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Blood ordering protocol based on proposed surgical implant in fractured neck of femur patients

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ABSTRACT

INTRODUCTION Fractured neck of femur patients frequently require blood transfusion. To improve the efficiency of blood ordering, we present a protocol which orders blood specific for the proposed surgical implant.

PATIENTS AND METHODS A retrospective audit over a 1-year period was performed. Patients were divided into six groups dependent on proposed surgical implant. The mean postoperative drop in haemoglobin concentration, the cross-match to transfusion ratio and transfusion indexes were calculated.

RESULTS Statistically significant differences in blood loss were found dependent on implant used. Using guidelines created by the British Committee for Standards in Haematology on the implementation of a maximum surgical blood ordering schedule, a new protocol for blood ordering based on proposed surgical implant was created.

CONCLUSIONS In fractured neck of femur patients awaiting operation, the type of implant can be used to anticipate blood loss and as a guide to blood ordering.

KEYWORDS

Medical audit – Blood loss – Clinical protocols – Blood transfusion – Femoral neck fractures – Prosthesis – Implants

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The incidence of fractured neck of femur is increasing and these patients often require blood transfusion.[1,2] Provision of blood is becoming increasingly expensive and, in addition to well-documented risks to the recipient, there is a theoretical risk of transmission of viruses including new variant Creutzfeldt-Jacob disease (vCJD).[3]

Previous attempts to improve the efficiency of blood ordering in these patients have advocated blood ordering policies for the group as a whole, *i.e.* all patients with a fractured neck of femur, or alternatively to patients based on the fracture pattern.[4,5]

As the same implant may be used for different fracture patterns, we investigated blood loss in patients undergoing operations for fractured neck of femur based on surgical implant. This study demonstrates that blood loss was dependent on which surgical implant was used. We propose a new blood ordering protocol based on the results.

Patients and Methods

A retrospective audit over a 1-year period beginning 1 March 2002 was performed. Patients undergoing operation for fractured neck of femur were identified from the theatre registers. Patients were divided into six groups depending on the type of surgical implant used. These were: cannulated hip screws; dynamic hip screw (DHS); Thompson's hemiarthroplasty, Austin Moore hemiarthroplasty, Hasting's and intramedullary hip screw (IMHS). The pre- and postoperative haemoglobin concentrations were used to calculate the mean drop in haemoglobin concentration post-procedure. Details of the number of units cross-matched and transfused postoperatively were used to calculate the cross-match to transfusion ratio (C:T ratio) and the transfusion index (mean number of units transfused per procedure). A one-way analysis of variance test (ANOVA) was used to look for statistical differences in the mean drop in haemoglobin concentration post-procedure between the groups. Using guidelines created by the British Committee for Standards in Haematology (BCSH) on the implementation of a maximum surgical blood ordering schedule (MSBOS), we calculated the efficiency of our department at blood ordering. Using these results, a new protocol for blood ordering based on proposed surgical implant was created.

Table 1 Number of procedures and mean postoperative drop in haemoglobin concentration

Implant	Number	Mean post-op. drop in haem. conc. (g/dl)
Dynamic hip screw	121	2.4
Intramedullary hip screw	4	4.6
Cannulated hip screws	28	1.1
Thompson's hemiarthroplasty	86	2.0
Austin Moore hemiarthroplasty	37	2.0
Hasting's	10	2.7
All groups	286	2.1

post-op.,postoperative
haem. conc., haemoglobin concentration

Results

In all, 315 patients were identified over the 1-year period. Twelve of these were excluded because of incomplete haematology records (3.8%). Seventeen patients had pre-operative blood transfusions and were also excluded (5.4%). The remaining 286 patients were included in this study.

The most common implant used was the DHS while the least common was the IMHS. There was no significant difference in the mean drop in haemoglobin concentration following operation between the DHS, Thompson's hemiarthroplasty, Austin Moore hemiarthroplasty and Hasting's groups ($P > 0.05$). The mean drops were 2.4 g/dl, 2.0 g/dl, 2.0 g/dl and 2.7 g/dl, respectively (Table 1). The mean drop in haemoglobin concentration was significantly less in the cannulated hip screws group than the other groups at 1.1 g/dl ($P < 0.05$). It was significantly more in the IMHS group than the other groups at 4.6 g/dl ($P < 0.05$). The mean drop in all groups was 2.1 g/dl.

The majority of cross-matched blood was transfused in patients in the DHS group. In the CHS group, three units were cross-matched but no blood was transfused. The transfusion index (number of units cross-matched divided by number of units used) was highest in the IMHS group at 1.75 (*i.e.* on average, 1.75 units was transfused in each IMHS case) and lowest in the CHS group at 0.00. In the other groups, the transfusion index was less than 1.00. The C:T ratio ranged between 1.13 and 1.60. The mean C:T ratio for all groups was 1.22, *i.e.* for every 122 units cross-matched, we would have transfused 100 units and 22 units would have been returned to the blood bank (Table 2).

Discussion

These results demonstrate statistically significant differences in blood loss and transfusion according to the implant used. There are no previous studies comparing blood loss occurring with individual implants used and all previous studies have examined the group as a whole or subdivided patients based on fracture pattern.[4,5] This study explains the inefficiency of blood ordering for the group as a whole, *i.e.* all fractured neck of femur patients. As different implants are used for individual fracture patterns, the most efficient way to order blood in these patients is to do so based on which surgical implant is proposed.

