Do we really need to routinely crossmatch blood before primary total knee or hip arthroplasty?

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Background A maximum surgical blood ordering schedule may lead to wastage of valuable resources due to over-ordering of blood and/or under-utilisation. We audited the results of a group-and-save (GS) policy for primary hip (THR) and knee (TKR) arthroplasty to evaluate its safety and practicality.

Patients and methods We conducted a retrospective review of consecutive patients attending for THR (177) or TKR (137) over a period of 8 months (phase 1). Following introduction of a limited GS policy, 205 THR and 147 TKR were reviewed prospectively over a corresponding period of 8 months (phase 2). Corresponding THR and TKR groups in each phase were comparable with respect to age, gender, length of stay, operating surgeon, pre- and lowest postoperative hemoglobin, reason for and timing of transfusion. Quantities (units) of blood requested pre- and postoperatively, transfused and returned to the blood bank, were recorded.

Results 77 and 62% of all blood requested for THR and TKR, respectively, in phase 1 was not used. 58 and 21% of patients undergoing THR and TKR, respectively, in phase 2 underwent preoperative GS, with 92% and 100% of all blood requested being used for transfusion. Overall, the quantity of blood returned was reduced by 25% for the THR group. Transfusion rates fell by 9% and 5% for the TKR and THR groups, respectively. We found no adverse events associated with blood from a GS sample. Cost savings of 37 800 euros were calculated estimated for the study period (phase 2).

Interpretation For routine primary THR/TKR, GS policy is a safe procedure. Reduction in non-utilisation of blood has economic and cost-saving implications for limited healthcare resources. Having subsequently introduced a group-and-save policy for all patients undergoing routine THR/TKR, considerable savings have been identified after only 2 months. ■

The UK blood transfusion service currently produces about 2.5 million units of blood per year, of which about 70% are used for elective surgery (Contreras 1992). A proportion of this may not be actually used (Nuttall et al. 1998). The British Committee for Standards in Haematology have produced guidelines indicating that the number of units crossmatched versus the number transfused, the C/T ratio, should not exceed 2:1 (Roberts et al. 2000). Routine crossmatching of blood will result in a high C/T ratio, if this blood is not subsequently used for transfusion. High ratios indicate that the blood bank must maintain a large bloodstock with resulting implications in terms of cost, manpower and storage. To improve efficiency, some hospitals have introduced the maximum surgical blood order schedule (MSBOS) (Voak et al. 1990, Murphy et al. 1995). Blood is ordered for a procedure according to an agreed protocol. This was endorsed by the British Committee for Standards in Haematology in 1991 (Roberts 1991). The MSBOS, however, does not take individual patient requirements into account, and thus may still be wasteful. Scoring systems and surgical blood order equations have also been developed, to help identify the number of units of blood required for patients undergoing hip or knee arthroplasty, but even with these being used, inefficiencies may still occur (Larocque et al. 1998, Nuttall et al. 1998). This could be the result of initial under-ordering of blood with subsequent crossmatching being required, or it may simply be a reflection of transfusion practices unrelated to patient factors—such as unidentified variables influencing the physician's decision to transfuse, or uncertainty about the relationship between hemoglobin levels and perioperative mortality (Larocque et al. 1998).

In attempting to address this problem of inefficiency and ever-increasing costs of blood products, we decided to introduce a group-and-save policy for primary hip and knee arthroplasty. A group-and-save approach involves ABO and RhD grouping and antibody screening of the recipient, as well as a computer or manual check of records. If no clinically significant antibodies are detected, blood can be provided rapidly following a 'spin' crossmatch to exclude a labeling error by the blood transfusion service (Gower et al. 1998, Wood 2000). This process takes about 15 min. A full crossmatch involves the above, plus incubation of the patient's serum with donor cells to ensure compatibility. This can take up to 1 hour (Wood 2000). The aims of the study were to determine whether such a policy is safe, practical, economical and worthwhile.

