Malaysian J Pathol 1996; 18(2): 107 – 112

Efficiency of blood usage for elective surgery in the University Hospital Kuala Lumpur

EJ LIM, M.Path., CG LOPEZ, FRCPA., VEERA SN, MBBS., MENAKA N, FRCPA., and *AMINAH A, M.Anaesthesia

*Departments of Pathology and *Anaesthesiology, Faculty of Medicine, University of Malaya, Kuala Lumpur*

Abstract

Provision of quality care, service and blood products to patients while containing costs and the amount of blood used should be the aim of every blood bank. Therefore a prospective audit was carried out over three months to determine how efficiently blood was being used in elective surgery in the University Hospital, Kuala Lumpur. Every case with blood crossmatched was monitored to determine the amount transfused and the posttransfusion haemoglobin level. Overcrossmatching of varying degrees was noted in almost all surgical procedures and overtransfusion in 45.5% of patients transfused. The rate of case postponement was 18.1%. These indicate inefficient utilization of blood and other resources. The transfusion index (TI) and range of units transfused were calculated for each procedure. They can be used as indicators of blood requirement and potential severity of hemorrhage. Suggestions to improve efficiency of blood utilization include the introduction and ongoing monitoring of guidelines on crossmatching and transfusion based on the data obtained here, by the hospital blood transfusion committee; the "group, screen and hold" practice for surgical procedures with high crossmatch transfusion ratios, low transfusion indices and a small range of units transfused could also be adopted.

Key words: Efficiency, blood usage, crossmatch-transfusion ratio.

INTRODUCTION

The challenge for today's Blood Transfusion services is to provide quality care, service and blood products to patients while containing costs and the amount of blood used. Inappropriate use of blood squanders limited resources of blood and money, and also brings about undesirable side effects. Inappropriate requests for blood also wastes resources and creates an artificial shortage of blood. Awareness of these problems has led to development of guidelines to promote rational use of blood. Studies in the United States of America, United Kingdom and Australia show that rational blood ordering results in great savings without harming patients.[1-9] There has been no comprehensive study done on blood usage in the University Hospital Kuala Lumpur (UHKL). Hence there is a need to critically review blood transfusion practices, to find out whether or not blood is being ordered and used rationally in elective surgery and to recommend suitable strategies for proper blood usage in this hospital.

MATERIALS AND METHODS

The UHKL has six surgical departments which include Surgery, Orthopaedic Surgery, Otorhinolaryngology, Ophthalmology, Obstetrics & Gynaecology and Oral Surgery which together have an allocation of approximately 500 beds and perform between 6000 - 6500 elective procedures a year. The population studied are the patients from these departments who undergo elective surgery and have blood requested for the surgery. This was a prospective study carried out to look at current transfusion practices and blood ordering practices of surgeons for elective surgery in UHKL and to make recommendations to ensure proper blood usage. The study was carried out over a three-month period beginning 3rd October 1994 and ending 2nd January 1995.

The data was obtained from the daily elective surgical list issued by the operation theatre, crossmatch request forms of each patient, haematology result computer records and where necessary, the patients' hospital records. The following information from the above sources were recorded and tabulated : the patient's name, age, sex and registration number; the patient's diagnosis and the type of surgery carried out; the number of units of blood requested as well as the number of units of blood actually transfused during and within 24 hours of surgery; the pre-operative haemoglobin (Hb) levels; the

Address for correspondence and reprint requests: Dr EJ Lim, Department of Pathology, Faculty of Medicine, University of Malaya, 50603 Kuala Lumpur, Malaysia.

TABLE 1: Formulae for calculation of CT ratio, transfusion index and degree of overtransfusion

CT ratio	=	Total number of red cell units crossmatched / Total number of red cell units transfused
Transfusion index	=	Total number of red cell units transfused for a procedure / Total number of occasions the procedure was performed
Degree of overtransfusion	=	Number of patients with posttransfusion Hb more than 11g/dl / Total number of patients transfused

posttransfusion Hb levels of patients who had been transfused in the period stated (the earliest available posttransfusion Hb level for each patient transfused was usually measured between the first and fourth post-operative days).

The crossmatch:transfusion (CT) ratio and the transfusion index was obtained for each type of elective surgery done.[4] The overall CT ratio and degree of overtransfusion were calculated. Table 1 shows the formulae for calculation of CT ratio, transfusion index and degree of overtransfusion. The ranges and mean numbers of units crossmatched and transfused per case for each type of procedure were also recorded.