One alternative to minimise the amount of cross-matched blood transfused is autologous transfusion. Three types of this are recognised: (i) predeposit; (ii) pre-operative haemodilution; and (iii) blood salvage. However, predeposit is impossible as patients present acutely with fracture neck of femur. Pre-operative haemodilution is feasible but these patients have already lost blood into the fracture site and reducing the haemoglobin concentration further would put an even greater stress on their cardiovascular system. Blood salvage is perhaps the most appropriate and feasible type of blood transfusion in these patients. However, it should be noted that the

Table 2 Transfusion indexes and cross-match to transfusion ratios

Implant	Total units transfused postop.	Total units cross-matched	Percentage of units transfused	Transfusion index	C:T ratio
Dynamic hip screw	114	129	88	0.94	1.13
Intramedullary hip screw	7	10	70	1.75	1.43
Cannulated hip screws	0	3	0	0.00	Infinity
Thompson's hemiarthroplasty	37	50	74	0.43	1.35
Austin Moore hemiarthroplasty	21	24	88	0.57	1.14
Hasting's	5	8	63	0.50	1.60
All groups	184	224	82	0.64	1.22

Table 3 Blood requirements based on proposed implant and pre-operative haemoglobin

	Sample requirement depending on pre-operative haemoglobin concentration		
Implant	< 10 g/dl	10–12.5 g/dl	≥ 12.5 g/dl
Cannulated hip screws	Cross-match appropriately Investigate cause of anaemia	No sample required	No sample required
Dynamic hip screw			
Thompson's hemiarthroplasty		Cross-match 2 units	Group and save
Austin Moore hemiarthroplasty			
Hasting's			
Intramedullary Hip Screw		Cross-match 4 units	Cross-match 2 units

recorded blood loss is considerably less for these procedures than in total hip (and to a lesser extent total knee) replacement surgery where it has become more widely used.[6] Further studies are needed to evaluate the use of blood salvage in fractured neck of femur patients.

The mean pre-operative haemoglobin of 12.7 g/dl and the overall transfusion index of 0.64 in this study is in line with previous reported studies.[7,8]

This audit was based on, and complies with, guidelines created by the British Committee for Standards in Haematology (BCSH) on the construction of a maximum surgical blood order schedule (MSBOS). The guidelines quote an ideal value of C:T ratio as 1.0 and state the C:T should not exceed 2.0.[9] We have demonstrated it is possible to improve the efficiency further by implementing a new protocol.

The BCSH guidelines advise that procedures in which there has been less than 30% of blood used (transfusion index less than 0.30) should only have a G&S. All other procedures should have blood cross-matched depending on the average number of units used in the past (*i.e.* previous transfusion index). When ordering blood, allowances must be made for the pre-operative haemoglobin. The lower its value, the more likely the patient is to need a blood transfusion. For simplicity, we have divided patients into three groups depending on the their pre-operative haemoglobin. In patients with fractured neck of femur, we use a 'transfusion trigger' of about 10 g/dl. Patients admitted with a haemoglobin level less than this require pre-operative transfusion and additional investigations into the cause of anaemia. The BCSH guidelines are most relevant when the patient has a 'normal' pre-operative haemoglobin; we have defined a 'normal' pre-operative haemoglobin in this sample of patients as being greater than 12.5 g/dl. For patients with a pre-operative haemoglobin of 10.0–12.5 g/dl, knowledge of expected blood loss for an implant can be used to estimate postoperative haemoglobin and necessary transfusion requirements.

The mean postoperative blood loss in patients in the CHS group was 1.2 g/dl and no patient in this group received a blood transfusion. It is not necessary to make blood provision (or a group and save) for patients with fractured neck of femur awaiting operation for a CHS.

The range in mean postoperative blood loss in patients in the DHS, Austin Moore, Thompson's and Hasting's group was 2.0–2.7 g/dl and the transfusion indexes were all less than one. Thus, most patients had no blood transfused at all and on average less than one unit of blood was transfused per procedure. Our blood bank policy is a minimum cross-match of two units for the benefits to outweigh the risks; therefore, if all these patients received a two unit cross-match, there would be a large amount of blood wastage. Other studies have shown that blood is often transfused if it is available even if it is not needed.[6] A suitable blood provision in patients with a haemoglobin greater than 12.5 g/dl awaiting operation for DHS, Austin Moore, Thompson's and Hasting's would be to take a sample for group and save. This is in line with previous studies.[10] In patients with a pre-operative haemoglobin between 10.0–12.5 g/dl, there is a higher probability that blood losses during surgery will cause a fall in haemoglobin below 10 g/dl 'triggering' transfusion. These patients should have a two unit cross-match.

The mean postoperative blood loss in the IMHS group was 4.6 g/dl and the transfusion index was 1.75. Approximately two units of blood were transfused per procedure and suitable blood provision for these patients with a haemoglobin greater than 12.5 g/dl would be to cross-match 2 units pre-operatively. For patients with pre-operative haemoglobin of 10.0–12.5 g/dl we recommend cross matching 4 units. This is summarised in Table 3.

Conclusions

In fractured neck of femur patients awaiting operation, the type of implant can be used to anticipate blood loss and as a guide to blood ordering.

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