ORIGINAL ARTICLE

Revisiting of Preoperative Blood Ordering Policy—A Single Institute's Experience in Taiwan

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Background: If unnecessary blood orders can be reasonably waived, it will reduce both workload and financial expenditure. A review of the surgical blood ordering practice is, therefore, mandatory.
Methods: Routine preoperative blood orders were retrospectively audited. After receiving the requests, we usually performed only type and screen tests without crossmatching until an actual need for transfusion occurred. Transfusion probability (number of patients transfused ÷ number of procedures × 100) was calculated. One unit of donation was defined as 500 mL whole blood. If surgical procedures were associated with insignificant blood loss (number of units transfused ≤ 1) and transfusion probability was less than 5%, then it was considered to be safe to disregard a preoperative blood order.
Results: The blood ordering practices for 5,472 patients who received various surgical procedures were reviewed over a period of 48 operation days. Neither preoperative requests for preparation of red cells nor transfusion was made in 3,482 patients. Preoperative requests for preparation of red cells were made in 1,990 patients, but only 751 (37.74%) actually received blood transfusion on the day of the operation. Analysis showed that it would have been safe to disregard a preoperative blood order for ophthalmic surgery, ear surgery, nose surgery (endoscopic sinus surgery, submucosal turbinectomy), microlaryngoscopic surgery, tracheostomy, thyroidectomy, mastectomy, laparoscopic cholecystectomy, hemicolectomy, hernioplasty, arthroscopic surgery, laminectomy, laparoscopically assisted vaginal hysterectomy, vasectomy and varicose vein surgery.
Conclusion: A review of preoperative blood orders has identified certain surgical procedures with insignificant blood loss and low transfusion probability, for which preoperative blood orders may be safely disregarded in order to reduce unnecessary laboratory workload while not jeopardizing patient safety. [*J Chin Med Assoc* 2006;69(11):507–511]

Key Words: blood ordering policy, pretransfusion test, surgery, transfusion

Introduction

For some surgical procedures, the preoperative blood order exceeds the actual need. Over-ordering of blood may be a common practice in some hospitals. Surgeons sometimes order blood crossmatching only on the basis of habit.[1] This can lead to problems in blood bank inventory management, incur sizable expenditures for commercial reagents, and result in unnecessary laboratory work and extra costs.

A transfusion service should follow policies that work toward more efficient use of blood inventory control and consequently a reduction in blood bank operation costs. Type and screen testing is one of the important policies used by blood banks to avoid blood being reserved unnecessarily.[2] The type and screen policy simply means that the patient's blood is grouped and serum is screened for possible red cell allo-antibodies. Units are not crossmatched until an actual need for transfusion occurs.[3] When an operation is expected to involve minimal blood loss, a type and screen order was recommended for surgical procedures that require blood in less than 10% of cases.[4]

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The requirements of pretransfusion testing have undergone repeated modification.[5] There are many surgical procedures, such as laminectomy, for which blood is routinely ordered but rarely used. Influenced by an increasing demand for cost-effectiveness and conservation of blood supply, a revision of blood ordering strategy based on an audit of an individual hospital is mandatory.

The present study aimed to identify, at a single institution, the common surgical procedures that have low transfusion probability and minimal blood loss by analyzing the preoperational blood orders. In such operations, type and screen tests may even be omitted to further decrease workload while maintaining patient safety.

Methods

Subjects

With the approval of the hospital transfusion committee, blood orders for surgical procedures performed during the period December 22, 2004 to March 15, 2005 in our hospital were retrospectively reviewed. We analyzed blood ordering practices to determine whether or not blood orders were made. Once a blood order was made, surgeons usually requested preparation of at least 1 unit of packed red cells. The blood bank followed the type and screen policy, whereby units were not crossmatched until an actual need for transfusion occurred. For patients with clinically significant antibodies or for procedures that required an average transfusion amount of 2 units or more, blood units were crossmatched in advance. Adequate daily inventory of blood components was ascertained and the availability of blood before the start of surgical procedures was confirmed.

