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An analysis of blood utilization for elective surgery in a tertiary medical centre in Malaysia

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Abstract

Background: The purpose of this study is to determine the efficiency of blood utilization for elective surgery at the University of Malaya Medical Centre (UMMC). A similar study conducted six years earlier in the same unit resulted in the introduction and implementation in December 1997 of the local Maximum Surgical Blood Order Schedule (MSBOS) and the Group Screen and Hold (GSH) procedure instead of a full crossmatch. This paper compares the findings of the current study with that conducted earlier. *Materials and methods:* A prospective survey of the blood ordering practice for elective surgery over a 3-month period, from February to April 2001 was conducted in the Transfusion Medicine Unit (TMU) of the UMMC. Outcome measures used in this study were (a) decision on whether to perform a full cross match or a GSH procedure using the MSBOS guidelines, (b) the crossmatch transfusion ratio (CT), (c) the transfusion index (TI) and (d) the degree of over transfusion calculated from the pre and postoperative hemoglobin levels. The CT ratio and the TI were calculated for each type of elective surgery performed during the study period. *Results:* In the present study 31.2% of cases had blood crossmatched as against 40.6% in the earlier one The overall CT ratio was 5.0 and many procedures were found to have a high CT ratio and a low transfusion index. It was observed that 47.7% of patients were over transfused as compared to 45.5% in the earlier study. *Conclusion:* The introduction of MSBOS and GSH has led to a significant decrease in the percentage ($p = < 0.05$) of cases for which a full crossmatch is done. The conservation policies have led to a decreased crossmatch workload and reduced blood outdating. Although the CT ratio has improved for many individual procedures, the overall CT ratio in fact increased from 4.4 to 5.0. There remains therefore, a continuous opportunity to improve transfusion practices by reviewing the local MSBOS. The transfusion index (TI) calculated for each procedure in this study can be utilized to recommend a GSH for those procedures with low TI.

Key words: blood utilization, elective surgery, cross match transfusion ratio, maximum surgical blood order schedule.

INTRODUCTION

Providing blood for patients undergoing elective surgical procedures uses considerable resources of blood transfusion services even when the blood is not transfused. It is not surprising therefore, that interest in audits and effective education in transfusion medicine has increased over the last decade. Audits permit the identification of areas of practice that can be improved, including follow-up education and discussion with the physicians who prescribe these transfusions. This study compares blood transfusion practices at the University of Malaya Medical Centre (UMMC) after the introduction of the local Maximum Surgical Blood Order Schedule (MSBOS) and the Group Screen and Hold (GSH) procedure to those prior to the introduction of these practices.[1] It assesses the impact that these practices have had and suggests the measures that can be put in place to further rationalise transfusion practices related to the ordering and use of blood in elective surgery.

Unnecessary ordering of blood for surgical patients can be reduced without having any detrimental effects on the quality of patient care.[2,3,4] Use of blood conservation policies such as the MSBOS and the GSH procedure have succeeded in curtailing unnecessary transfusion practices. The MSBOS schedule used by blood banks lists the maximum amount of blood that may be ordered initially for common elective surgical procedures.[5] It is a guide that is

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determined by past surgical blood use. For procedures where blood is not usually needed, the patient's blood sample is grouped and screened for irregular antibodies. Compatible units are crossmatched only if antibodies are detected. Where the antibody screen is negative no further procedure is followed until blood is actually needed. When it is so needed, the blood is made available within 15 minutes after an immediate spin technique. The group and antibody screen has been shown to be 99.99% effective in preventing the transfusion of incompatible blood.[6]

METHODS AND MATERIALS

The University of Malaya Medical Centre is an 860-bedded hospital with approximately 7500 to 8000 elective surgical cases performed each year. Since late 1997, the hospital has shifted from routine compatibility testing of blood for transfusion to a new system. The new system involves decisions being made as to whether to perform a full cross match or a GSH procedure using guidelines based on the local MSBOS.