Patients and methods

The study consisted of two phases. Phase 1 was a retrospective review of all consecutive patients attending for routine primary hip (THR) and knee (TKR) arthroplasty during the period January 1, 2000 to August 31, 2000. Patients were identified from the hospital admissions database using the ICD-10-CM codes W40.1 and W41.1 for cemented and uncemented TKRs, respectively, and W37.1 and W38.1 for cemented and uncemented THRs, respectively. Data recorded included age, gender, length of hospital stay, grade of operating surgeon, and also preoperative and lowest postoperative hemoglobin levels. Information regarding the number of units of blood requested pre- and postoperatively, used for transfusion, and returned to the blood bank was recorded. Demographic and operative data were obtained by review of the medical records. Blood results and information regarding crossmatching of blood was obtained from the hospital hematology database system. The request or use of other blood products such as fresh frozen plasma or platelets was not recorded. The timing and clinical reason for any transfusion was noted. The decision to transfuse intra-operatively, if required, was left to the anesthetist. Postoperative hypotension was treated initially with colloids. Patients were transfused postoperatively if they had continual hypotension that was unresponsive to colloid or crystalloid therapy, or if they developed symptomatic anemia – postural hypotension, lethargy or exacerbation of angina. The decision to transfuse postoperatively was undertaken by the surgeon team responsible for the patient. Asymptomatic patients were transfused if their postoperative hemoglobin was < 8 g/dL, according to preexisting guidelines within the department. Data in phase 1 were collected by a single observer (GM).

Following identification of a problem with over-ordering of blood, a group-and-save (GS) policy was introduced by two consultants (the two senior authors) in the department. Subsequently, all of their patients undergoing routine primary THR/TKR had a preoperative GS as opposed to crossmatch. (Identification of clinically significant antibodies resulted in the patient having a routine crossmatch prior to surgery). This constituted phase 2 of the study. Prospective data were collected as before for the period January 1, 2001 to August 31, 2001. In addition, any episodes of patient safety being compromised due to awaiting blood from a GS sample were recorded. Information was collected by a single observer, who was different to the one used in phase 1 (KH).

Statistics

Continuous and categorical variables were compared using Student's t test and the χ^2 test, respectively. A probability level of < 0.05 was considered significant.

Results

THR groups

In phases 1 and 2, 177 and 205 patients (respectively) underwent primary THR. All records were reviewed. The two groups were similar regarding age, gender, length of hospital stay, grade of sur-

Demographic data for the THR and TKR groups

	THR phase 1 (n=177)	THR phase 2 (n=205)	P-value	TKR phase 1 (n= 137)	TKR phase 2 (n= 147)	P-value
Gender (% male)	38	42	0.5	43	38	0.3
Age (years, mean (SD)	68 (12)	68 (12)	0.6	72 (9)	72 (8)	0.5
Preop. hemoglobin, g/dL, mean (SD)	13.3 (1.4)	13.3 (1.3)	0.9	13.4 (1.4)	13.5 (1.3)	0.3
Postop. haemoglobin, g/dL, mean (SD)	9.6 (1.4)	9.6 (1.5)	0.9	9.5 (1.5)	9.5 (1.6)	0.6
Mean length of stay, days, mean (SD)	9.4 (3.7)	9.1 (4.2)	0.5	9.8 (5.1)	9.3 (4.1)	0.1
Consultant performing procedure (%)	64	72	0.2	69	62	0.3

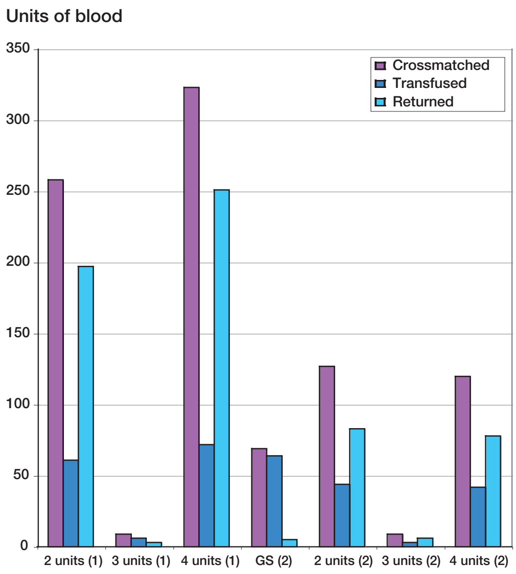

Figure 1. Differences in blood use between phases 1 and 2 – THR group.