RESULTS

In the period studied, there were 2306 listed cases of elective surgery. 2433 units of blood were crossmatched for 936 of these listed cases. Of these, 170 cases with 469 units of blood crossmatched were postponed for various reasons. Therefore only the remaining 766 cases were studied. The patients ranged in age from 1 year to 96 years with a peak age-group of 25 to 35 years. 64.2% were females and 35.8% males. The overall total number of blood units crossmatched for all the cases studied were 1964 and the total number transfused 446. Therefore the overall crossmatch: transfusion ratio (CTR) was 4.4. 23.4% of the cases were from the General Surgical unit; 8.5% from the Cardiothoracic unit; 6.8% were urology cases; 2.2% were neurosurgical cases; 1.0% belonged to the plastic surgical unit. 32.8% of the cases were from the department of Obstetrics and Gynaecology with 14.9% listed for lower segment Caesarian sections (LSCS) and 17.9% being gynaecological cases. The department of Orthopaedic surgery accounted for 22.7% of the cases while the department of Otorhinolaryngology accounted for a mere 2.1% of the cases studied. 72 different kinds of surgical procedures were performed.

Obstetrics & Gynaecology

The blood usage indices for Obstetrics and Gynaecological cases are summarised in Table 2. LSCS done for reasons other than placenta praevia was the most frequently performed elective surgical procedure (96 cases) and had one of the highest total number of units crossmatched i.e. 196 units. The TI was 0.09, indicating that patients were rarely transfused. The CT ratio was correspondingly very high i.e. 21.78. Gynaecological laparoscopies and vaginal hysterectomies with transfusion indices of 0.12 and 0.15, and high CT ratios of 17.00 and 13.50 respectively were two other procedures where a lot more blood was crossmatched than transfused. The TAHBSO also had a high CT ratio of 5.03 but the TI of 0.51 suggested that the patients were more frequently transfused than in the earlier mentioned cases. Wertheim's hysterectomy and LSCS done for placenta praevia on the other hand appeared to have more economical CT ratios of 1.46 and 3.85 respectively. We did not look into whether overtransfusion was a contributary cause of these lower CT ratios as there were too few cases of these procedures with proper documentation of posttransfusion Hb levels.

Surgical Cases

Table 3 shows the blood usage for surgical cases. Patients undergoing thyroidectomy and TURP were found to have very low transfusion indices and therefore were hardly ever transfused. However, very high CT ratios of 58 and 28 respectively were recorded. Many of the other procedures that were looked into, like excisions/ simple procedures, laparoscopic cholecystectomy, simple mastectomy, pyeloplasty/lithotomy and split skin grafting also had low transfusion indices and high CT ratios. Procedures like laparotomy, partial gastrectomy, CABG and ASD closure appeared to have more economical CT ratios of 4.00 or less but had

TABLE 2: Blood usage indices for surgical procedures in the department of Obstetrics & Gynecology

Procedure	No.	Units crossmatched			Units transfused			CT ratio
		Range per case	Mean per case	Total	Range per case	Mean per case (TI)	Total	
LSCS - placenta praevia	18	2-4	2.78	50	0-10	0.72	13	3.85
LSCS - general	96	2-4	2.04	196	0-2	0.09	9	21.78
TAHBSO	65	1-6	2.55	166	0-8	0.51	33	5.03
Laparoscopy	17	1-3	2.00	34	0-2	0.12	2	17.00
Vaginal hysterectomy	13	2-3	2.08	27	0-2	0.15	2	13.50
Wertheim's hysterectomy	10	4-10	4.8	48	0-9	3.30	33	1.46

TI = transfusion index; CT = crossmatch-transfusion: LSCS = lower segment caesarian section; TAHBSO = total abdominal hysterectomy and bilateral salpingo-oophorectomy

TABLE 3: Blood usage indices for surgical procedures in the departments of General Surgery, Urology, Cardiothoracic surgery and Plastic surgery