A prospective audit of blood usage was carried out from February to April 2001. All requests of blood for elective surgery during this period were monitored. The data was gathered from the daily surgical lists for elective cases, blood transfusion request forms, and computer records. The patient's name, age, sex, registration number, ward, diagnosis, type and date of surgery, and the number of units requested, crossmatched and transfused during and within 24 hours of surgery were recorded. The number of units unused and the pre- and postoperative haemoglobin levels were also noted. The postoperative haemoglobin level was taken as that measured between the first and fourth post-operative days similar to that done in the previous study. The degree of over transfusion was calculated. All listed cases for which blood had been crossmatched were recorded, including those which had been subsequently postponed for some reason. The crossmatch transfusion ratio (CT) and the transfusion index (TI) were obtained for each type of elective surgery done. A standard method of determining the efficiency of blood ordering is to calculate the ratio of units cross-matched to units transfused. A CT ratio of about 2.5:1 has been held to be acceptable for a hospital with a full range of clinical services.[6]

The TI is derived by the total number of red cell units transfused for a procedure divided by the total number of occasions the procedure was performed. The degree of over-transfusion is calculated by the number of patients with post transfusion Hb of more than 11g/dl divided by the total number of patients transfused.[1]

The six surgical departments at the Centre are Surgery, Orthopaedics, Obstetrics & Gynaecology, Otorhinolaryngology, Oral Surgery and Ophthalmology. In our study the latter three departments are tabulated under the caption ENT.

RESULTS

The number of cases listed for elective surgery for the three-month period was 1897. Thirty-nine percent of the listed cases were from the General Surgical Unit, 30% from Orthopaedics, 21% from O&G and 10% was from the ENT department. One thousand six hundred and twenty seven units of blood were cross-matched for 591 cases (Table 1). In effect, cross matching of blood was done for 31.2% of the cases. This compared favourably with the practice prior to the introduction of the MSBOS and GSH. The earlier study recorded blood units cross-matched for 40.6% of listed cases. The average number of units of blood cross-matched per case however had increased marginally, from 2.6 units per case previously to 2.8 units per case now. This may be accounted for by the mix of cases for which crossmatching is now conducted as compared to the previous study. There was also an improvement in the postponement rate. In the previous study 170 of the 936 cases (18.1%) for which the blood had been crossmatched had been postponed.[1] This involved 469 units of blood. In this study only 53 out of 591 cases (9.0%) crossmatched were postponed which involved 153 units of blood (Table 1).

One thousand four hundred and seventy four units were cross-matched for 538 cases. 297 units of blood were transfused. The overall CT ratio was 5.0. Of the 538 cases operated we were able to trace 128 patients who had been transfused with red cells and had documented post transfusion Hb levels. Of these patients 47.7% were over transfused. This over-transfusion rate is high in comparison to that of other centres where such studies have been conducted. In these other centres over transfusion ranged from 27 to 39%.[7,8,9]

Surgery

The implementation of conservation policies resulted in blood being crossmatched for only 185 of the 748 listed cases (Tables 1 and 2). The

GSH procedure was implemented for 563 cases. It was adopted for cases such as herniotomy, thyroidectomy, cholecystectomy, simple mastectomy and other minor surgical cases for which blood was being cross-matched previously. Six hundred and forty five units were cross-matched for the 185 cases of which only 158 units were transfused. The overall CT ratio was 4.0. The CT ratio was however significantly lower for procedures such as abdomino-perinea1 resection (1.9:1), hepatectomy (2.4: I) and aortic aneurysm (1.8:1). Although economical CT ratios were noted for procedures such as gastrectomy (3:1), and radical transurethral resection of bladder tumour (TURBT) (1.1:1), the total number of cases involved were too small for conclusion as to transfusion practice in such procedures.

High CT ratios and low transfusion indices were noted for thoracotomies, coronary artery bypass graft (CABG), valve replacement/repair, nephrectomies, transurethral resection of prostate (TURP) and TURBT. Therefore a further reduction in the number of units routinely crossmatched for these cases is suggested. Interestingly enough, the CT ratios for procedures such as CABG and valve replacement were very reasonable in the last study.

Orthopaedics

A total of 568 cases were listed, out of which blood was matched for 195 cases and a GSH procedure was done for 373 of them (Tables 1 and 3). A total of 527 units were matched for the 195 cases but only 76 units were transfused. The overall CT ratio for Orthopaedics was 6.9. The CT ratio for open reduction and internal fixation that was one of the more frequently performed elective orthopaedic procedures was unacceptably high at 45.5. It was 6.25 in the previous study. Above and below knee amputations and hemiarthroplasty showed high CT ratios at 12 and 12.5 respectively. The transfusion indices were low for these procedures and therefore a group and screen technique is suggested for them in future. For cases such as total hip replacement (THR), total knee replacement (TKR) and scoliosis where the transfusion indices were found to be low, a further reduction in the number of units cross-matched is suggested. The CT ratios for THR/TKR and dynamic hip screw fixation (DHS) do

