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Audit

Cross-match protocols for femoral neck fractures – finding one that can work

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***Background*: Cross-match practice for patients with femoral neck fractures continues to cause concern due to a failure of compliance to the existing protocols. To address this issue, a number of studies were conducted over a 3-year period.**
***Methods*: First, the existing cross-match practice for patients admitted with femoral neck fractures was reviewed to demonstrate the deficiencies within the system. Second, the opinion of anaesthetic and orthopaedic trainees was assessed regarding blood requirements for different femoral neck fractures following surgery and the justification of their perceptions.**
***Results*: A summation of the studies is reported which demonstrates the reasons for the poor compliance to previous protocols.**
***Conclusions*: A simple and effective protocol is provided that has helped reduce pre-operative cross-matching of femoral neck fractures from 71% to 16.7% when assessed 2 years after its introduction.**

Key words: Blood transfusion – Femoral neck fractures – Protocol

The use of homologous blood following surgery has come under increasing scrutiny over the last decade due to numerous reports of immune suppression within the recipient,[1–3] manifesting as an increase risk for the development of postoperative nosacomial infections.[4–6] In addition, fears of viral transmission through transfusion have resulted in a national change of homologous blood into a leukocyte-depleted format that has meant a 2-fold increase in the cost of blood to £80.00 per unit. Due to the health risks and financial implications, attempts have been to provide guidelines for cross-match and transfusion practices for numerous surgical procedures.

In orthopaedic practice, patients admitted with femoral neck fractures are routinely cross-matched blood at the time of assessment in the emergency department. Studies have demonstrated the inefficiency of this practice and, unfortunately, recommendations by these authors have rarely made any lasting impact.[7–10] In order to address this issue, we performed a combination of retrospective and cross-sectional studies to develop a practice that was resistant to time-related degradation.

Patients and Methods

The first aspect of the study was to identify the frequency of cross-match requests for patients admitted with femoral neck fractures and the subsequent transfusion rate. Patients with femoral neck fractures that had required surgery during a 12-month period between July 1998–1999 were identified from theatre records.

Patients' surgical procedures were divided into three groups based upon the fracture pattern. A patient's

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Table 1 Cross-match and transfusion rates for 240 femoral neck fractures

Fracture/surgery	Number of cases	Number cross-matched (%)	Total units cross-matched	Number transfused (%)	Total units used
Intertrochanteric fractures	129	92 (71%)	208	54 (42%)	114
Subcapital fractures – hemi-arthroplasty	91	72 (79%)	160	14 (15%)	34
Subcapital fractures – AO cannulated screws	20	6 (30%)	16	2 (13%)	6
Total	240	170 (71%)	384	70 (29%)	154

Table 2 Transfusion index and cross-match:transfusion ratio for the intertrochanteric fractures managed by dynamic hip screw fixation and subcapital fractures managed by AO cannulated screw insertion or hemi-arthroplasty

Group	Transfusion index	Cross-match: transfusion ratio	% cross-matched blood not used
Intertrochanteric fractures	0.87	1.8	45
Subcapital fractures – hemi-arthroplasty	0.37	2.6	62.5
Subcapital fractures – AO cannulated screws	0.36	4.7	78.7
Total	0.64	2.5	60

Transfusion index (number of units used divided by number of surgical procedures); if less than 0.5 suggests routine cross match not needed.
Cross-match transfusion ratio (number of units requested divided by the number of units used); if greater than 2.5 suggests ordering of blood is surplus to requirements.

haemoglobin level at admission and following surgery were retrieved from the haematology database. The number of units of blood requested for each patient and the subsequent administration of blood transfusion was also noted. A simple comparison of frequency of blood ordering and consumption were assessed for the different surgical procedures.

Transfusion index and cross-match:transfusion ratios (C:T) were determined.[7,8] Transfusion index is the measure of the average blood used per procedure and values less then 0.5 indicate that routine cross-matching is not required for the procedure in question. The cross-match:transfusion ratio is a measure of the efficiency of blood ordering and values greater than 2.5 indicate excessive ordering.

