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Blood Transfusion Policies in Elective General Surgery: How to Optimise Cross-Match-to-Transfusion Ratios

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Cross-match/transfusion ratio · Transfusion · Surgery · Maximum surgical blood ordering schedule · MSBOS

Summary
Objective: Preoperative over-ordering of blood is common and leads to the wastage of blood bank resources. The preoperative blood ordering and transfusion practices for common elective general surgical procedures were evaluated in our university hospital to formulate a maximum surgical blood order schedule (MSBOS) for those procedures where a cross-match appears necessary. **Methods:** We evaluated blood ordering practices retrospectively in all elective general surgical procedures in our institution over a 6-month period. Cross-match-to-transfusion ratios (C:T) were calculated and compared to current trust and the British Society of Haematology (BSH) guidelines. The adjusted C:T ratio was also calculated and was defined as the C:T ratio when only cross-matched blood used intraoperatively was included in the calculation. **Results:** 541 patients were identified during the 6-month period. There were 314 minor and 227 major surgeries carried out. 99.6% (n = 226) of the patients who underwent major surgery and 95.5% (n = 300) of the patients having minor surgery had at least a group and save (G and S) test preoperatively. A total of 507 units of blood were cross-matched and 238 units were used. The overall C:T ratio was therefore 2.1:1, which corresponds to a 46.9% red cell usage. There was considerable variation in the C:T ratio, depending on the type of surgery performed. The adjusted C:T ratio varied between 3.75 and 37. **Conclusions:** Compliance with transfusion policies is poor and over-ordering of blood products commonplace. Implementation of the updated recommended MSBOS and introduction of G and S for eligible surgical procedures is a safe, effective and cost-effective method to prevent preoperative over-ordering of blood in elective general surgery. Savings of GBP 8,596.00 per annum are achievable with the incorporation of updated evidence-based guidelines in our university hospital.

Introduction

The need for blood in hospitals continues to exceed the volume collected by the transfusion services. Studies have shown that there is frequently a gross over-ordering of blood for elective surgical intervention, in excess of actual and anticipated needs [1]. This leads to substantial costs and a burden to the transfusion services. In addition, over-ordering leads to the non-availability of cross-matched units while reserved for a specific patient.

Evidence-based protocols for the transfusion of red blood cells are lacking due the paucity of randomised clinical trials. Worldwide, the introduction of evidence-based transfusion guidelines and strategies for improved blood utilisation has been shown to be cost effective and safe. Strategies include timely and adequate preoperative assessment of risk, optimised baseline haemoglobin, intraoperative techniques to minimise blood loss and transfusion-guided targeted therapy [2–4]. Frequently, regular audits are required to ensure a balance of supply and demand based on institutional variation secondary to patient and surgeon differences. Policies for a trust's maximum surgical blood ordering schedule (MSBOS) can be implemented based upon both results of audits and by discussion and agreement between medical teams [5, 6].

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Table 1. Transfusion data as per surgery type

Operation	n	Number of patients cross-matched	Number of units cross-matched[a]	Number of units transfused (#)[b]	Number of units transfused intraoperatively (#)[b]	C:T ratio[c]	Adjusted C:T ratio[d]	Blood usage, %
Anterior resection	26	12	30	12 (2)	4 (2)	2.5	7.5	40.0
Abdomino-perineal resection	8	6	17	5 (1)	0	3.4	17	29.4
Closure colostomy	5	4	8	36 (1)	0	0.2	8	450
Hemicolectomy	35	20	74	44 (9)	2 (2)	1.7	37	59.5
Liver resection	28	28	168	39 (11)	20 (7)	4.3	8.4	23.2
Reversal Hartman	8	2	6	4 (1)	0	1.5	6	66.7
Reversal ileostomy	17	7	13	2 (1)	0	6.5	13	15.4
Sigmoid colectomy	16	11	28	12 (6)	7 (4)	2.3	4	42.8
Whipple's operation	13	13	78	9 (4)	9 (4)	8.7	8.7	11.5
Pouch formation	5	5	10	1 (1)	0	10	10	10.0

[a]Units cross-matched preoperatively.
[b]# refers to the number of patients who received a transfusion in that group.
[c]Number of cross-matched units used/number of cross-matched units requested.
[d]Defined as the C:T ratio when only cross-matched blood used intraoperatively was included in the calculation.

Table 2. Suggested transfusion policy as a result of the study: Major surgery

Operation	n	Current policy	Adjusted C:T ratio[a]	Current blood usage, %	Suggested new policy	Estimated cost saving per annum incorporating new policy, GBP
Anterior resection	26	2 units	3.75	40.0	2 units	–
Abdomino-perineal resection	8	2 units	17	29.4	G and S only	224
Closure colostomy	5	–	8	450	G and S only	–
Hemicolectomy	35	2 units	37	59.5	G and S only	980
Liver resection	28	6 units	8.4	23.2	4 units	784
Reversal Hartman	8	–	6	66.7	G and S only	–
Reversal ileostomy	17	–	13	15.4	G and S only	–
Sigmoid colectomy	16	2 units	4	42.8	G and S only	448
Whipple's operation	13	4 units	8.7	11.5	2 units	364
Pouch formation	5	2 units	10	10.0	G and S only	140

[a]Defined as the C:T ratio when only cross-matched blood used intraoperatively was included in the calculation.