TABLE 1: Blood utilization indices in the various departments of UMMC

Departments	Total no. of listed cases (%)	No. of cases for which blood was CM	No. of cases for which GSH	Total no. of units CM	Total no. of units transfused	CTR
Surgery	748 (39%)	185	563	645	158	4.0
Orthopaedics	568 (30%)	195	373	527	76	6.9
Obstetrics and Gynaecology	400 (21%)	171	229	370	58	6.3
ENT	181 (10%)	31	150	82	5	16.4
Total	1897	591	1306	1627	297	
No. of cases postponed		53		153		
No. of operated cases for which blood was crossmatched		538		1474	297	5.0

Abbreviations: CM = crossmatched, GSH = group screen and hold, CTR = crossmatch-transfusion ratio.

TABLE 2: Blood utilization indices for general surgery

Procedure	Total no. of cases	No. of cases for which blood was CM	No. of units CM	No. of transfused	CTR	TI	Recommendation GSH/CM
Laparotomy	10	8	22	2	11	0.2	GSH
Herniotomy	91	3	5	1	5	0.01	GSH
Thyroidectomy	31	2	4	1	4	0.03	GSH
Adrenalectomy	3	3	12	0	12	0.03	GSH
Cholecystectomy	46	3	6	1	6	0.02	GSH
Simple mastectomy	42	0	0	0	0	0	GSH
Radical mastectomy	7	7	18	4	4.5	0.57	GSH
Oesophagotomy	1	1	6	6	1	6	4-6 units
Gastrectomy	3	3	12	4	3	1.3	3 units
Colectomy	7	3	22	2	11	0.29	GSH
AP resection, colon	15	15	50	27	1.9	1.8	3 units
Colostomy closure	11	2	3	0	3	0	GSH
Pancreatectomy	5	5	26	4	6.5	0.8	2-4 units
Splenectomy	3	3	10	1	10	0.33	2 units
Hepatectomy	9	9	48	20	2.4	2.2	3-4 units
Plastic surgery	14	8	12	3	4	0.37	GSH
Arterial Bypass	4	4	12	3	4	0.75	2 units
IVC tumour excision	2	2	10	6	1.7	3	3-4 units
AAA	4	4	17	9	1.8	2.25	3-6 units
Tracheostomy	10	1	4	3	1.3	0.3	GSH
Pneumonectomy	9	9	35	3	11.6	0.3	GSH
CABG	14	14	77	10	7.7	0.7	2-4
Valve replacement/ Repair	12	12	60	14	4.2	1.1	2-4
Pyeloplasty/ Lithotomy	17	12	23	2	11.5	0.12	GSH
TURP	25	8	15	0	15	0	GSH
TURBT	12	12	25	0	25	0	GSH
Radical TURBT	2	2	12	11	1.1	5.5	2-3 units
Ureteric repair	2	2	4	0	4	0	GSH
Uretheral repair	2	2	4	0	4	0	GSH
Nephrectomy	6	6	22	4	5.5	0.66	GSH
Craniotomy/ Cranioplasty	2	2	6	2	3	1	GSH
Brain tumour resection	15	15	55	12	4.5	0.8	2-3 units
Spinal cord tumour resection	3	3	9	1	9	3	3-4 units
Others	329						
Total	748	185	645	158	4		

Abbreviations: CM- crossmatched, CTR- crossmatch-transfusion ratio, TI- transfusion index, GSH- group screen and hold, AP- abdomino-perineal, IVC – Inferior Vena Cava, AAA- abdominal aortic aneurysm, TURP- transurethral resection of prostatic, TURBT- transurethral resection of bladder tumour, CABG- coronary artery bypass grafting

TABLE 3: Blood utilization indices for orthopaedics

Procedure	Total no. of cases	No. of cases for which blood was CM	No. of units CM	No. of units transfused	CTR	TI	Recommendation GSH/CM
ORIF of Femur	78	43	91	2	45.5	0.04	GSH
Other compound fractures	137	13	26	4	6.5	0.30	GSH
THR/TKR	37	32	115	21	5.4	0.54	GSH
Hemiarthroplasty	12	12	25	2	12.5	0.166	GSH
DHS	24	18	41	5	8.2	0.27	GSH
Scoliosis repair	14	14	60	22	2.7	1.57	4-6 units
TB spine-dbridement	3	3	14	3	4.7	1	3 units
AKA/BKA	10	5	12	0	12	0	GSH
Spinal fracture	6	6	23	4	5.8	0.66	2-3 units
Paediatric deformities	55	24	46	1	46	0.04	GSH
Osteotomy	7						
Others	185	28	74	10	7.4	0.35	GSH
TOTAL	568	195	527	74	6.9		

