions compared to no drains. We reported in our reinfusion drain group that the mean volume of blood drained was 667.9 mls (range : 100-1250 mls) and we reinfused a mean volume of 513.6 mls (range : 100-1000 mls), which was 76.9% of the mean drainage volume. The average amount we salvaged from the knee and reinfused was reflective of published data (1,10,15). Routine use of unwashed cell salvage systems have been recommended post-operatively for elective orthopaedic surgery, when blood loss is expected to be between 500-1000 ml (11). It is therefore reasonable to suggest that if closed suction drains are used, they should have the built in facility for reinfusion.

We postulate that blood loss may be less when no drain is inserted due to the tamponade effect of the knee's soft tissue envelope and this has been reflected in the significant difference observed between the study and control groups' haemoglobin levels on day 1 and 3 post surgery. Concerns have been highlighted with respect to post-operative wound healing and infection in the presence of a haematoma (17). We did not observe a higher rate of wound infection, breakdown and dehiscence, haematoma or reoperations for wound complications in the control group and this reflects the

findings some of the published literature comparing wounds treated with a drain and those treated without a drain (9,17).

The majority of studies published on blood salvage and reinfusion drains have compared them with standard closed suction systems and understandably, results have been better with respect to reducing allogeneic transfusion rates. However, the available literature comparing the use of no drains in total knee arthroplasty and reinfusion systems continues to be limited. Adalberth *et al* (1) randomised 90 total knee arthroplasty patients to receive no drain, an autotransfusion system or a closed suction drain. They reported no significant differences between the groups for mean haemoglobin and haematocrit levels post-op, drainage volume, requirement for allogeneic transfusions, knee swelling and range of motion or post-operative stay. Our findings differed with respect to the allogeneic transfusion rate, which we observed to be greater in the reinfusion drain group.

The weaknesses of the present study include the nonrandomised design, which did not allow for rigorous control of perioperative variables such as demographics and co-morbidities and small sample size.

CONCLUSIONS

Despite this study's limitations, we view the findings as valuable and it has impacted upon our practice. In our experience the use of reinfusion drains did not reduce the need for allogeneic transfusions over and above reclaimed autologous blood, when compared with no drain insertion and we cannot justify their routine use with primary unilateral knee arthroplasty. Reinfusion drains may well have a role in cases where blood loss is expected to be greater, such as revision arthroplasty and bilateral total knee arthroplasty. This study highlights the need for further research into this area, with a prospective randomised trial.

REFERENCES

1. Adalberth G, Brystrom S, Kolstad K, Mallmin H, Milbrink J. Postoperative drainage of knee arthroplasty is not necessary : a randomized study of 90 patients. *Acta Orthop Scand* 1998 ; 69 : 475-478.
2. Beirbaum B, Callaghan J, Galante J *et al*. An analysis of blood management in patients having a total hip or knee arthroplasty. *J Bone Joint Surg* 1999 ; 81-A : 2-10.
3. Blumberg N, Heal JM, Murphy P, Agarwal MM, Chuang C. Association between transfusion of whole blood and recurrence of cancer. *British Med J (Clin Res Ed)* 1986 ; 30 : 293 (6546) : 530-533.
4. Brunson ME, Alexander JW. Mechanisms of transfusion-induced immunosuppression. *Transfusion* 1990 ; 30 : 651-658.
5. Cheng SC, Hung TS, Tse PY. Investigation of the use of drained blood reinfusion after total knee arthroplasty : a prospective randomised controlled study. *J Orthop Surg* 2005 (Hong Kong) ; 13 : 120-124.
6. Cone J, Day L, Johnson GK, Murray DG, Nelson CL. Blood products : optimal use, conservation, and safety. *Instruct Course Lectures* 1990 ; 39 : 431-434.
7. Dalen T, Skak S, Thorsen K, Fredin H. The efficacy and safety of blood reinfusion in avoiding homologous transfusion after total knee arthroplasty. *Am J Knee Surg* 1996 ; 9 : 117-120.
8. Dramis A, Plewes J. Autologous blood transfusion after primary unilateral total knee replacement surgery. *Acta Orthop Belg* 2006 ; 72 : 15-17.
9. Esler CN, Blakeway C, Fiddlen 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.
10. Gannon DM, Lombardi AV, Mallory TH *et al*. An evaluation of the efficacy of postoperative blood salvage after total joint arthroplasty. A prospective randomised trial. *J Arthroplasty* 1991 ; 6 : 109-114.
11. Hamer AJ, Dobson PMS, Earnshaw PH, Knowles S, Newman JH. Blood conservation in elective orthopaedic surgery. Presented at the Annual Meeting of BOA 2005.
12. Han CD, Shin DE. Postoperative blood salvage and reinfusion after total joint arthroplasty. *J Arthroplasty* 1997 ; 12 : 511-516.
13. Kirkos JM, Krystallis CT, Konstantinidis PA *et al*. Postoperative re-perfusion of drained blood in patients undergoing total knee arthroplasty : is it effective and cost efficient ? *Acta Orthop Belg* 2006 ; 72 : 18-23.
14. Majkowski RS, Currie IC, Newman JH. Postoperative collection and reinfusion of autologous blood in total knee arthroplasty. *Ann R Coll Surg Engl* 1991 ; 73 : 381-384.
15. Mauerhan DR, Nussman D, Mokris JG, Beaver WB. Effect of postoperative reinfusion systems on haemoglobin level in the primary total hip and knee arthroplasties. A prospective randomised study. *J Arthroplasty* 1993 ; 8 : 523-527.
16. Moonen AF, Knoors NT, Van Os JJ, Verburg AD, Pilot P. Retransfusion of filtered shed blood in primary total hip and knee arthroplasty : a prospective randomised clinical trial. *Transfusion* 2007 ; 47 : 379-384.

17. **Parker MJ, Roberts CP, Hay D.** Closed suction drainage for hip and knee arthroplasty. A meta-analysis. *J Bone Joint Surg* 2004 ; 86-A : 1146-1152.
18. **Simpson MB, Murphy KP, Chambers HB, Bucknell AL.** The effect of post-operative wound drainage reinfusions in reducing the need for blood transfusions in elective total joint arthroplasty : a prospective randomised study. *Orthopedics* 1994 ; 17 : 133-137.
19. **Slagis SV, Benjamin JB, Volz RG, Giordano GF.** Postoperative blood salvage in total hip and knee arthroplasty. A randomised controlled trial. *J Bone Joint Surg* 1991 ; 73-B : 164-165.
20. **Spence RK, Sculco TP, Keating EM, Nelson CL.** Changing transfusion practices on orthopaedic surgery. *Orthopedics* 1995 ; 18 : 842-845.
21. **Thomas D, Wareham K, Cohen D, Hutchings H.** Autologous blood transfusion in total knee replacement surgery. *Br J Anaesth* 2001 ; 86 : 669-673.