Introduction

It is imperative to justify blood transfusions on two accounts. First, there are public and medical concerns regarding transfusion-associated infections. Second, blood transfusions are costly [1]. Trauma and orthopaedics are the fourth largest medical field regarding consumption of blood. Methods of reducing intraoperative blood loss using pharmacological agents such as desmopressin (DDAVP; Ferring Pharmaceuticals) and aprotinin have not proved successful, although tranexamic acid reduced blood loss and blood transfusion after knee arthroplasty [2]. However there are increased risks of thromboembolic complications when tranexamic acid is used [3]. Intraoperative and postoperative autologous transfusions, salvaging blood lost during and after an operation using Solcotrans and Haemonetics Cell Saver IV, could prove as expensive as a blood transfusion and pose the theoretical problems of transfusing bone or cement debris. Preoperative autologous transfusion, a method in which preoperative donation of 2–4 units of red cells (typically 1 unit per week) for autologous transfusion at or after operation is increasingly practiced. This method, however, cannot be used in patients with unstable angina, aortic stenosis and severe hypertension. In addi-

Effects of knee flexion following knee arthroplasty on postoperative blood loss: a study on 50 patients

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Received: 11 September 2003
Accepted: 10 March 2004

Abstract Increased public and medical concerns regarding transfusion-associated infections and the cost involved in blood transfusion necessitate the imperative to justify transfusions. Since knee arthroplasties are often performed under tourniquet control, most blood loss occurs in the postoperative period. This makes this surgery ideally suited for evaluating techniques that decrease postoperative blood loss. A prospective study was carried out on 50 primary knee replacements (25 knees flexed, 25 knees extended) to evaluate the effect of maintaining the knee in 90 degrees of flexion in the immediate (24 h) postoperative period on postoperative need for transfusion. The volume of blood collected in the drains was used to estimate postoperative blood loss. Drop in haemoglobin was estimated by calculating the difference in preoperative and postoperative concentrations. Patients in the group with flexion of the knee lost a mean of 313 ml blood (2.0 g/dl drop in Hb); this was significantly less than that in the control (extension) group which lost 590 ml (3.2 g/dl drop in Hb). This decreased blood loss in the flexion group was reflected in the transfusion rates: 1 patient in the flexion group requiring transfusion compared to 6 patients in the extension group. Knee flexion following knee replacement is a simple yet effective method for decreasing postoperative blood loss and therefore transfusion rates.

Key words Knee arthroplasty • Postoperative flexion • Blood loss • Transfusion rate
tion, a number of issues militate against the wider application of this procedure. These include late: cancellation of surgery which could lead to waste; the fact that criteria for transfusion of donated units should be identical to those for ordinary units; and current UK guidelines that stipulate that autologous units be tested for the same range of markers of transmissible disease as homologous donations, which raises the costs and leads to ethical dilemmas if positive results are obtained [4–6].

Knee arthroplasties represent a sizable percentage of elective orthopaedic procedures. Moreover, since knee arthroplasties are performed under tourniquet control, most of the blood loss is in the postoperative period. Techniques at targeting postoperative blood loss should therefore decrease the need for blood transfusion in these patients. Therefore, I undertook a study on 50 patients undergoing knee arthroplasty to test the hypothesis that flexion of the knee in the immediate postoperative period would decrease postoperative blood loss and therefore transfusion rates.

**Materials and methods**

A total of 50 consecutive patients were recruited for this study. There were 16 males and 34 females with a mean age of 72 years (range, 49–87 years). The first 25 patients that gave an informed consent to have their knees flexed in the postoperative period formed the flexion group. The knee was maintained in 90 degrees of flexion in the immediate postoperative period for 24 hours. This was achieved using either a foam wedge or pillows folded below the knee. In the remaining 25 patients, the knee was left extended, according to normal practice, in the postoperative period for 24 hours. After 24 hours all patients received continuous passive movement for 2–3 days.

The study only included patients admitted for primary knee arthroplasty. Patients who had bleeding disorders or who were on anticoagulants in the preoperative period were excluded, as were patients who had previous knee surgery. All patients received non-steroidal anti-inflammatory drugs (NSAIDs) for analgesia preoperatively. A dose of 1.5 g cefuroxime was given intravenously shortly before the operation and two more doses of 750 mg were given at 6 and 12 hours after the first dose.

The PFC total knee prosthesis (Johnson & Johnson Professional Inc., Raynham, MA, USA) was used in all cases and inserted using standard technique. All prostheses were cemented using Palacos cement with gentamicin (Schering Plough, Kenilworth, NJ, USA). Three different surgeons performed the operations. All operations were performed under tourniquet control (250–350 mmHg) after the limb was elevated or exsanguinated. The tourniquet was released at the end of the operation only after bandaging the limb. In each knee, one intra-articular drain was used. The nursing staff removed the drains in the afternoon the day after surgery. Analgesia was achieved in all patients by a PCA (patient-controlled analgesia) system using morphine. This was substituted by NSAIDs after 24 hours. Patients also received 20 mg low molecular weight heparin for prophylaxis against deep vein thrombosis, which was started on the first postoperative day, and they wore thromboembolic deterrent stockings in the postoperative period. Postoperative blood loss was assessed by comparing the volume of blood in the drains at the time of their removal. Measuring the difference in preoperative and postoperative blood haemoglobin (Hb) in the 2 groups assessed the drop in haemoglobin. Postoperative haemoglobin was checked 48 hours after surgery.

The indication for blood transfusion in our department was not set at a specific value for Hb concentration or haematocrit level. Each transfusion was prescribed with regard to the patient’s age, general condition, fall in Hb and cardiovascular status. Blood transfusions were generally ordered when the postoperative Hb was less than 9 g/dl. Postoperative complications such as wound complications, thromboembolic complications or soft tissue haematomas were also assessed. Although there was no routine screening for thrombosis, clinically suspected thromboembolic complications were investigated with Doppler ultrasound or pulmonary scintigraphy.

**Statistical analysis**

Statistical analysis was performed with the use of the SAS statistical package (SAS Institute, Cary, USA) and included paired t testing and multiple analyses of variance. A value of p<0.05 was considered significant.

**Results**

The hypothesis that postoperative knee position affects the need for blood transfusion after knee arthroplasty was tested in 50 patients; the first 25 patients who consented to having the operated knee maintained at 90° for 24 h formed the flexion group (Table 1); the remaining 25 patients had the operated knee extended for 24 h (Table 2). Since all operations were performed using tourniquets, which were only released after bandaging the limbs after surgery, there was negligible intraoperative blood loss in all the patients (data not shown). The mean postoperative blood loss in the group who had their knees flexed after surgery was 313 ml (SD=117 ml); this value is significantly less (p<0.001) than that in the group who had their knees extended after surgery, i.e. 590 ml (SD=138 ml). The mean difference in preoperative and postoperative haemoglobin concentrations in the knee flexion group was 2.0 g/dl (SD=0.5 g/dl) while that in the knee extension group was 3.2 g/dl (SD=0.7 g/dl) (p<0.001). There was one superficial wound infection in the knee flexion group and none in the knee extension group. One patient in the knee flexion group received a blood transfusion compared to 6 patients in the knee extension group (p<0.001).

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