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Audit

A one-centre prospective audit of peri- and postoperative blood loss and transfusion practice in patients undergoing hip or knee replacement surgery

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We prospectively audited peri-operative blood loss and blood transfusion practice in 42 elderly patients (mean age, 71.8 years, 68% female) undergoing hip or knee surgery in an orthopaedic unit. Only in 57% of all operations was blood loss recorded. Compliance with the Maximum Surgical Blood Ordering Schedule (MSBOS) was variable, and Cross-matching to Transfusion (C/T) ratios were low. In 86% of operations, blood had been issued pre-operatively (average three units, range = 1–61 units). Of these patients, 75% subsequently received a transfusion. In 26% of all the operations, the transfusion, although confirmed by the blood transfusion laboratory records, had not been recorded in the medical or nursing notes. The average pre-operative Hb in the transfusion group was 123 g/l (range, 80–144 g/l) and 112 g/l postoperatively and after a transfusion (range, 75–133 g/l). This compared to the non-transfusion group's value of 124 g/l (range, 86–186 g/l) and 113 g/l (range, 77–147 g/l) postoperatively. The high blood issuing and transfusion rates raise the concern that transfusions are being given in response to habit or blood availability, and not medical indications. This would imply that some patients are exposed to unnecessary risks. Furthermore, inadequate documentation of the transfusion process opens the medical profession to criticism and medical, legal and ethical complications regarding patient care. Positive improvements suggested by regular medical audit may help address these problems.

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Increased public and medical concerns regarding transfusion-associated infections such as with HIV, hepatitis C and prions, necessitate the imperative to justify transfusions,[1] and audit to improve transfusion practice has been widely encouraged.[2]

Medical audits establish a focused structure for quality assessment and improvement in the delivery of health care. A transfusion audit can provide education to doctors, blood bank technologists and nurses, who can all influence transfusion practice. They can be involved in reviewing and improving documentation of transfusions and related events, such as blood loss, after surgery. Proper documentation is necessary, as blood loss or transfusion records may aid the management of subsequent clinical complications such as maintaining fluid balance or understanding a patient's postoperative status. Furthermore, the universal concept of the accountability of blood products for safety reasons is undisputed. Deaths due to mistakes in identifying and matching blood are still a major complication following blood transfusions.[3] Poor documentation may also lead to wastage of blood in the longer term, and this carries financial implications and further depletes valuable blood reserves.

As part of a commitment to providing quality patient care, relevant information such as the degree of blood loss experienced, pre-operative and postoperative haemoglobin (Hb), and transfusion requirements should be adequately documented.[4] Because of the frequent requirements for transfusions in orthopaedic surgery and the perceived variations in blood usage, we collected relevant data to review documentation and patterns of transfusion practice and blood issuing in 42 patients undergoing hip or knee surgery (mean age, 71.8 years; 32% male, 68% female).

Patients and Methods

Selection of patients

We consecutively assessed the peri-operative blood status and blood transfusion requirement of 42 patients undergoing hip or knee surgery for orthopaedic (osteo-arthritic) or traumatic (hip fracture) problems. All patients who attended hospital during the study period in October 1997 and were to undergo dynamic hip screw (DHS) and cemented hemi-arthroplasty operations were included.

Design of the questionnaire and collection of data

A questionnaire was designed to record relevant information. Pre-operative and postoperative haematocrit (Hct) and haemoglobin (Hb), the degree of peri-operative and postoperative blood loss (where indicated), and the number of transfusion units given (if any) were recorded. Data were obtained from the medical, nursing and operation notes on successive ward visits.

Follow-up

The Blood Transfusion Service (BTS) of the North-East of Scotland records were checked to see if they coincided with the information gained from the patient's hospital notes. Medical records (case notes and reports sections) were also retrieved 3 months after the end of this phase of the study to ensure information gathered on the ward had not been incomplete.

Analysis of data

Data were collated to establish the patterns of blood loss, and the frequency and volume of blood transfused. The patients' hospital notes and BTS records were assessed for this purpose. Based on the Hct and Hb values, as well as the blood loss and medical status of the patient, the criteria for blood transfusions were evaluated. MSBOS (Maximum Surgical Blood Ordering Schedule) compliance was also assessed and the cross-matching to transfusion (C/T) ratio was calculated. Data were stored and analysed on Microsoft Excel '97 (Viglen Pentium: 200MMX).