Procedure	No.	Units crossmatched			Units transfused			CT ratio
		Range per case	Mean per case	Total	Range per case	Mean per case (TI)	Total	
Excisions/ simple procedures	32	1-4	1.84	59	0-2	0.25	8	7.38
Laparotomy	30	1-6	2.87	86	0-8	1.07	32	2.69
Thyroidectomy	25	2-6	2.32	58	0-1	0.04	1	58.00
Laparoscopic cholecys tectomy	13	2	2	26	0-2	0.15	2	13.00
Simplemastectomy	12	2-4	2.50	30	0-2	0.17	2	15.00
Colectomy/ AP resection of rectum	12	2-4	3.17	38	0-2	0.50	6	6.33
Partial gastrectomy	10	2-4	3.6	36	0-4	0.90	9	4.00
Pyeloplasty/lithotomy	17	1-4	2.12	36	0-2	0.18	3	12.00
TURP	15	0-2	1.87	28	0-1	0.07	1	28.00
CABG	15	6-10	6.27	94	0-6	3CO	45	2.09
ASD closure	12	4-18	6.5	78	0-4	2.17	26	3.00
SSG	10	1-4	2.2	22	0-2	0.30	3	7.33

AP = anterior posterior; TURP = transurethral resection of prostate; CABG = coronary artery bypass graft; ASD = atrial septal defect; SSG = split skin graft

TABLE 4: Blood usage indices for surgical procedures in the department of Orthopedic surgery

Procedure	No.	Units crossmatched			Units transfused			CT ratio
		Range per case	Mean per case	Total	Range per case	Mean per case (TI)	Total	
ORIF	83	1-4	2.41	200	0-4	0.39	32	6.25
DHS	36	1-4	2.61	94	0-3	0.33	12	7.83
TKR/THR	20	2-6	3.35	67	0-6	0.55	11	6.09

ORIF = open reduction and internal fixation of fractures; DHS = dynamic hip screw installation; TKR/THR = total knee replacement/total hip replacement

much higher transfusion indices (0.90 or more). There were too few cases with documented posttransfusion Hb levels, therefore we did not look into whether overtransfusion was a cause of the lower CT ratios in these cases.

Blood usage for ***Orthopaedic Surgical cases*** are shown in Table 4. Open reduction and internal fixation of fractures (ORIF) were found to be one of the most frequently performed elective surgical procedures. All the three orthopaedic procedures studied here that is, ORIF, dynamic hip screw installation (DHS) and total knee replacement/total hip replacements had high CT ratios of between 6 to 8. TKR / THR however also showed a relatively high TI of 0.55 while the other two had lower transfusion indices.

224 cases of other miscellaneous procedures were performed. This consisted of surgical procedures like open cholecystectomy, transurethral resection of bladder tumour, cleft palate repair and diagnostic dilatation and curettage. Due to the small numbers, the data on these cases were not analysed.

Degree of Overtransfusion

Of the 766 patients studied, we were able to trace 134 patients who had been transfused with red cells within 24 hours of surgery and had documented post-transfusion Hb levels. Using the formula stated above we found out that 45.5% (61) of this subset of patients had been over-transfused.

Postponed cases

Of the 170 postponed cases (18.1% of total listed cases with blood crossmatched), 29 cases were postponed because the patients were unfit for general anesthesia, 108 cases because of lack of operating time and 1 case because of insufficient blood stock in the blood bank. This latter figure appears less than expected and could be because only cases with blood already crossmatched were included in this study. 2 cases were postponed because of incompatible crossmatches and 4 cases because of unavailability of intensive care unit beds. In the remaining 26 cases the reason for postponement of surgery could not be elicited.

DISCUSSION

A crossmatch:transfusion ratio (CTR) of 2.5:1 is generally accepted by transfusion authorities as an efficient level of utilization of crossmatched blood.[1,2] In our study, except for CABG and Wertheim's hysterectomy, this desired CTR seems to have been exceeded in all the other types of surgical procedures. In some, like LSCS and TURP, the ideal CTR appears to have been exceeded by a wide margin. The overall CTR of 4.4 implies that, on the whole, only about one fifth of the blood crossmatched for elective surgery is transfused. Therefore it appears that a large number of units of blood are crossmatched but not utilized, indicating that a lot of blood that could be put to better use had been reserved to no avail. This also suggests that a significant amount of time spent by overworked blood bank technologists as well as reagents used for crossmatching were also wasted. The significant number of cases listed but postponed for various reasons probably leads to even greater wastage of manpower, reagents and reservation of blood that is not utilized.

The transfusion index of each surgical procedure is an index of blood requirement for that particular procedure.[4] It can therefore be used as a guide to assess the necessity of crossmatching and also helps to indicate the appropriate number of units that need to be crossmatched. The maximum number of units

transfused for each procedure indicates the potential severity of bleeding in each procedure and is also a useful guide to decide whether crossmatched blood needs to be kept in reserve especially in those procedures where the CTR is relatively low.[4]

The degree of overtransfusion obtained here is also found to be high compared to that in various other centres where overtransfusion ranged from 27% to 39%.[10-12] This suggests that blood has been further wasted here and patients have been unnecessarily exposed to the very significant dangers of blood transfusion.