The second study was a postal questionnaire of all the Northwest regional specialist registrars (SpRs) in anaesthetics and orthopaedic surgery as well as senior house officers (SHOs) in both specialities within five regional teaching hospitals. A hypothetical situation was proposed requiring trainees to cross-match patients presenting with either intertrochanteric or subcapital fractures with a pre-operative haemoglobin level between 8–13 g/dl. In addition, the source of the trainees' practice was requested.

Based on the findings, a cross-match protocol was proposed and its efficiency was evaluated 2 years after its initial introduction. The frequency of cross-match and blood utilisation was re-assessed for patients undergoing surgery for femoral neck fractures between February and August 2001.

Results

Theatre records identified 240 patients that had required surgery for femoral neck fractures; 129 patients had required the insertion of a dynamic hip screw for the management of an intertrochanteric fracture and 91 patients had undergone a hemi-arthroplasty for a displaced subcapital fracture. The remaining 20 patients with a subcapital fracture had been stabilised with AO cannulated screws.

Table 3 Source of trainee's practice for the cross-match requirements of patients with femoral neck fractures

	Anaesthetic guidelines	Orthopaedic guidelines	Own experience	Journals	Colleagues	No policy
Anaesthetic SpRs	11	2	35	19	26	7
Orthopaedic SpRs	7.2	21.7	36.2	15.9	15.9	2.9
Anaesthetic SHOs	13.5	7.7	26.9	13.5	26.9	11.5
Orthopaedic SHOs	13.3	24.4	26.7	8.9	20	6.7
Total (%)	11.3	14	31.2	14.3	22.2	7

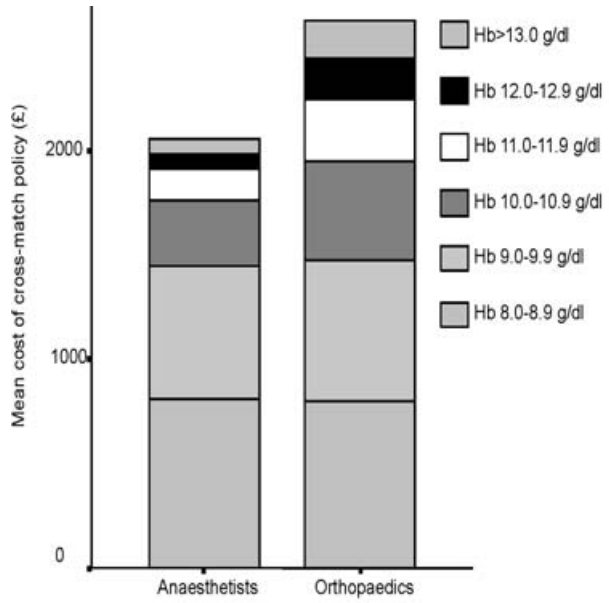

Figure 1 The difference in cross-match practice between trainees for patients with femoral neck fractures and haemoglobin levels between 8–13 g/dl. The cross-match practice has been converted to a cost implication. One unit of blood costs £80.00 and a cross-match has a cost of £20.00; hence, the greater the volume cross-matched, the greater the financial implication.

The frequency of cross-match requests and subsequent transfusion is illustrated in Table 1. This demonstrates that 71% of the patients were cross-matched 384 units of blood on admission; however, only 29% of the patients subsequently required a blood transfusion resulting in a surplus of 230 units of blood following surgery.

Table 2 illustrates the transfusion index and cross-match:transfusion ratio for the intertrochanteric fractures managed by dynamic hip screw fixation and subcapital fractures managed by AO cannulated screw insertion or hemi-arthroplasty.

A total of 129 trainees responded to the postal questionnaire giving a 79% response rate. Figure 1 reveals that, irrespective of the intended surgery, all trainees requested a similar volume of pre-operative cross-matched blood for patients with a presumed haemoglobin level between 8–9 g/dl; however, beyond a haemoglobin level of 10 g/dl, the anaesthetic trainees requested significantly less blood then orthopaedic trainees.

