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Medical audit

An audit on the blood transfusion requirements for revision hip arthroplasty

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The hospital transfusion committee of Swindon and Marlborough NHS Trust had formulated a maximum surgical blood ordering schedule (MSBOS) which included the standard practice of 6 units of blood for revision hip arthroplasty. A retrospective audit of 73 patients who underwent revision hip arthroplasty over a year was undertaken to identify current practice and to ensure that the standard was adequate for patient safety. Information regarding the number of units requested, number of units transfused, pre-operative haemoglobin (Hb), lowest postoperative Hb and number of additional units of blood requested within 3 days postoperatively, was collected from patients' case-notes. Of the 73 patients, 80.3% received less than 6 units, 12.2% received 6 units and 7.5% received more than 6 units. Based on pre-operative Hb, blood usage was analysed. Of cross-matched units, 92.3% were used when pre-operative Hb was < 12 g/dl, 64.4% were used when Hb was between 12.1–13.0 g/dl, 54.3% were used when the Hb was between 13.1–14.0 g/dl, 38.9% were used when Hb was between 14.1–15.0 g/dl and 39.7% used with pre-operative Hb of > 15.0 g/dl. Of the total, 14 patients had a postoperative Hb of < 9 g/dl for whom additional units of blood were ordered and given to achieve a Hb of between 10.1–14.2 g/dl prior to discharge. This audit suggests that in patients with pre-operative Hb of 13 g/dl or more, the cross-match could be 4 units instead of 6 units for revisions.

Key words: Blood transfusion – Revision hip arthroplasty – Audit – MSBOS

Increased public and medical concerns regarding transfusion-associated infections and the cost involved in blood transfusion necessitate the imperative to justify transfusions.[1] As part of the rationalisation of their blood transfusion requests, the Hospital Transfusion Committee of Swindon and Marlborough NHS Trust had formulated a maximum surgical blood ordering schedule (MSBOS) which included the standard of 6 units of whole blood for revision hip replacement.

An audit was undertaken by the orthopaedic department to identify current practice, to assess compliance with standard and to ensure the best practice in the ordering and use of blood transfusion for patients undergoing revision hip replacement.

Patients and Methods

All patients who underwent revision hip replacements over a year were included in the audit. The sample consisted of 73 patients, 66 of whom underwent single stage revision and 7 of whom underwent two stage revision (removal of hip replacement and insertion of

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Table 1 Standards agreed for this audit

Criteria	Standards	Exceptions
A maximum of 6 units of blood to be requested for revision hip replacement (MSBOS)	100%	Units of blood requested for use pre-operatively where Hb was low on admission
The ratio of requested units: transfused units (MSBOS standard)	Ratio of 2 or less	Surgery cancelled or patient died prior to surgery
Patient safety to be assured by postoperative Hb of not less than 9 g/dl	100%	None

Table 2 Results of blood usage for single stage revisions

Pre-operative Hb (g/dl)	Patients (*n*)	Patients who had 6 units cross-matched (%)	Mean units of blood used (units)	Cross-matched units of blood used (%)	Change in Hb range (g/dl)	Additional units of blood cross-matched (units)
10.1–12.0	4	100	5.2	92.3 (24/26)	1.0 to –1.7	4 in 1 patient
12.1–13.0	16	100	5.2	64.4% (58/90)	0.2 to –5.7	25 (20, 3 and 2, respectively for 3 patients)
13.1–14.0	20	100	3.6	54.3% (63/116)	–1.2 to –6.6	13 1 patient
14.1–15.0	15	100	2.8	38.9 (35/90)	–1.7 to –6.3	8
> 15.0	11	100	2.5	39.7 (25/63)	–1.7 to –7.5	3

antibiotic impregnated cement as the first stage followed by re-insertion of the hip prosthesis at a later date as the second stage). Of the total, 66 patients (32 male, 34 female) underwent single stage revision and 7 patients (5 male, 2 female) underwent two stage revision. The age range was 47–92 years (mean, 69 years).

Data regarding the number of units of blood requested, number of units of blood transfused, pre-operative haemoglobin (Hb, g/dl), lowest postoperative Hb (g/dl) and number of additional units of blood transfused were collected retrospectively from the patients' case-notes. This was later transferred to a computer database (Microsoft Excel) for analysis. The standards agreed for this audit are shown in Table 1.

Results

We had the following compliance rates with the cross-match:transfusion ratio (C:T ratio) of 2:1: 71.2% (47/66 patients) for single stage revisions, 71.4% (5/7 patients) for the first stage of a two stage revision and 85.7% (6/7 patients) for the second stage of a two stage revision. The results are broken down by pre-operative haemoglobin and type of revision.

One stage revision

The data are summarised in Table 2.