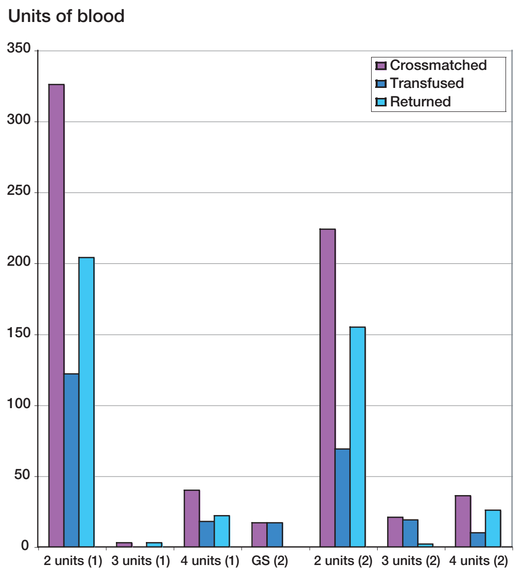

Figure 2. Differences in blood use between phases 1 and 2 – TKR group.

geon, and pre-/post-hemoglobin levels (Table). In phase 1, most patients (62%) had 2 units requested preoperatively and in total, 590 units were requested preoperatively. The use of blood requested is shown in Figure 1. 57 patients (32%) were transfused using a total of 139 units, an average of 2.4 units per person. The remaining 120 patients had 451 units (77%) of blood requested which was returned to the blood bank. This represents a "wastage" of 3.8 units per person.

In phase 2, 58% of THR patients underwent preoperative GS. The total number of units requested overall was reduced to 325. Details of blood usage are given in Figure 1. 57 patients (28%) were transfused using a total of 153 units, an average of 2.7 units per person. This was not significantly different from phase 1 (p = 0.5). The remaining 148 patients had 172 units (52%) requested which was returned. This represents a "wastage" of 1.2 units per person.

TKR groups

137 and 147 patients underwent primary TKR in phases 1 and 2, respectively. The groups were comparable (see Table). In phase 1, 126 patients (92%) had 2 units crossmatched preoperatively, with a total of 369 units being requested. The use of blood requested is shown in Figure 2. 56 patients (41%) were transfused with a total of 140 units, an average of 2.5 units per person. The remaining 81 patients had 229 units (62%) requested, which was returned to the blood bank. This represents a

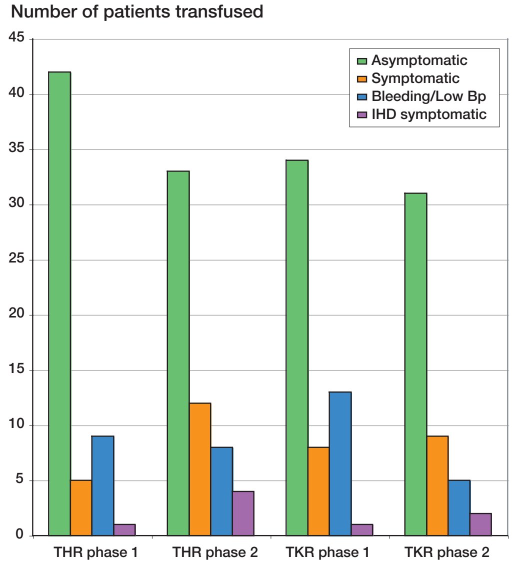

Figure 3. Reasons for transfusion.

'wastage' of 2.8 units per person. Only 31 patients (21%) had a preoperative GS sample in phase 2. Of these, all subsequent blood requested was used for transfusion. The total number of units requested in phase 2 was reduced to 298. Details of blood usage for phase 2 are given in Figure 2. 47 patients (32%) were transfused with 115 units, an average of 2.4 units per person. This was not significantly different from phase 1. 183 units (61%) were returned to the blood bank, which represents a 'wastage' of 1.8 units per person.

There were no instances recorded of patient safety being compromised due to awaiting blood from a GS sample, in either the hip or knee groups. No patients were transfused intraoperatively. For the most part, the patients transfused were asymptomatic (Figure 3).

Discussion

The patients in both phases compare well in terms of age and sex with previous reports of patients undergoing primary joint replacement (Bierbaum et al. 1999). It must be noted, however, that the two groups were not part of a randomized controlled trial and differed only in the timing of the group and in whether or not the group-and-save policy had been implemented.