Type and screen policy

For some procedures, surgeons either did not make any blood order or requested only a preparation of 1 unit of packed red cells before the operation. After receiving the requests, the blood bank usually performed only type and screen tests without crossmatching. If the patient had clinically significant red cell antibodies or if massive bleeding was expected, a minimum of 1 unit of packed red blood cells was crossmatched in advance and the compatible blood components placed on reserve.

Pretransfusion tests

Pretransfusion testing consists of ABO grouping, Rh(D) grouping, antibody screening and major crossmatching. ABO blood group was determined by testing the red blood cells with anti-A, anti-B and anti-A,B (Gamma Biologicals Inc., Houston, TX, USA). Confirmation of the test results was provided by testing the serum of the blood under investigation with group A_1 and group B red blood cells, and by comparing the reaction pattern with those observed in red cell testing. Tube test method using anti-D Series 5 (Immucor Inc., Norcross, GA, USA) was performed to test red blood cells for the presence or absence of D antigen. The low ionic polycation test using BKT test kit (TITUS Inc., Kansas, MO, USA) was utilized for antibody screening and major crossmatching.

Transportation

A pneumatic transport system (TELECOM Bedrijfscommunicatie B.V., Capelle aan den IJssel, The Netherlands) has been used by the blood bank to transport blood components for years. The transportation of blood components takes an average of 1 minute and 30 seconds without any measurable hemolysis.

Evaluation of surgical blood ordering practices

For each type of operation, the number of procedures (P), number of requests for pretranfusion test (R), and number of patients transfused (T) were recorded, and the following indices were calculated.

1. Transfusion probability (%) = $(T \div P) \times 100$
   Surgical procedures with transfusion probability < 5% were considered as rarely requiring transfusion. Surgical procedures with transfusion probability ≥ 20% were considered as commonly requiring transfusion.
2. Amount of red cells transfused on the day of operation. Blood loss was considered minimal if less than 1 unit of red cells was transfused on the day of operation. (One unit of donation was defined as 500 mL whole blood in this study.) If transfusion probability was < 5% and the operation was expected to have minimal blood loss, then it would be considered safe to disregard a preoperative blood order.
3. Request rate (%) for pretransfusion test = $(R \div P) \times 100$
   A value < 10% was considered to be indicative of a pretransfusion test that was rarely requested.
4. Ratio of "request for pretransfusion test" to transfusion (R/T ratio) = $R \div T$
   An R/T ratio > 10 indicated that less than 10% of the procedures for which pretransfusion tests were requested required transfusion. If R/T ratio > 10

and transfusion probability < 5%, they were considered strongly indicative of excessive requests for pretransfusion tests.

Results

We reviewed the charts of 5,472 patients who received various surgical procedures in a period of 48 operation days. The surgical procedures included urogenital surgery ($n=588$), general surgery ($n=739$), neurosurgery ($n=262$), orthopedics ($n=721$), plastic surgery ($n=390$), chest surgery ($n=249$), hand surgery ($n=102$), colorectal surgery ($n=300$), pediatric surgery ($n=187$), cardiovascular surgery ($n=306$), ophthalmic surgery ($n=783$, including cataract surgery in 124 and visual correction in 54), ear surgery ($n=107$, including tympanoplasty in 62 and mastoidectomy in 6), nose surgery ($n=101$, including endoscopic sinus surgery in 32 and submucosal turbinectomy in 30), throat surgery ($n=215$, including microlaryngoscopic surgery in 85, tracheostomy in 19, and laryngectomy in 8), adult oral surgery ($n=86$), pediatric oral surgery ($n=15$), and gynecologic surgery ($n=321$).

No blood order or transfusion was made in 3,482 patients. Of the 1,990 patients for whom preoperative blood orders were made, only 751 (37.74%) received blood transfusion on the day of operation; in the remaining 1,239 patients (62.26%) who did not receive blood transfusion, our analysis found that the preoperative blood order could have been disregarded safely in 256 (20.66%).