Pre-operative Hb 10.1–12.0 g/dl (*n* = 4)
A total of 26 units were ordered for surgery, 24 (92.3%) were used and no units were ordered postoperatively. Blood usage in this group ranged from 4– 0 units (mean, 5.2 units). Change in the Hb ranged from +1.0 to –1.7 g/dl (mean, –0.5 g/dl).

Pre-operative Hb 12.1–13.0 g/dl (*n* = 16)
A total of 90 units were ordered for surgery, 58 (64.4%) were used. For one patient, an additional 20 units were ordered during surgery, 18 (90%) of which were used and a further 8 units were ordered postoperatively which were all used (100%). This patient had a deep venous thrombosis following previous hip replacement and was put on a heparin infusion on the day prior to revision surgery. One patient, a tablet-controlled hypertensive with a postoperative Hb of 7.2 g/dl, had 3 units cross-matched and transfused. Another patient, who was operated on for aseptic loosening of his hip replacement, had 2 units cross-matched and transfused as he had a postoperative Hb of 7.9 g/dl. Blood usage in this group ranged from 0–24 units (mean, 5.2 units). Change in Hb ranged from +0.2 to –5.7 g/dl (mean, –2.9g/dl).

Pre-operative Hb 13.1–14 g/dl (*n* = 20)
A total of 116 units were ordered for surgery, 63 (54.3%) were used and 13 units were ordered postoperatively of which 9 (69.2%) were used. Blood usage in this group ranged from 0–9 units (mean, 3.6 units). Change in Hb ranged from –1.2 to –6.6 g/dl (mean, -3.7 g/dl).

Pre-operative Hb 14.1–15.0 g/dl (*n* = 15)
A total of 90 units were ordered for surgery, 35 (38.9%) were used and 8 units were ordered postoperatively of which 7 (87%) were used. Blood usage in this group

Table 3 Results of blood usage in first stage of a two stage revision

Pre-operative Hb (g/dl)	Patients (*n*)	Patients who had 6 units cross-matched (%)	Mean units of blood used (units)	Cross-matched units of blood used (%)	Change in Hb range (g/dl)	Additional units of blood cross-matched (units)
10.1–12.0	2	100	13.5	100 (6/6)	0.3 to –2.2	21 in 1 patient, 17 used (81%)
13.1–15.0	3	100	4.7	55.6 (10/18)	–3.0 to –6.0	4 in 1 patient, 4 used (100%)
> 15.0	2	100	1.5	37.5 (3/8)	–3.4 to –4.8	Nil

Table 4 Results of blood usage in second stage of two stage revision

Pre-operative Hb (g/dl)	Patients (*n*)	Patients who had 6 units cross-matched (%)	Mean units of blood used (units)	Cross-matched units of blood used (%)	Change in Hb range (g/dl)	Number of additional units of blood cross-matched (units)
10.1–12.0	4	100	3.7	62.5 (15/24)	1.2 to –3.4	Nil
13.0–15.0	3	66.6	4.6	87.5 (14/16)	–2.9 to –5.7	14 in 1 patient, 10 used

ranged from 0–6 units (mean, 2.8 units). Change in the Hb ranged from –1.7 to –6.3 g/dl (mean, –3.9 g/dl).

Pre-operative Hb > 15.0 g/dl (*n* = 11)

A total of 63 units were ordered for surgery, 25 (39.7%) were used and 3 units were ordered postoperatively of which 2 (66.7%) were used. Blood usage in this group of patients ranged from 0–6 units (mean, 2.5 units). Change in Hb ranged from –1.7 to –7.5 g/dl (mean, -4.8 g/dl). Fourteen patients had a postoperative Hb of < 9 g/dl; these patients had additional units of blood to achieve a Hb of between 10.1–14.2 g/dl prior to discharge.

Two stage revision

The data are summarised in Tables 3 and 4.

Pre-operative Hb 10.1–12.0 g/dl (*n* = 2)

First stage: 12 units were ordered for surgery, all 12 (100%) were used. A further 21 units were ordered during surgery for one patient who had a cardiac arrest on the operating table. The surgery had to be abandoned and completed a week later. The change in Hb ranged from +0.3 to –2.2 g/dl (mean, –0.95 g/dl).

Second stage: 24 units were ordered and 15 (62.5%) were used. Blood usage for this group ranged from 2–5 units (mean, 3.7 units). The change in Hb ranged from +1.2 to –3.4 g/dl (mean, –1.4 g/dl).

Pre-operative Hb 13.1–15 g/dl (*n* = 3)

First stage: 18 units were ordered for surgery of which 10 (55.6%) were used. Four units were ordered postoperatively, all 4 (100%) of which were used. Blood usage for this group ranged from 0–10 units (mean, 4.7 units). The change in Hb ranged from –3.0 to –6.0 g/dl (mean, –4.3 g/dl).