There are 2 basic tests performed to type blood, namely the group and save (G and S) and the cross-match tests. The G and S test is a method to identify the blood by the ABO group system. The serum is saved so that further blood typing can be performed if necessary. It is easier and faster to perform than a cross-match test and does not remove blood from the common pool. Cross-matched means to fully type a sample and a unit of red cells to look for cross-reactivity. Blood is ready to use, but it is removed from the common pool. Pragmatic guidelines from the British Society of Haematology (BSH) are based on a cross-match-to-transfusion ratio (C:T) of 2:1, meaning that blood should not be available for surgery if the usage is below 50% of what was requested [7]. Patient safety is clearly paramount and there is a need for flexibility in these guidelines; clinical judgement is required in cases predicted to need higher blood volumes. The policy aims are to guide less experienced medical staff and to ensure economical blood ordering practices based on results of individual institutional blood ordering audits.

The aim of this study was to audit compliance with national guidelines and compare this to our current in-house policies, with the aim of creating updated local policies that minimise resource wastage. We also wished to measure the potential cost savings by the introduction of updated evidence-based policies.

Material and Methods

Data was collected retrospectively during a 6-month period in a single university teaching hospital. Patients were identified through the transfusion services electronic database and our operating theatre database. Consecutive elective general surgical procedures were included from both hepatobiliary and pancreatic and colorectal surgical specialities.

Table 3. Suggested transfusion policy as a result of the study: Minor surgery

Operation	n	Current policy	Current practice	Current blood usage, units[a]	Suggested new policy	Estimated cost at failure to follow policy, GBP[b]	Estimated cost saving incorporating new policy, GBP[b]
Laparoscopic cholecystectomy	79	no blood bank test	100% had G and S	0	no blood bank test	1,580	–
EUA	29	no blood bank test	100% had G and S, 6.9% had CM	0	no blood bank test	608	–
Laparoscopy and IOUS	54	–	100% had G and S	0	no blood bank test	–	1,080
Ano-rectal daycase	50	no blood bank test	100% had G and S, 4.0% had CM	0	no blood bank test	1,028	–
Groin hernia repair	56	no blood bank test	96% (n = 54) had G and S	0	no blood bank test	1,080	–
Other anterior abdominal wall hernia repair[c]	14	–	100% had G and S	0	no blood bank test	–	280
Liver biopsy	6	G and S	100% had G and S	0	G and S	–	–

EUA = Examination under anaesthesia, IOUS = intraoperative ultrasound, G and S = group and save, CM = cross-match.
[a]Intraoperative blood usage.
[b]Per annum.
[c]Not including incisional hernia.

Data collected included type of surgery, preoperative investigations including number of units cross-matched, number of units transfused and the timing of transfusion. This data was used to calculate the C:T ratio, which was defined as the number of cross-matched units used (perioperative and until hospital discharge)/number of cross-matched units requested. The adjusted C:T ratio was defined as the C:T ratio when only cross-matched blood used intraoperatively was included in the calculation. It is assumed that all blood used intraoperatively was required emergently and could not wait for the processing of a G and S test. The ratios were calculated only if at least 6 surgeries had been performed in the 6-month study period. Costs incurred are calculated on a G and S and a cross-match test costing GBP 10.00 and 7.00 per unit, respectively.

In our hospital, cross-matching analysis takes the transfusion services 1 h and a G and S test takes 40 min. A cross-match test in 'live time', for rare cases when red cells are needed unexpectedly and only a G and S test was done, takes 45 min. These figures are, however, subject to substantial variation from numerous factors.

The primary outcome was compliance with the BSH national guidelines [4]. Secondary outcomes were compliance with in-house policies for G and S tests and cross-matching of blood for elective surgery and also to investigate any cost savings with an updated transfusion policy. The global aims were to reproduce updated trust policies based on the department's use of the transfusion services. Exclusion criteria were emergency surgical procedures, patients transfused preoperatively and surgeries cancelled.

Results

During the 6-month period, 541 patients were identified. There were 314 minor and 227 major surgeries carried out. 2 patients were transfused preoperatively and 5 patients cancelled and were excluded. 5 patients scheduled for a Whipple's operation had disseminated disease at laparotomy and were converted to a palliative bypass surgery instead.

Of the patients who underwent major surgery and of those having minor surgery, 99.6% (n = 226) and 95.5% (n = 300), respectively, had at least a G and S test preoperatively. The 1 patient in the major surgery group who had no G and S test was a Jehovah witness. A total of 507 units of blood were cross-matched, of which 238 units were used. 2 patients in the minor surgery group had a postoperative transfusion after an examination under anaesthesia (EUA) and biopsy (n = 1), reversal ileostomy (n = 1).