In order to address the problems mentioned above that have come to light as a result of this study, one suggestion is for a hospital blood transfusion committee consisting of representatives from the various departments which conduct surgery, the departments of Anesthesiology, Internal Medicine, Paediatrics and the Blood Bank to formulate steps to improve the quality of blood transfusion services and optimise expenditure and blood usage.[12-15] Based on experiences elsewhere, some of the suggested responsibilities of the blood transfusion committee would include looking into the problems highlighted here as well as other aspects of blood transfusion and to come up with suitable guidelines for blood ordering and transfusion practices in this hospital. Apart from that, the committee could also institute continuous monitoring to ensure adherence to these guidelines, and also formulate a system for individual cases where such guidelines may have to be waived.

A point arising from this study that could be addressed by the hospital blood transfusion committee could be the replacement of routine compatibility testing by the "type, screen and hold" procedure for surgical procedures with CTR's more than 2.5, low transfusion indices (less than 0.5)[4,16-18] as well as a low number of maximum blood units transfused. Examples of procedures that would fit this description would be LSCS done for reasons other than placenta praevia,[16] TURP and thyroidectomies. In the "type, screen and hold" procedure, blood is not crossmatched; instead the patient's blood is screened for antibodies by using internationally accepted techniques and reagents a few days prior to the procedure. If no antibodies are detected, no blood will be crossmatched. If the need does arise for transfusion, crossmatching can be accomplished in ten minutes using the immediate spin method. If antibodies are detected in the antibody screening tests, suitable blood units lacking the corresponding antigens and compatible with the patient will have to be provided prior to surgery. Several studies have shown the "type, screen and hold" procedure to be safe if done according to recommended techniques.[1,3,9] In the case of TURP, factors that could be predictive of increased bleeding like a history of chronic retention of urine could also be used to help decide on the necessity of crossmatching.[19] For other types of surgical procedures, the decision whether or not to routinely crossmatch blood could be guided by the values of the CTR's, transfusion indices and the maximum number of units transfused for each procedure. Should the decision be made to routinely crossmatch blood, the number of units required could be based on the calculated transfusion indices.

In order to successfully reduce overcrossmatching, it is also very important to look into the possible reasons as to why it occurs. A review of the literature suggested various possible reasons for overcrossmatching. These included a lack of confidence on the part of the surgeons in the ability of the blood bank to supply blood immediately if required.[5,16,18,20] The lack of a proper system with regards to blood ordering and the lack of education of hospital doctors on existing blood ordering systems[2,5,11,15,20] were two other areas which also appeared to have contributed to overcrossmatching. This included lack of a formal maximum surgical blood ordering schedule (MSBOS)[2,18] and a proper system to ensure the enforcement and regular updating of the MSBOS[5,11,14,20] as well as lack of the institution of the "type, screen and hold" system.[2,18] This therefore led to doctors making decisions on the number of blood units to be ordered based on habit, traditions and medico-legal concerns rather than on objective factors.[2,16] The ordering of blood appeared to be even more indiscriminate if the ordering of blood for surgery was left to inexperienced house officers who have been known to overorder blood due to lack of communication with the senior doctors.[4,14] The failure to address other causes of delay in blood delivery, e.g. poor communication between the wards or operation theatre and the Blood Bank[2] was also found to be a cause of overcrossmatching. In one study the lack of confidence in the surgical skills of certain surgeons and their ability to predict the patients' bleeding potential led to overcrossmatching.[18]

As we did not investigate this aspect in this study, an extension of this study is necessary to

identify the factors contributing to overcrossmatching in UHKL. The identification of the reasons for overcrossmatching is important in any centre so that the Blood Transfusion Committee can formulate steps to rectify them. Often retraining of staff and the allowance of a trial period are necessary before new practices in transfusion can be implemented. This will allow the blood bank staff, surgeons and other doctors to familiarise themselves with and gain confidence in the new practices and to allow any unforeseen problems to be ironed out.

Guidelines on criteria for transfusion introduced by a transfusion committee and continuous monitoring to ascertain the suitability of these guidelines with modifications made whenever necessary may also help reduce overtransfusion and ensure patient safety. Another area that deserves further study is the problem of postponement of listed surgical cases. Since the causes of postponement elicited here are multidisciplinary in origin, a transfusion committee with members from the various disciplines may be in a better position to deal with this issue.

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