The transfusion rates in phase 1 of 32% for the THR group appear to be lower than reported previously, whereas the corresponding transfusion rates of 41% for the TKR group are comparable (Bierbaum et al. 1999). It has been shown recently that high transfusion rates may be a reflection of availability of blood, and not of medical indications (Sudhindran 1997, Roberts et al. 2000). This practice may expose patients to unnecessary risks associated with blood transfusion. Further unnecessary allocation of blood units may cause a delay in crossmatching of blood in emergency situations (Roberts et al. 2000).

The introduction of a maximum surgery blood order schedule and the use of surgical blood order equations have attempted to address the problem of high C/T ratios. These rely on a locally agreed tariff of blood ordering or on preoperative factors such as hemoglobin level, weight and type of surgery. They are still not completely efficient (Murphy et al. 1995, Larocque et al. 1998). Hadjianastassiou et al. (2001) revealed inconsistent transfusion guidelines in their practice. They suggested some guidelines including 1) adoption of a group-and-save (GS) policy for primary TKR surgery, 2) transfusion only at a certain "trigger" level – namely, if the patient's hemoglobin is < 8 g/dL – and if transfusing, to transfuse with at least 2 units.

Two previous studies have established that a GS policy can result in economic savings, but these studies were relatively small and no information was given regarding the criteria for transfusion (Mackay et al. 1995, Gower et al. 1998). In our department, we had already implemented a transfusion trigger of < 8 g/dL prior to commencing the study. This may be reflected in the lower transfusion rates observed initially. It has also been shown in hip fracture patients that mortality is unaffected by transfusion when the pre-transfusion hemoglobin is > 8 g/dL (Carson et al. 1988). In our department, patients with a history of ischemic heart disease or symptoms attributable to anemia or hypotension not corrected by crystalloids or colloids are transfused at higher levels if required.

The results of phase 1 revealed considerable returns of unused blood. 77 and 62% of units requested for THR and TKR, respectively, were not used for transfusion. In all, 680 units of a total of 949 units requested were not used. This represents a C/T ratio of 3.5:1, which is much higher than the recommended level of 2:1. Currently, it costs 118 euros to crossmatch one unit of blood in our hospital. This charge is passed on to the hospital by the regional transfusion centre. In comparison, a group-and-save approach costs approximately 14 euros. Thus, theoretically, in phase 1 the sum of 80,539 euros was spent by the department for the preparation of blood that was not actually transfused.

Following introduction of the GS policy, 60% of the THR group underwent GS. This resulted in a considerable fall, 25%, in blood being returned to the blood bank. The corresponding reduction in the TKR group was smaller; but only 20% of these patients underwent a GS, probably as a reflection of the fact that the senior authors' work is mainly hip-based. Transfusion rates were also noted to fall, by 5% and 9% respectively, in the THR and TKR groups, although this was not significant. This may be a reflection of blood becoming less readily available, and also a reflection of greater awareness within the department and stricter adherence to transfusion guidelines. It must be noted that the two senior authors are primarily hip surgeons, and this may be reflected in a lower transfusion rate compared to surgeons performing fewer hip replacements. Phase 2 revealed that 355 out of 633 units crossmatched were not used. The CT ratio fell to a more reasonable figure of 2.3:1, and the cost of unused blood fell to a theoretical ∈ 42039, representing a saving of 38 500 euros compared to the previous year.

The average number of units transfused varied from 2.4–2.7 per person. This is in agreement with the recommendations advocated by Hadjianastassiou et al. (2001).

From these results, and to complete the audit cycle, we introduced a group-and-save policy for all patients in the department undergoing primary joint replacement, in February 2002. We reviewed the results after two months. 38 patients underwent THR. 7 of these (18%) were transfused with an average of 2.6 units each. All 18 units requested were used. 39 patients underwent TKR. 6 were transfused with an average of 2.3 units each. All blood requested was transfused. Thus, the C/T ratio in our department is currently 1:1, which easily falls within the remit of the standards recommended by the British Committee for Standards in Haematology (Roberts et al. 2000).

Conclusion

A group-and-save policy appears safe, practical, very worthwhile and considerable economic savings can be achieved. We continue to use this approach in our department, and we recommend this practice to ease the burden on the commonly overstretched blood transfusion service.

No competing interests declared.

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