Abbreviations: CM- crossmatched, CTR- crossmatch-transfusion ratio, TI- transfusion index GSH- group screen and hold, ORIF- open reduction and internal fixation, THR- total hip replacement, TKR- total knee replacement, DHS- dynamic hip screw, TB- tuberculosis, AKA/BKA- above/below knee amputation

TABLE 4. Blood utilization indices for Obstetrics & Gynaecology

Procedure	Total no. of cases	No. of cases for which blood was CM	No. of units CM	No. of units transfused	CTR	TI	Recommendation GSH/CM
LSCS (Previous LSCS/BOH)	47	47	63	1	63	0.02	GSH
LSCS (Regular)	44	0	0	0	0	0	GSH
LSCS (PP)	5	5	16	2	8	0.4	GSH
TAHBSO	76	70	165	24	6.9	0.34	GSH
Wertheims hysterectomy	5	5	24	12	2	2	4 units
Vaginal hysterectomy	13	10	20	0	20	0	GSH
Myomectomy	8	6	12	0	12	0	GSH
Laparotomy	22	19	54	19	2.8	1	2 units
Cystectomy	13	8	16	0	16	0	GSH
Others	167	0	0	0	0	0	GSH
Total	400	171	370	58	6.3		

Abbreviations: CM- crossmatched, CTR- crossmatch-transfusion ratio, TI- transfusion index, GSH- group screen and hold, LSCS- lower segment Caesarean section, BOH- bad obstetric history, PP- placenta praevia, TAHBSO- total abdominal hysterectomy and bilateral salphingo-oopherectomy not show any significant improvement when compared with the previous study. Paediatric cases formed about 10% of the total orthopaedic surgical procedures. The CT ratio (46:1) was found to be abnormally high for these cases.

Obstetrics and Gynaecology

Out of a total of 400 listed cases, blood was matched for 171. Group and screen was adopted for 229 cases (Tables 1 and 4). Three hundred and seventy units were matched for the 171 cases of which only 58 units were transfused. The overall CT ratio was 6.3. High CT ratios were observed in total abdominal hysterectomy and bilateral salpingo-oopherectomy (TAHBSO), vaginal hysterectomies, myomectomies and cystectomies. All elective lower section cesarean sections (LSCS) cases were grouped and screened unless there was a previous scar. LSCS for bad obstetric history and placenta praevias had high CT ratios (63:1 and 8:1 respectively). The CT ratio for LSCS due to placenta praevia (8:1) was higher when compared with the earlier study (3.9:1). A G&S was done for laparoscopy, hysteroscopy, tubal ligation, oopherectomy and simple cystectomy. The CT ratio was within limits for Wertheim's hysterectomy and laparotomies. Except for Wertheim's hysterectomy, procedures such as TAHBSO and vaginal hysterectomy had higher CT ratios when compared with the earlier study.

ENT

A total of 181 cases were listed which formed 10% of the overall elective surgical list. Eighty two units of blood were crossmatched for 31 cases, and a GSH procedure was adopted for the remainder (150). Of these only 5 units were transfused. The CT ratio was 16.4%.

DISCUSSION

Ordering large quantities of crossmatched blood for surgical patients of which little is ultimately utilised, creates an artificial shortage in the reserves, wastes valuable technical time and squanders expensive reagent. Blood banks face an ever-increasing demand for blood and its components. When this demand exceeds the resources of the blood bank, implementation of the surgical lists will be compromised. Blood banks need to adopt blood-conserving policies. Numerous studies indicate that the introduction of MSBOS and GSH schedules have resulted in substantial monetary savings, a reduction in blood that is outdated and a decrease in blood bank workload.[10, 11, 12, 13]

On the whole, the implementation of the MSBOS and the GSH procedure since late 1997 in the hospital, apart from improved blood inventory control, resulted in a significant reduction in unnecessary or inappropriate crossmatching of blood for routine elective surgical cases (p=<0.05, Table 5). This has led to savings in terms of manpower and cost. This saving has been translated into increased production of components for increasing demand. However, in spite of these positive results and careful monitoring of the transfusion requests, we found that the overall CT ratio is about the same as in the earlier study (p=>0.05, Table 5).