The overall C:T ratio was therefore 2.1:1, which corresponds to a 46.9% red cell usage. There was considerable variation in the C:T ratio, depending on the type of surgery performed (table 1). The adjusted C:T ratio varied between 3.75 and 37. 16 patients from the major surgery group returned to the theatre after the original surgery for a complication requiring blood products. The indication for the remaining patients requiring red cells was clinically indicated postoperative anaemia.

27 patients received intraoperative red cell transfusion, totalling 56 units. The median number of intraoperative units was 2 (range 1–7). 182 units were transfused postoperatively in 27 patients. The median number of red cell units transfused was 3 (range 1–36).

Tables 2 and 3 describe the current in-house policies, together with what was actually requested in surgical pre-assessment. As a result of the findings, suggestions for new policies are made. Any operation in which there is 0 or 1 unit of red cells per patient transfused can be safely managed with a preoperative G and S as opposed to a cross-match test.

A cost savings analysis was performed based on the updated policies and an estimated GBP 8,596.00 per annum of savings would have been possible had these been adhered to. This is only with the surgeries specified in tables 2 and 3 where at least 6 procedures were performed during the study period. The results demonstrate that compliance with policies is very poor. In total, 220 patients underwent a minor operation where the current in-house policy was 'no blood bank test' (table 3). Of these 220 patients, only 6 (2.73%) were correctly managed preoperatively with a G and S test. All the remaining 114 patients had G and S testing.

Discussion

The study aimed to audit compliance with in-house policies on the use of the blood transfusion service. What is clear is that compliance is poor (2.73% in some areas) and that we are over-ordering blood products in many surgeries. In the absence of an explicit MSBOS, ordering for blood transfusion is frequently based on the subjective anticipation of blood loss instead of audit-based estimates of requirement in a particular procedure. The current policy for MSBOS in our university hospital for various hepatobiliary and colorectal surgeries can be streamlined as a result of this study and without impacting patient safety. This would reduce the burden on the blood transfusion service and generate considerable cost savings.

Since the introduction of the MSBOS, hospitals have implemented policies for blood ordering in an attempt to improve blood stock management and reduce wastage. Our hospital's MSBOS policies vary depending on the type of surgery performed (tables 2 and 3). The BSH recommendation is that blood is not made available unless usage is more than 50%, which is equivalent to a C:T ratio of 2:1 [7]. Although the global C:T ratio was 2.1:1, indicating that our usage is appropriate to demand, the adjusted C:T ratios per surgery varied between 3.75 and 37, suggesting that we are grossly over-ordering cross-matches in certain surgeries.

Only patients receiving intraoperative red cells or requiring secondary operations for complications required immediate blood transfusion. If clinically indicated, red blood cells could have been made available after a G and S test at considerably lower cost. Further monies could be saved if the planned exploratory operations requiring cross-matched blood were only requested once the proposed surgery was confirmed by intraoperative findings.

Our results demonstrate that over-ordering of routine preoperative practices is almost uniform throughout all elective general surgical procedures. G and S tests were requested for simple procedures such as hernia repair, lateral sphincterotomy and uncomplicated examinations under anaesthesia. Not only is this unnecessary, but it also adds to the burden of the blood transfusion service. There is clearly a need for flexibility in these policies and there are cases where anticipated blood losses are greater due to patient and operative factors. Patient safety should never be adversely affected by policies and regular audits are needed to ensure that changes in outcomes are frequently monitored to maintain standards. All members of the medical team, including the pre-assessment nurses who are requesting the G and S tests, need educating into the reasons behind these policies.

Preoperative over-ordering of blood has been documented for nearly 40 years [1]. A number of studies subsequent to this have confirmed that over-ordering continues and that each institution should create an MSBOS based on their evidence base and the BSH guidelines [8–11].

Several of the policies for major surgeries (table 2) can be modified so that they require only a G and S test. In our university hospital, with exceptions, a G and S test is valid for 6 weeks and a cross-match test for only 2 days. In addition, many of the minor surgery policies (table 3) can be modified to need no blood bank investigations preoperatively. These modifications in both major and minor surgery will bring about considerable reductions in burdening of the transfusion service.

A drawback of our study is the relatively short amount of time examined. C:T ratios were only calculated if the procedure was carried out more than 5 times in the 6-month period and therefore some 'less performed' operations were excluded, including those performed at peripheral hospital sites. These included operations such as division of adhesions, excision of lipoma, open exploration of the common bile duct, small bowel resection and panprocto-colectomy. The policies suggested are therefore incomplete and require further evaluation to create complete evidence-based policies for all elective general surgical procedures.

In conclusion, over-ordering of red cell products is common in many elective general surgical operations. The requesting of G and S tests is almost uniform throughout all major and minor surgeries and cannot be justified based on this audit. Implementation of the recommended MSBOS and the introduction of G and S tests for eligible minor surgical procedures is a safe, effective and financially beneficial strategy. It should, however, be borne in mind that policies are only to provide an aid in decision-making, and clinical judgement by experienced medical personnel is required in predicted difficult cases.

Disclosure Statement

The authors did not provide a conflict of interest statement.

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