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Analysis of Blood Cross-match Ordering Practice in Surgical Patients at Ndola Central Hospital

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Abstract: **Although blood ordering is a common practice in surgical field, the average requirement for a particular procedure is usually based on subjective anticipation of blood loss rather than on evidence based estimates. Over-ordering with minimal utilization squanders technical time, reagent and imposes extra expenses on patients. The purpose of this study was to determine the efficiency of blood utilization for elective and emergency surgery at Ndola Central Hospital with a view of establishing a Maximum Surgical Blood Order Schedule (MSBOS).**

Methods: Laboratory-based retrospective descriptive study was conducted at Ndola Central hospital. Data for elective and emergency surgeries were collected from all discharged surgical patients and blood bank registries. Blood utilization was calculated using crossmatch to transfusion ratio (C/T), transfusion probability (%T), and transfusion index (TI) indices.

Results: During the study period, the transfusion department was requested to prepare 2,300 units of blood for 2,100 patients. Of these, 810 units were transfused for 400 patients. Blood transfusion from the units crossmatched was 35.2%. The overall ratios of C/T, %T, and TI index were 2.8, 20.0%, and 0.40, respectively. These blood utilization indices showed a different value between each department. In department of surgery, for instance, overall C/T ratio was 2.8 with high ratio in elective than emergency (4.1 versus 1.9). In addition, the overall %T was 14.5% with 20.9% in emergency and 9.7% in elective patients. On the other hand, in department of gynecology and obstetrics, the overall C/T ratio was 2.8 with elective surgical patients having the highest C/T ratio (4.3) than emergency patients (1.6). Moreover, the overall %T and TI were 26.1% and 0.38, respectively.

Conclusions: The overall blood utilization was not encouraging and excessive crossmatching with minimal transfusion practice was observed in elective surgical patients. However, for emergency surgical procedures blood utilization was within the acceptable limits. Therefore, blood ordering pattern for elective procedures need to be revised and over-ordering of blood should be minimized. Moreover, the hospital with blood transfusion committee should formulate maximum surgical blood ordering policies for elective surgical procedures and conduct regular auditing.

Keywords: **Blood Requisition, elective surgery, MSBOS, Transfusion Index, cossmatch.**

1. INTRODUCTION

Providing blood for patients undergoing 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.

Blood transfusion is one of the most common procedures performed during hospitalizations and it is a rapid method of correcting anaemia and currently one of the common forms of treatment offered to cancer patients. Blood transfusion plays a major role in the resuscitation and management of surgical patients [1] and ordering of blood is usually a common

practice in elective and emergency surgical procedures [2]. More than 75million units of blood are collected annually worldwide (approximately 75000 units in Zambia), every day millions of people require blood transfusions, most transfusions are intended to save lives but also put a patient at risk if blood is contaminated by an infectious disease [3].Blood component transfusion can be a vital and lifesaving intervention when given appropriately. However transfusion is not risk-free and therefore careful consideration of its clinical benefit for each individual patient is essential. Supply of blood components is a finite resource, relying on continuous public donation to maintain adequate stocks, as components have a limited period of viability. Blood and its various components is therefore an extremely valuable commodity, requiring careful allocation to maximize clinical benefit and avoid wastage .Increasing demand for blood and blood products together with rising cost and transfusion associated morbidity led to a number of studies that review blood ordering and transfusion practice [5, 6].Since the introduction of blood transfusion into clinical practice, its appropriate use has been the subject for debate. It has been reported that only 30% of crossmatched blood is used in elective surgery [7]. In the absence of an explicit maximum blood order policy, ordering for blood transfusion is frequently based on subjective anticipation of blood loss instead of evidence based estimates of average requirement in a particular procedure [8, 9]. Such practices have greater implications in resource constrained settings. This may cause exhaustion of valuable supplies and resources both in Technologist/Scientist time, effort, and biochemical reagents. It also adds to financial burden for each patient undergoing a surgical procedure [4]. Data from several developing countries have shown gross over ordering of blood in 40% to 70% of patients transfused [10-13]. In South Africa, for example, 7–10% of blood is wasted annually because of over ordering of blood [14]. Reports from India, Kuwait, and Nigeria also showed utilization rate of 28% [1], 13.6% [15], and 69.7% [4], respectively. Even in trauma patients, utilization is less than 50% [16]. Common variations in rates of transfusion may be due to many factors, including differing opinions on the threshold level of hemoglobin below which a patient needs blood transfusion, differences in surgical and anesthetic techniques, cancellation of cases, differences in case mix, preoperative anemia, and lack of availability of transfusion protocols. This may reflect uncertainty about the relative benefits and risks of transfusion and the different perceptions of the value of minimizing blood loss and subsequent transfusion [17].