Most ophthalmic surgery (T:P = 0:783), ear surgery (T:P = 0:107), nose surgery (endoscopic sinus surgery, T:P = 1:32; submucosal turbinectomy, T:P = 0:30), microlaryngoscopic surgery (T:P = 1:85), and tracheostomy (T:P = 0:19) did not require blood transfusion. The distribution of blood orders for other common surgical procedures that rarely required transfusion (transfusion probability < 5%) is summarized in Table 1. Neither blood order nor transfusion was necessary for these surgical procedures. Excessive requests for pretransfusion tests (R/T ratio > 10 and transfusion probability < 5%) were found for hemicolectomy, laminectomy and laparoscopically assisted vaginal hysterectomy.

The distribution of blood orders for common surgical procedures that often required transfusion (transfusion probability ≥ 20%) is summarized in Table 2. Procedures with transfusion probability > 30 included laryngectomy, gastrectomy, pancreatectomy, coronary artery bypass graft (CABG), aortic aneurysm repair (AAR), total hip replacement, and total knee arthroplasty. A median amount of red cells transfused of more than 2 units was only found for CABG and AAR.

Table 1. Blood orders for common elective surgical procedures that rarely required transfusion

	Procedures, *n*		R		T:P* (%)	R:P† (%)	R:T
	P	Without blood order	Untransfused procedures, *n*	T (RBC‡)			
General surgery							
Thyroidectomy	67	66	1	0 (0)	0	1.5	1:0
Mastectomy	26	24	1	1 (1 U)	3.8	3.8	2:1
LC	71	65	5	1 (1 U)	1.4	7.0	6:1
Hemicolectomy	21	0	20	1 (1 U)	4.8	95.2	21:1
Hernioplasty	124	123	0	1 (1 U)	0.8	0	1:1
Orthopedic surgery							
Arthroscopic surgery	30	30	0	0 (0)	0	0	0:0
Laminectomy	15	0	15	0 (0)	0	100	15:0
Gynecology							
LAVH	33	1	31	1 (1 U)	3	96.9	32:1
Urology							
Vasectomy	54	53	1	0 (0)	0	1.9	1:0
Vascular surgery							
Varicose vein surgery	13	13	0	0 (0)	0	0	0:0

Transfusion probability (%) = (T ÷ P) × 100; †request rate (%) for pretransfusion test = (R ÷ P) × 100; ‡RBC = median amount of red cells transfused. R = number of requests for pretransfusion tests; P = total number of procedures; T = number of patients transfused; U = unit (1 unit defined as 500 mL whole blood); LC = laparoscopic cholecystectomy; LAVH = laparoscopically assisted vaginal hysterectomy.

Table 2. Blood orders for common elective surgical procedures that often required transfusion

	Procedures, *n*		R		T:P* (%)	R:P† (%)	R:T
	P	Without blood order	Untransfused procedures, *n*	T (RBC‡)			
Throat surgery							
Laryngectomy	8	2	1	5 (1 U, 1–2 U)	62.5	75	1.2
General surgery							
Gastrectomy	47	2	27	18 (1 U, 1–2.5 U)	38.3	95.7	2.5
Pancreatectomy	17	0	8	9 (1.5 U, 1–2 U)	52.9	100	1.9
Cardiac surgery							
CABG	41	1	7	33 (2 U, 0–7 U)	80.5	97.6	1.2
Aneurysm repair	20	0	1	19 (3 U, 1–15 U)	95	100	1.1
Orthopedic surgery							
Hip replacement	34	2	20	12 (1 U, 1–2.5 U)	35.3	94.1	2.7
Knee arthroplasty	81	0	38	43 (1 U, 1–3 U)	53.1	100	1.9
Gynecology							
TAH + BSO	10	0	8	2 (1.5 U, 1–2 U)	20	100	5
Urology							
TURP	100	2	77	21 (1 U, 1 U)	21	98	4.7