Second stage: 16 units were ordered and 14 (87.5 %) were used. A further 14 were ordered during surgery for one patient who had had a triple coronary artery by-pass surgery and was on aspirin. Of the 14 units cross-matched, 10 (71.4%) were used. The change in the Hb ranged from –2.9 to –5.7 g/dl (mean, –4.9 g/dl).

Preoperative Hb > 15 g/dl (*n* = 2)

First stage: 8 units were ordered and 3 (37.5%) were used. The change in Hb ranged from –3.4 to –4.8 g/dl.

One patient had a post-transfusion Hb of < 9 g/dl for whom 2 additional units of blood were ordered and given.

Discussion

The British Committee for Standards in Haematology formulated guidelines outlining that, in general, the ratio of the number of units of blood ordered and transfused should not exceed 2:1. As shown in the results, there was a 72.5% compliance rate in our patients, a compliance rate which could be improved upon by cross-matching less blood in selected groups of patients.

Weiskopf *et al.*[2] investigated the effects of anaemia in 31 healthy volunteers and patients. Acute isovolaemic reduction of Hb to 5 g/dl did not result in detectable inadequate oxygenation. Although not advocating allowing postoperative Hb in surgical patients to sink to 5 g/dl, the authors agree with Roberts *et al.*[3] in the suggestion that patients without cardiovascular or pulmonary disease need not be given a transfusion unless their Hb falls to < 8 g/dl. Carson *et al.*,[4] in a study of 8787 hip fracture patients, reported that 42% underwent a postoperative blood transfusion. Analysis of the data to establish the benefits of transfusion and the trigger haemoglobin levels at which transfusion should be given,

concluded that a postoperative haemoglobin of 8 g/dl or more did not seem to affect the 30- or 90-day mortality rate. In a study by Sudhindran,[5] 53% of units transfused violated recommended guidelines. He called for objective and easily adaptable guidelines for the purposes of blood transfusion.

Methods of reducing intra-operative blood loss using pharmacological agents such as desmopressin (DDAVP) and aprotinin have not proved very successful. Intra-operative and postoperative autologous transfusion, salvaging blood lost during and after an operation using Solcotrans and Haemonetics Cell Saver IV, could prove as expensive as a blood transfusion with the theoretical problems of transfusing bone or cement debris. Pre-operative autologous transfusion, a method where pre-operative donation of 2–4 units of red cells (typically 1 unit a week) for autologous transfusion at or after operation is increasingly practised. This method, however, cannot be used in patients with unstable angina, aortic stenosis and severe hypertension. In addition, a number of issues mitigate 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, which stipulate that autologous units be tested for the same range of markers of transmissible disease as homologous donations; this raises the costs and leads to ethical dilemmas if positive results are obtained.[6]

Thus it is increasingly evident that there is a need to review the risks versus benefits of transfusions of blood. The rising cost involved in blood transfusion makes it important to use blood resources more effectively. This shift in thinking should be met by raising the awareness of good transfusion practice, and modifying transfusion guidelines where appropriate.

Conclusions

We had a 54.3% usage of cross-matched blood in single stage revisions with pre-operative Hb in the 13–14 g/dl range, a 39% usage of cross-matched blood with the pre-operative Hb in the 14–15 g/dl range, and a 39.7% usage of blood in patients with a pre-operative Hb of more than 15 g/dl. Similarly, in the two stage revision, we only had a 55.6% usage of blood when the pre-operative Hb was more than 13 g/dl. From these results we conclude that the MSBOS standard for single and two stage revisions with a pre-operative Hb of 13 g/dl could be 4 units rather than 6 units of blood. We have changed our MSBOS standard accordingly and continue to audit.

References

1. Nicholis MD. How safe is blood? *Anaesth Intensive Care* 1993; **21**: 13–4.
2. 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.
3. Roberts M, Ahya R, Greaves M, Maffulli N. A one-centre prospective audit of peri- and postoperative blood loss and transfusion practice in patients undergoing hip or knee replacement surgery. *Ann R Coll Surg Engl* 2000; **82**: 44–8.
4. Carson JL, Duff AMHS, Berlin JA, Lawrence VA, Poses RM, Huber EC *et al*. Postoperative blood transfusion and postoperative mortality. *JAMA* 1998; **279**: 199–205.
5. Sudhindran S. Perioperative blood transfusion: a plea for guidelines. *Ann R Coll Surg Engl* 1997; **79**: 299–302.
6. Kirk RM, Mansfield AO, Cochrane J. Haematological assessment and blood component therapy. In: Kirk RM, Mansfield AO, Cochrane J, eds. *Clinical Surgery in General – RCS Course Manual*. London: The Royal College of Surgeons of England, 1996; 85–90.