Results

The proportions of the four surgery types are displayed in Figure 1. Of the 42 patients, 39 had complete records held on the BTS database, and 37 records were retrieved at follow-up. Of these 37, we established that 32 had blood routinely issued pre-operatively (44% had 3 units issued; range, 2–6 units). According to the BTS records, 82% of these patients went on to receive a blood transfusion. One patient received one unit, 18 received two units, five received three units and two received received four units (Fig. 2). In 26% of the cases, transfusion records in the medical notes did not confirm those held on the BTS database. In over half of these cases, this was because the medical notes did not have

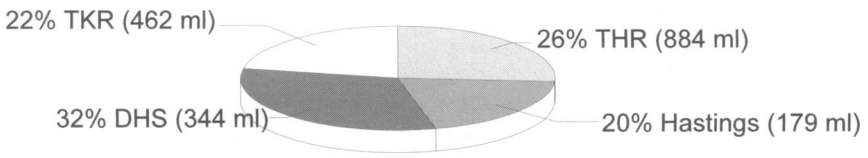

Figure 1 Representation of the different surgery types. Mean blood losses for each surgery type are in brackets. TKR, total knee replacement; THR, total hip replacement; DHS, dynamic hip screws; Hastings, cemented hemi-arthroplasty

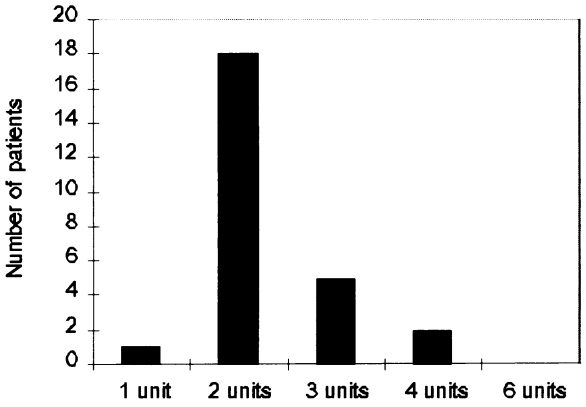

Figure 2 Patterns of blood administration according to BTS records

Table 1 Maximum Surgical Blood Ordering Schedule compliance and crossmatched-to-transfused ratios for the four surgery types

	MSBOS Compliance	Patients cross-matched ($n = 37$)	Patients transfused ($n == 27$)	C/T ratio
DHS	65%	10	7	1.4:1
Hastings	84%	8	3	2.6:1
THR	64%	10	10	1:1
TKR	74%	9	7	1.3:1

TKR, total knee replacement; THR, total hip replacement; DHS, dynamic hip screws; Hastings, cemented hemi-arthroplasty

the necessary form (North-East of Scotland Blood Transfusion form) despite the BTS typically having issued three units. In two cases, a total of six units were unaccounted for, as no blood was transfused but only 3 of the 9 units issued were returned to the blood bank. Furthermore, one patient only received one transfusion unit as a routine measure. Finally, in the other two cases, blood was not issued according to the BTS records, yet a BTS form was discovered in the medical notes that stated that blood had been issued routinely.

Only in 57% of all operations was blood loss recorded. The patients who received a transfusion had an average pre-operative Hb of 123 g/l (range, 80–144 g/l) and of 112 g/l postoperatively (range, 75–133 g/l). This compared to the non-transfusion group's values of 124 g/l (range, 86–186 g/l) and 113 g/l postoperatively (range, 77–147 g/l). MSBOS compliance was generally high, especially in the cases of Hastings and TKR operations. The cross-matching to transfusion (C/T) ratios for the four techniques are displayed in Table 1.

Eight patients had hypertension, 13 cardiovascular disease (five angina), eight had pulmonary disease (mostly COAD); there were also three cases of diabetes mellitus and three patients had a previous history of cancer. Only two patients had anaemia and, according to BTS records, they received two and three units of blood, although the medical notes could not confirm one of these transfusions.

Discussion

The high number of patients receiving blood routinely issued pre-operatively (32 of 37), with the subsequent high transfusion rate of 82%, raises the concern that transfusions are being administered due to habit rather than medical indications. This may, in some instances, represent less than optimal peri-operative care, as patients may develop complications due to an inappropriate transfusion. In addition, if units of blood are unnecessarily allocated to individual patients, emergencies requiring rapid cross-matching may be delayed because the blood bank reserves are depleted.

The British Committee for Standards in Haematology formulated guidelines outlining that, in general, the ratio of the number of units ordered and the number of units transfused should not exceed 2:1. As shown in Table 1, the C/T ratios comply with this for all the procedures except the Hastings operations. Indeed the THR operations had a high MSBOS compliance with a C/T ratio of one. This means that all those undergoing a THR and who had blood cross-

matched, went on to receive a transfusion. The DHS and TKR C/T ratios are also satisfactory reflecting that transfusion was preceded by routine cross-matching. The good MSBOS compliance with such C/T ratios could suggest that blood transfusions were being used optimally, without wastage of ordered blood products. However, one could argue that some of these blood transfusions were being given in response to immediate availability and habit as the MSBOS does not take into account individual differences in blood requirements for the same procedure.

