



## Autologous blood transfusion after primary unilateral total knee replacement surgery

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**A prospective study was undertaken to assess the efficacy and financial cost of the use of an autologous blood transfusion device in the reduction of allogeneic blood requirements of patients undergoing primary unilateral total knee arthroplasty.**

**Forty-nine consecutive patients received either the CellTrans™ blood salvage device (group A of 32 patients) or the Redivac high vacuum drainage system (group B of 17 patients). The preoperative and postoperative haemoglobin levels were recorded at 72 or 96 hours.**

**Nine percent of group A patients received an allogeneic blood transfusion compared to 59% in group B. There was an average saving of 1.1 unit of allogeneic blood per patient in group A ( $p < 0.001$ ). The total cost per patient was about €111 less for the group A patients.**

**Autologous re-infusion was found in this study to be an effective method of reducing allogeneic blood requirements and to afford significant cost savings in primary unilateral knee arthroplasty.**

**Keywords :** blood drainage ; blood salvage ; autologous transfusion.

Blood transfusion has associated risks including transmission of infection, incompatibility reactions and increased postoperative infection rates (1). The cost of blood products is increasing as well and this has added enthusiasm among orthopaedic surgeons to decrease their use and minimise patient exposure to allogeneic blood. Techniques available include preoperative deposition, perioperative salvage, or postoperative wound drainage and reinfusion.

The aim of this study was to assess the efficacy and financial cost of postoperative reperfusion of drained blood in patients undergoing primary unilateral total knee arthroplasty.

### PATIENTS AND METHODS

Forty-nine patients undergoing primary unilateral total knee arthroplasty over a consecutive 30-day period were randomised into control (group B) and study groups (group A). In both groups the operation was performed utilising a tourniquet, which was released after

### INTRODUCTION

The need for blood transfusion after total knee arthroplasty is frequent. A review of the literature shows a need for allogeneic blood after 18% to 95% of total knee procedures in patients who do not predonate autologous blood (8).

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the application of pressure dressings. Deep and superficial drains were inserted before closure and connected either to a standard suction drain (Redivac) or to a CellTrans™ (Summit Medical) reinfusion system.

The drain calibre of the auto-transfusion and standard vacuum drains were 14 Ch and 10 Ch respectively. The drains were removed routinely at 48 hours.

Thirty-two patients (group A) received a postoperative blood salvage drainage system. This group consisted of 11 males and 21 females (age range 49 to 83, average 69 years).

Seventeen patients (group B) received a standard vacuum drainage system. This group consisted of 4 males and 13 females (age range 62 to 91, average 72 years).

Seven patients who were initially allocated in group B received an auto-transfusion drain and eventually included in group A.

In group A, a deep drain was connected to a Summit Medical CellTrans™ blood retrieval device, in which the blood was filtered through 40 µm filter before being reinfused.

Before closure of the wound, two drainage tubes were inserted. The tubes were connected through a Y-connector to the CellTrans™ assembly, which contains two transfusion bags.

The clamps remained closed for 20 minutes after the wound had been closed off. The drainage was started in the recovery room and collected for 6 hours or until 600 ml of blood had accumulated, at which point reinfusion took place. Therefore this device allows collection of up to 1200ml of transfusable blood or for up to a maximum of twelve hours. Thereafter the blood collected in the drains was discarded.

In group B, a Redivac vacuum drain was used whose contents were eventually discarded.

All patients received four perioperative doses of cefuroxime, and all implants were cemented with Palacos cement with gentamicin. All patients wore TED stockings and received thromboprophylaxis with aspirin 150mg once daily, starting on the first postoperative morning.

The preoperative haemoglobin level together with postoperative haemoglobin levels on the 3rd or 4th day were recorded. The proportion of the patients who had haemoglobin estimations at the fourth day was similar in each group. The external blood loss was measured in all patients, as was the volume of both allogeneic and autologous transfusion. The trigger for transfusing allogeneic blood was a post-operative Hb of less than 9.0g/dl or clinical symptoms of anaemia.

Table I. — Preoperative and postoperative haemoglobin levels in both groups.

Haemoglobin levels (g/dl)	Group A (Auto-transfusion drain)	Group B (Standard vacuum drain)
Preoperative	12.8	12
Postoperative	10.1	9.7

The transfusion policy was identical for both groups of patients throughout the duration of the study. All patients gave informed consent.

## RESULTS

During preoperative assessment all patients had haemoglobin estimations. There was no significant difference in the average preoperative values of 12.8 and 12.0 in groups A and B respectively (table I).