**Transfusion probability (%) = (T ÷ P) × 100; †request rate (%) for pretransfusion test = (R ÷ P) × 100; ‡RBC = median amount of red cells transfused, range. R = number of requests for pretransfusion tests; P = total number of procedures; T = number of patients transfused; U = unit (1 unit defined as 500 mL whole blood); CABG = coronary artery bypass graft; TAH = total abdominal hysterectomy; BSO = bilateral salpingo-oophorectomy; TURP = transurethral resection of prostate.*

Discussion

Cost containment in the blood bank can be achieved by continual assessment of the statistical indices of surgical blood orders. At all times, one should strive for simplification, with patient safety as the primary concern. Careful monitoring of the practices of ordering blood components can lead to improved patient care and significant cost savings.[6] Auditing the surgical blood ordering practice may improve the efficiency of the use of blood for transfusion and avoid unnecessary ordering of blood.[7]

The crossmatch-to-transfusion ratio (C/T ratio) has been a useful tool for monitoring blood transfusion practice. C/T ratio > 2.5 means that < 40% of crossmatched units are transfused.[3] Over-ordering is evidenced by an excessively high C/T ratio, which has been reported to range from 17.6–64.1:1 for obstetric patients, including those undergoing cesarean section.[8] In our hospital, we use the "request for pretransfusion test" to transfusion ratio (R/T ratio) to evaluate over-ordering. For example, the R/T ratio for total abdominal hysterectomy with bilateral salpingo-oophorectomy was 5, which indicated no excess requests for pretransfusion tests.

The probability of a transfusion was defined by Mead et al as (number of patients transfused ÷ number of patients crossmatched) × 100.[9] A value > 30% was considered to be indicative of significant blood usage. In the present study, we did not crossmatch in advance unless the patient had clinically significant antibodies or massive bleeding was expected. We therefore modified the probability of a transfusion as (number of patients transfused ÷ number of procedures) × 100. For elective surgery with transfusion probability < 5% and the expected required amount of transfused packed red cells no more than 1 unit, a preoperative blood order may be safely disregarded. This policy would save both costs and time.

Surgical blood ordering strategies are influenced by the skill of the surgeon, the turnaround times of pretransfusion tests and blood issuance, the efficiency of the transportation of blood units, and blood inventory. Orders may be modified by the surgeon if the patient's condition is indicative of unexpected blood loss. We used the low ionic polycation test, which is a fast and reliable pretransfusion test for the detection of red cell antibodies[10] and which has been proven to be a suitable testing procedure for people in Taiwan.[11] Shortening of the turnaround time for blood issuance and implementation of the pneumatic transportation system have both greatly improved the opportune supply of blood components when urgent orders are placed.

In summary, we recommend that surgical blood ordering be made according to the following criteria:

1. There is no need to request a pretransfusion test when transfusion probability < 5% and the anticipated amount of red cell transfusion is no more than 1 unit.
2. The type and screen test should be done when transfusion probability ≥ 5% or the anticipated amount of red cell transfusion is greater than 2 units.
3. Crossmatching should be performed in advance for patients with clinically significant antibodies or for procedures that have an average transfusion level ≥ 2 units.

In applying these criteria, the surgeon must be aware of certain important variables: the surgeon's own skills; preoperative hemoglobin level and hemodynamic status of the patient; estimated amount of blood loss; patient's tolerance to blood loss; and the turnaround times of pretransfusion tests and transportation of blood components. Also, the availability of blood for an emergency situation should be confirmed preoperatively. The policy of acceptance of blood orders for elective surgeries requires close relationships among the transfusion medicine, surgery and anesthesiology services. More importantly, the policy should obtain the approval of the institutional transfusion committee.

In conclusion, the blood transfusion audit has become an essential aspect in formulating guidelines for surgical blood ordering. Data concerning surgical blood orders should be reviewed periodically. Based on the statistical results, the transfusion committee may establish realistic ordering levels for each procedure. Regular monitoring of surgical blood ordering practice is well worth the effort. It is suggested that every hospital should consider reviewing its own policy to establish a suitable surgical blood ordering policy.

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