Assuming that each transfusion unit raises the Hb by around 10 g/l,[5] one can estimate that the average post-operative (before a two unit transfusion) Hb levels for those in this study would have been around 90–92 g/l. Weiskopf *et al.*[6] investigated the effects of anaemia in 32 healthy volunteers and patients. Acute isovolaemic reduction of Hb to 50 g/l did not result in detectable inadequate oxygenation. Although not advocating allowing postoperative Hb in surgical patients to sink to 50 g/l, the authors suggested that patients without cardiovascular or pulmonary disease need not be given a transfusion unless their Hb fails to less than 60–70 g/l. Although other factors, such as major co-morbidity, are not taken into account in this study, the observations suggest that there was overuse of blood transfusions. In a recent study of 8787 hip fracture patients (60 years or older), Carson *et al.*[7] reported that 42% underwent a postoperative transfusion. Analysis of the data to establish the benefits of transfusions, and the trigger haemoglobin levels at which a transfusion should be given, concluded that a postoperative haemoglobin level of 80 g/l or more did not seem to affect the 30 or 90 day mortality rate.

A further worrying finding in our audit was that in 26% of operations, transfusion records in the medical notes did not match those held by the BTS. This is a large figure and, at best, implies inadequate records, but at worst, it could represent cases where administration of blood products was not recorded. The possibility of having a significant minority of transfusions not following standard practice raises great concern.

Metz and his colleagues[8] claimed that 10–16% of transfusion units were given inappropriately. Soumerai *et al.*[9] reported that, after a brief intervention consisting of a short lecture followed by printed guidelines, the number of transfusions not in compliance with pre-determined criteria decreased by 40% in the study surgeon group, compared with a 9% increase in the control surgeon group. This strongly suggested that availability rather than clinical indications were prompting many transfusions. Toy[10] reported how one audit-style review brought inappropriate transfusions down from 1.4% to 0%. Furthermore, all transfusions which did not meet with the predetermined screening requirements fell from an initial 3.2% to 0.5% after the review year. These changes represent quantifiable improvements in transfusion practice. Not only were fewer patients unnecessarily exposed to the risks of transfusion, but the blood resources were also being used more effectively. Other studies also suggest that inappropriate blood transfusions continue to be administered to a large extent. Sudhindran[11] reported that, during his study period, 53% of units transfused violated the recommended guidelines. He reported that these transfusions were given largely to bleeding, yet haemodynamically stable, patients, or to patients whose haemoglobin simply had fallen below 100 g/l. He called for objective and easily adaptable guidelines for the purposes of blood transfusion.

It is increasingly evident there is a need to review the risks *versus* benefits of transfusions of blood and blood products. The risks remain, but the benefits of blood transfusions are no longer uniformly accepted. This shift in thinking should be met by raising the awareness of good transfusion practice, and modifying transfusion guidelines where appropriate.

Conclusions

The practice of routinely ordering and administering blood without clear medical indications continues and deserves closer attention. Use of patient-specific factors such as pre-operative Hb, age, weight, associated illness, medication and estimated blood loss may help reduce inappropriate transfusions and lower costs. Regular medical audits to raise awareness and improve the appropriateness of transfusions not only will provide tangible benefits to the patient, but to the health service as a whole.

References

1. Nicholls MD. How safe is blood? *Anaesth Intensive Care* 1993; **21**: 13–4.
2. Hartigan G. National audit of the quality of the clinical blood transfusion process. *J R Coll Physicians Lond* 1996; **30**: 36.
3. Contreras M. *ABC of Transfusion*, 2nd Edn. London: BMJ Publishing, 1992.
4. Mintz PD. Quality assessment and improvement of transfusion practices. *Haematol Oncol Clin North Am* 1995; **9**: 219–320.
5. Hope RA, Longmore JM, Hodgetts TJ, Ramrakha PS. *Oxford Handbook of Clinical Medicine*, 3rd Edn. Oxford: Oxford

University Press, 1996.
6. Weiskopf RB, Viele MK, Feiner J, Kelley S, Lieberman J, Noorani M *et al.* Human cardiovascular and metabolic response to acute, severe isovolemic anemia. *JAMA* 1998; **279**: 217–22.
7. Carson JL, Duff AMHS, Berlin JA, Lawrence VA, Poses RM, Huber EC *et al.* Peroperative blood transfusion and postoperative mortality. *JAMA* 1998; **279**: 199–205.
8. Metz J, McGrath KM, Copperchini ML, Haeusler M, Haysom HE, Gibson PR *et al.* Appropriateness of transfusions of red cells, platelets and fresh frozen plasma. An audit in a tertiary care teaching hospital. *Med J Aust* 1995; **162**: 572–3,
9. Soumerai SB, Salem-Schatz S, Avorn J, Casteris CS, Ross-Degnan D, Popovsky MA. A controlled trial of educational outreach to improve blood transfusion practice. *JAMA* 1993; **270**: 961-6.
10. Toy PTCY. Effectiveness of transfusion audits and practice guidelines. *Arch Pathol Lab Med* 1994; **118**: 435–7.
11. Sudhindran S. Perioperative blood transfusion: a plea for guidelines. *Ann R Coll Surg Engl* 1997; **79**: 299–302