Table 4 The protocol used by the haematology MLSO to arrange suitable pre-operative cross-match of patients with femoral neck fractures

Haemoglobin (g/dl)	Blood requested
> 11	G&S
9.0–10.9	Cross-match 2 units
8.0–8.9	Cross-match 3 units
7.0–7.9	Cross-match 4 units and inform SHO
< 6.9	Inform SHO

Table 3 reflects the trainees' justification of their cross-match practice. It reflects that evidence-based literature only influenced 14.3% of the trainees whereas 53.4% of the trainees had constructed a practice based on their opinion or that of a colleague.

Two years following the introduction of the protocol illustrated in Table 4, the frequency of cross-match of patients with femoral neck fractures was reduced to 16.7% in the 72 patients that were identified between February and August 2001. In addition, 75% of the patients that had been cross-matched subsequently required a blood transfusion. A total of 28 units were requested at admission with only 8 units being returned unused following surgery.

Discussion

A review of the literature demonstrates a number of increasing concerns regarding blood transfusion.[4–6,11–14] It no longer represents a risk-free practice due to the recognised association of immune modulation,[1–3] increased post-operative infections,[4–6] and potential transmission of viral infections. As a consequence, current practice is to reduce patient exposure to homologous blood by using either pre-donated autologous blood, pre-operative haemdilution or cell salvage systems in addition to justifying the need for transfusion on clinical grounds rather then having pre-determined haemoglobin level at which blood transfusion is initiated.

Additional concerns regarding blood transfusion are directed towards a financial implication. Prior to 1998, only 10% of the homologous blood was termed as leukocyte-depleted; however, due to concerns of transmission of slow growing virus mediators, a UK Government-directed initiative was issued in August 1998 resulting in all homologous blood being leukocyte depleted. This had a financial implication of doubling the cost of a unit of blood to £80.00, excluding the cost of the actual cross-match. Another worrying aspect is that donated blood has a shelf-life of 35 days; unless advertising campaigns are successful in recruiting regular donors, reduction in regional stores is a very possible concern. In order to aid the blood banks, a number of authors have concentrated on initially attempting to justify the routine ordering of blood prior to surgery.

The annual incidence of femoral neck fractures in the UK population is reported as 1 in 100, with women having a life-time risk of 15% and men having a life-time risk of 5%. Most of these patients will undergo surgery and previously cross-match practices had resulted in a request of 2 units of blood

for the patient at time of admission. This clearly represents a significant burden on limited resources. As a consequence, reviews addressed the frequency of cross-match and subsequent utilisation of the ordered blood. These have demonstrated that patients with intertrochanteric fractures have the most notable change between pre- and post-operative haemoglobin levels and our first study shows that the mean loss was 3.1 g/dl whereas subcapital fractures had only a mean loss of 1.8 g/dl.

In our second study, it was demonstrated that anaesthetic requirements of pre-operative blood availability was notably less then those that were being provided by orthopaedic trainees. Combining these two studies, a protocol is proposed for the pre-operative cross-match requirements of patients with femoral neck fractures as illustrated in Table 4.

Orthopaedic trainees are typically unaware of a patient's haemoglobin level at admission and cross-match requests routinely made when all other serological investigations are performed. Authors previously have suggested 'group and saving' all femoral neck fractures with subsequent cross-match requests when the patient's haemoglobin level is made available. This unfortunately results in increased workload for the orthopaedic trainee with the potential for lapse over time as a consequence of, or following, a change in orthopaedic staff. Our protocol requires the orthopaedic trainee to state simply 'femoral neck fracture' and the haematology MLSO analysing the full blood count request will subsequently arrange the appropriate volume of pre-operative blood. This reduces the workload of both orthopaedic trainees and the haematology MLSO for whom each cross-match request need 40 min to perform. A follow-up study 2 years following the initial proposal of the protocol with four changes of junior orthopaedic trainees showed no lapse in the benefit of the protocol. Prior to the introduction of protocol, 71% of the patients admitted with femoral neck fractures were cross-matched on admission in comparison to only 16.7% at our recent review. The protocol has gained acceptance within the anaesthetic, haematology and orthopaedic departments with a call to expand to include additional elective and emergency surgery.

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