Three out of 32 patients in group A (9%) and 10 out of 17 patients in group B (59%) received an allogeneic blood transfusion. The total number of units of blood transfused was 6 and 22 in groups A and B respectively. No patients required blood transfusion after the second postoperative day. Furthermore, none of the patients who received allogeneic blood postoperatively had a haemoglobin value of more than 10g/dl.

Postoperative haemoglobin estimations were 10.1 and 9.7 in groups A and B respectively after blood transfusion (table I).

There was a difference in the allogeneic blood requirements of the two groups. On average, group A patients needed 0.2 units per patient of allogeneic blood compared with 1.3 units of blood per group B patient.

No patients suffered transfusion reactions.

Data was analysed using Student's 't' test. Using the CellTrans system significantly reduced the percentage of patients receiving allogeneic transfusion ( $p < 0.001$ ).

## DISCUSSION

In this study, the use of CellTrans Medical Summit Auto transfusion system showed that a sig-

nificant reduction in the use of allogeneic blood could be achieved in patients undergoing primary total knee replacements.

There are several methods of collecting and transfusing autologous blood: preoperative blood donation, perioperative cell salvage, on table haemodilution and postoperative blood salvage.

Postoperative wound drainage systems are particularly applicable to total knee replacement surgery as most of the blood loss is in the immediate postoperative period after release of tourniquet. Several studies have shown that autologous re-infusion is safe for use in joint arthroplasty (2, 5, 6). In drained blood the leucocyte and platelet counts are reduced. Despite complement activation as well as activated coagulation factors in the drainage blood, systemic activation after re-infusion does not appear to take place (4).

The identification of transfusion transmitted diseases such as Human Immunodeficiency viruses (HIV), hepatitis C (HCV) and new variant Creutzfeldt-Jacob (nvCJD) disease has led to an increasing number of tests which need to be performed before allogeneic blood transfusion. These tests have increased the cost of production of all red cell products considerably, therefore the use of blood salvage systems have been welcomed with enthusiasm by the orthopaedic surgeons and hospital managers in the United Kingdom.

The cost of each blood bank unit including laboratory costs is €179. The costs of the auto-transfusion device and the vacuum drain are €78.2 and €8.1 respectively. Therefore, the average cost incurred per patient in group A was €124.2 whereas the average cost per patient in group B was €235.2. Thus this system was cost effective and this has only been shown in one other study carried out in the United Kingdom (7).

Another significant factor in cost saving is the potential reduction in hospital stay, due to lower infection rates with autologous transfusions, which can be 2.5 times higher with allogeneic transfusions (3).

There are some limitations in our study. Initially a fairly even number of patients were allocated into the two groups. Some patients though, who were

allocated in group B eventually received an auto-transfusion drain and were added to the group A. The decision was taken by the surgical and / or the anaesthetic team based on the intraoperative blood loss and the general medical condition of the patient. Therefore, the two groups did not consist of an equal number of patients.

Also, it was not possible to conduct this study in a totally blind manner. The decision to transfuse allogeneic blood based on clinical symptoms of anaemia could be subjective and this could be a bias.

In conclusion, within the limitations of our study, we have found that re-transfusion of autologous blood is an effective and cost saving method in reducing the requirement for allogeneic blood transfusion. We therefore recommend the use of autologous blood transfusion drains in routine total knee arthroplasty.

## REFERENCES

1. **Breakwell LM, Getty CJM, Dobson P.** The efficacy of autologous blood transfusion in bilateral total knee arthroplasty. *Knee* 2000 ; 7 : 145-147.
2. **Chang-Dong H, Dong-Eun S.** Postoperative blood salvage and re-infusion after total joint arthroplasty. *J Arthroplasty* 1997 ; 12 : 511-516.
3. **Duffy G, Neal KR.** Differences in postoperative infection rates between patients receiving autologous and allogeneic blood transfusion : a meta-analysis of published randomised and nonrandomised studies. *Transfusion Med* 1996 ; 6 : 325-328.
4. **Han CD, Shin PE.** Post operative blood salvage and re-infusion after total joint arthroplasty. *J Arthroplasty* 1997 ; 12 : 511-516.
5. **Newman JH, Bowers M, Murphy J.** The clinical advantages of autologous transfusion. A randomised controlled study after knee replacement. *J Bone Joint Surg* 1997 ; 79-B : 630-632.
6. **Shenolikar A.** Cell salvage auto transfusion in total knee replacement surgery. *Transfusion Medicine* 1997 ; 7 : 277-280.
7. **Sinha A, Sinha M, Burgett S.** Reinfusion of drained blood as an alternative to homologous blood transfusion after total knee replacement. *Int Orthop* 2001 ; 25 : 257-259.
8. **Woolson ST, Wall WW.** Autologous blood transfusion after total knee arthroplasty. *J Arthroplasty* 2003 ; 18 : 243-249.