THE CLINICAL ADVANTAGES OF AUTOLOGOUS TRANSFUSION
A RANDOMISED, CONTROLLED STUDY AFTER KNEE REPLACEMENT

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We have carried out a randomised, controlled trial on 70 patients having unilateral total knee replacement in which transfusion was either with homologous bank blood or by reinfusion of unwashed blood salvaged after operation.

No complications or adverse effects were observed from reinfusion. The need for bank blood was reduced by 86% in the reinfusion group but, more importantly, the number of infective episodes was significantly less when the use of bank blood was avoided. The mean length of stay in hospital was also reduced by more than two days.

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Several studies have shown that salvage of blood after operation and reinfusion can reduce the need for homologous transfusion with its attendant risks.1-3 When undertaken in knee replacement it is a simple technique which is relatively inexpensive and comparable in cost to homologous transfusion.

Recent reports have suggested that there may be additional clinical and economical advantages in avoiding the use of homologous blood. In 1988 Tartter noted a lower incidence of postoperative infection in patients undergoing colorectal surgery when no homologous blood had been used. He suggested that transfused bank blood had an immunosuppressive effect. Similar observations have been made in other surgery.5,6 A comparable reduction in general infections after orthopaedic procedures has also been associated with the avoidance of homologous transfusion.7-10 None of these, however, was in a controlled, randomised study and all used preoperative collection rather than postoperative salvage as a means of providing blood for transfusion.

We report the clinical results of a randomised, prospective controlled trial in which transfusion in patients having total knee replacement (TKR) was either with homologous bank blood or by the postoperative salvage and reinfusion of unwashed blood.

PATIENTS AND METHODS

We obtained the approval of our ethical committee to carry out a randomised, controlled trial to assess the transfusion requirements, infection indicators and length of stay of patients having TKR.

We allocated 70 consecutive osteoarthritic patients having unilateral TKR with a cruciate-sparing Kinemax Plus (Howmedica Inc, Rutherford, New Jersey) prosthesis using random-number tables, to have transfusion with bank blood as required or to receive reinfusion of blood salvaged postoperatively. There was no specific stratification of the groups but they were broadly similar with a predominance of women, an average age of 72 years and similar haemoglobin levels before operation (Table I).

In both groups the operation was performed utilising a tourniquet which was released after the application of pressure dressings. Deep and superficial drains were inserted before closure and connected either to a standard haemovac or to the Dideco 797 reinfusion system (Sorin Biomedical UK Ltd, Midhurst, UK) which maintains a constant suction pressure of –25 mmHg. The drainage collected by the latter system was mixed with citrate in a ratio of 12:1 so that it was maintained in a suitable state for reinfusion and filtered during collection and again during reinfusion through a 40 μm filter; no washing took place. Drainage was collected for six hours or until 500 ml had accumulated, at which point reinfusion took place.

All patients received three perioperative doses (1g) of cephamandole, and all implants were cemented with Palacos cement with gentamicin. All patients wore TED stockings but no other form of thromboprophylaxis was used.
The postoperative management of the patient was left entirely to the discretion of the surgical team in charge. Homologous transfusion or oral iron was given to patients in either group if the responsible clinician felt that it was required because of clinical problems or anaemia. The decision to begin antibiotic therapy also lay with the surgeons treating the patient, as did the timing of discharge from hospital.

The blood loss was measured in all patients, as was the volume of both homologous and autologous transfusion. In all patients the haemoglobin level was measured on the first, third and seventh postoperative days.

Episodes of postoperative infection were assessed as planned prospectively. We noted all temperature readings over 38.5°C as well as infections seen on daily wound inspection. Antibiotic usage was recorded as was the length of stay after operation.

We performed statistical analysis using the chi-squared and Mann-Whitney tests.

RESULTS

There was no difference in the mean total postoperative drainage between the two groups despite the difference in suction pressure. The findings in the reinfusion group, however, were distorted by one very substantial loss of 3013 ml, for which no specific explanation was found. In both groups the mean drainage was approximately 900 ml. Reinfusion with a mean volume of 682 ml took place in 28 of the 35 patients in the autologous group. In six of the other seven patients drainage was insufficient to warrant reinfusion and in the remaining patient there were technical problems.

Only three of the 35 patients in the reinfusion group required supplementary bank blood compared with 28 of the 35 in the control group (p < 0.001). In total, only seven units of bank blood were used in the reinfusion group compared with 50 in the control group (p < 0.001), an overall saving of 86%. Despite this difference the postoperative haemoglobin levels were similar (Table I).