In general surgery procedures, the CT ratio varied greatly. It was within acceptable limits for abdominal-perinea1 resection of colon, hepatectomy and aortic aneurysm. Although economical CT ratios were also observed for radical TURBT, pancreatectomy and splenectomy the number of cases involved are too small to be conclusive. High CT ratios and low transfusion indices were noted for thoracotomies, CABG, valve replacement/repair, TURP, TURBT and nephrectomy. Unlike in the earlier study, the findings here indicate high CT ratio and low TI in cardiac surgery. This is probably due to advanced techniques and improved surgical skills. Although the amount of blood cross-matched for cardiac surgery was reduced from 6-10 units prior to the introduction of conservation procedures to 6 units, the actual blood usage was less than three units. The findings of this study therefore indicate that there should be a further reduction in the number of units routinely cross-matched for cardiac surgery cases. For all other procedures that have recorded high CT ratios and low transfusion indices, a further reduction in units cross-matched or a conversion to GSH is suggested.

For orthopaedic procedures, a low TI was recorded for procedures such as total hip and knee replacements, hemiarthroplasty, ORIF and scoliosis. For these procedures, a GSH procedure or a further reduction in the number of units matched is suggested. Paediatric cases formed 10% of the total orthopaedic procedures. Many of the paediatric cases have very low transfusion indices. Here too, a group and screen procedure may be adopted. In a study done by Grupp-Phelan and Tanz, it was found that transfusions were uncommon in children with virtually all surgical diagnoses.[14] However, in our hospital blood is routinely matched for all cases and the

TABLE 5. Analysis of blood utilization in elective surgery in comparison to previous study

	February to April 2001 No. (%)	October to December 1994 No. (%)	p value
Listed cases	1897	2306	
Listed cases grouped and screened	1306 (68.8%)	0 (0%)	
Listed cases for which blood crossmatched	591 (31.2%)	936 (40.6%)	$p < 0.05$
Units crossmatched for listed cases	1627	2433	
Units crossmatched but cancelled due to postponement	153 (9.4%)	469 (19.3%)	
Units crossmatched for operated cases	1474	1964	
Units transfused	297 (20%)	446 (22.7%)	
Crossmatch-transfusion ratio	5.0	4.4	$p > 0.05$
Percentage of overtransfusion	47.7%	45.5%	

CT ratio was found to be abnormally high (46:1). A significant contributing factor is that only a small volume of blood is usually sent as a sample in paediatric cases and this is inadequate for both a GSH procedure and a crossmatch if the need arose. The staff at the transfusion unit would in these cases routinely cross-match the sample. This problem can be overcome by requesting where possible for a larger volume of blood sample.

In gynaecological procedures, TAHBSOs, vaginal hysterectomies, LSCS for placenta praevias and cystectomies, the CT ratios range from 6.9 to 63. In these procedures, a further reduction in the number of units crossmatched is recommended.

In addition, this study also revealed a high degree of over-transfusion indicating that a significant percentage of patients had been over-transfused and unnecessarily exposed to risks of transfusion. There is an urgent need to address this problem.

However, for the blood conservation policies to succeed the trust, confidence and cooperation of clinicians is critical. The clinicians need to be confident that the Transfusion Medicine Unit is capable of supplying blood on time when there is an urgent need before being willing to accept the GSH practice.

In many obstetric and paediatric procedures, surgeons insist on taking crossmatched blood to the theatre, keeping the units there and returning unused blood after the surgery is over. This is because surgeons fear delay in getting blood in times of emergency as a result of the distance between the blood bank and the theatres, and that porters may not deliver the blood on time. Junior medical staff with limited knowledge of the true nature of blood usage in specific surgical procedures often makes excess orders of blood for crossmatch, which has been reported elsewhere[1,5]. Many feel that having more blood available is safer and this results in over-ordering. It is recommended that the CT ratio and the TI for each procedure be used as a guide to modify the existing MSBOS based on the findings of this study (Tables 2, 3, & 4).

For continued improvement of transfusion practice, continuous surveillance of the utilisation pattern is needed, especially since our hospital has a large and changing surgical staff. The MSBOS schedule can then be accordingly reviewed and modified because based on past practice it may have become obsolete in the light of more recently acquired data.

Continuous cooperation and frequent informal discussions between the anaesthesiology and surgical departments with the Transfusion Medicine Unit is required for further reduction in the preoperative crossmatch ordering. It is necessary to continually educate incoming house surgeons and new attending surgeons concerning the value of the GSH procedure and the crossmatching guidelines. Continuous monitoring by members of the transfusion staff is necessary for the success of these blood-conserving policies.

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