Temperatures greater than 38.5°C were recorded in four patients in the study group as compared with 16 in the control group (p < 0.001); three patients in the transfused group had infections of the urinary tract and there was one chest infection in the reinfused patients (Table II). The possibility of infection led to the prescription of antibiotics during the postoperative period in 12 of the control group but in only two of those who had autologous transfusion (p < 0.05), usually because of inflammation of the wound.

The average length of stay after operation was 12.6 days in the reinfused group and 15.2 days in the control group (p < 0.05).

There was no clinical evidence of deep-vein thrombosis, coagulopathy or impaired renal function in any of the patients although routine venograms and coagulation studies were not performed.

DISCUSSION

It is not possible to conduct a study such as this in a totally blind manner. It is unlikely, however, that the nursing staff responsible for charting the temperature would have biased their recordings. Although the method of management of the need for transfusion was recorded in the notes it is also improbable that this influenced the subsequent treatment. Similarly, discharge dates would have been determined by factors such as the patient’s general health, available support and circumstances at home. We therefore feel that the lack of blinding is unlikely to have been an important factor.

Our study has again confirmed the safety of postoperative infusion of unwashed blood after TKR and shown that considerable savings in the use of bank blood may be achieved. Our results compare favourably with those achieved with the Solcotrans systems, possibly because the Dideco equipment delivers citrate continuously at a predetermined ratio, so that small volumes of salvaged blood do not have to be discarded because of

| Table I. Haematological assessment (mean ± SD) of the homologous and reinfusion groups |
|---------------------------------|----------------|----------------|
|                                | Reinfusion (n = 35) | Homologous transfusion (n = 35) |
| Preoperative Hb (g/dl)         | 13.4 ± 1.2        | 13.2 ± 1.4     |
| One-week Hb (g/dl)             | 11.4 ± 1.4        | 10.9 ± 1.4     |
| Mean blood loss (ml)           | 896 ± 545         | 891 ± 401      |
| Mean volume reinfused (ml)     | 682 ± 360         | -              |
| Median homologous transfusion (units; range) | 0 (0 to 3) | 2 (0 to 4) |
| Number receiving homologous transfusion | 3                | 28*            |
| Number needing oral iron       | 0                | 10*            |
| Total homologous units for group | 7                | 50*            |

* p < 0.05

| Table II. Postoperative clinical observations in both groups |
|-----------------|----------------|----------------|
|                 | Reinfusion (n = 35) | Homologous transfusion (n = 35) |
| Temperature >38.5°C | 4             | 16*            |
| Antibiotic usage   | 2             | 12*            |
| Proven infection   | 1 (chest)     | 3 (urinary tract) |
| Mean (sd) length of stay in days | 12.6 ± 3.8 | 15.2 ± 5.3 |

* p < 0.05
excess citrate in the collected fluid.

Some reports from North America have questioned the requirement for postoperative reinfusion after unilateral TKR. Slagis et al. felt that the cost was not justified, but they routinely used a cell washer which we believe to be expensive and unnecessary. Marks et al. found that postoperative reinfusion was ineffective but they combined it with the preoperative collection of blood, and it is doubtful if both systems need to be used in the same patient. We believe that postoperative reinfusion alone is safe and effective after unilateral TKR, being the least troublesome and the least expensive of the available methods of autologous transfusion.

Previous studies have been concerned with safety and the saving of bank blood. Our study has shown clinical and economic benefits. The decrease in febrile reactions and general postoperative infection observed by Tartter has been confirmed. Although the reduction in antibiotic usage was considerable, the saving in cost was small since only short courses of oral agents were required. The reduction in the length of stay in hospital which probably related to anxiety about the possibility of infection, is welcome to both patients and hospital staff.

The exact mechanism which results in higher rates of febrile episodes and wound problems after homologous transfusion has yet to be determined but it seems that these problems can be reduced by avoiding the use of bank blood. It has recently been reported that hospitalisation costs more for patients having joint replacement when homologous transfusion is used. The use of a reinfusion technique after TKR can reduce costs by shortening the hospital stay as a result of less febrile and infective episodes.

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After this study was completed Sorin Biomedical Ltd agreed to pay £1000 towards the salary of the current transfusion fellow who is not an author. Other than this no benefits in any form have been received or will be received from a commercial party related directly or indirectly to the subject of this article.

REFERENCES