A number of indices are used to determine the efficiency of blood ordering and utilization system. Boral Henry was the first that suggested the use of crossmatch to transfusion ratio (C/T ratio) in 1975 [5]. Consequently, a number of authors used C/T ratio for evaluating blood transfusion practice. Ideally, this ratio should be 1.0, but a ratio of 2.5 and below was suggested to be indicative of efficient blood usage [4]. The probability of a transfusion for a given procedure is denoted by %T and was suggested by Mead et al. in 1980 [18]. A value of 30% and above has been suggested as appropriate [4]. The average number of units used per patient crossmatch is indicated by the transfusion index (TI) and signifies the appropriateness of number of units crossmatched. A value of 0.5 or more is indicative of efficient blood usage [4, 5].

A Maximum Surgical Blood Order Schedule (MSBOS) provides guidelines for frequently performed elective surgical procedures by recommending the maximum number of units of blood to be crossmatched preoperatively [19]. A MSBOS reduces the preoperative cross matching of blood in surgical cases in which there is less likelihood of blood transfusion [20,21]. Implementation of MSBOS has almost universally resulted in substantial reduction of direct and indirect costs [22]. It has also proven to be an effective tool for quality assurance by reducing the stress on the blood transfusion services, more efficient use of bloodstocks and reduction in the wastage due to outdating. As a first step towards developing a Maximum Surgical Blood Order Schedule for Ndola Central Hospital, we conducted a retrospective study of different surgical services to find out the current transfusion practices. The C/T ratio, Transfusion Index (Ti) and transfusion probability (%T) where calculated.

A search of the literature using Medline revealed no information on the requisition and utilization of blood in Zambian Hospitals. This is therefore the first study conducted in Zambia with a view of establishing the MSBOS.

2. METHODOLOGY

This was a laboratory-based retrospective descriptive study and was conducted at the Ndola Central Hospital blood Bank, located in Ndola, Zambia. Ndola Central Hospital is a 900-bed referral hospital for Northern part of Zambia. An audit of blood usage over a period of 36 months was carried out from January 2012 to December 2014. Blood requisition and transfusion of surgical, obstetrics, and gynecological cases were compiled and reviewed. Patient's age and sex, number of units prepared, crossmatched, and transfused, number of patients crossmatched and transfused and source of blood donation or collection were collected from discharged patient medical records and blood bank registries. Data were coded, entered, and analyzed using SPSS Version 16. Blood utilization indices were computed with the following equation.

(i) Crossmatch to transfusion ratio (C/T ratio) = number of units crossmatched/number of units transfused. A ratio of 2.5 and below is considered indicative of significant blood usage.

(ii) Transfusion probability (%T) = number of patients transfused/number of patients crossmatched × 100. A value of 30% and above was considered indicative of significant blood usage.

(iii) Transfusion index (TI) = number of units transfused/number of patients crossmatched. A value of 0.5 or more was considered indicative of significant blood utilization.

(iv) Maximal Surgical Blood Order Schedule (MSBOS) =1.5 × TI.

(v) In current study blood was wasted when a patient failed to use his/her already prepared blood in any case.

Permission to conduct this study was obtained from the Senior Medical Superintendent of Ndola Central Hospital .Confidentiality of the information obtained was assured by using code numbers than personal identification names and keeping all the research data locked.

3. RESULTS

During the study period a total of 2,558 patients underwent major elective and emergency surgical procedures. Among these, 2001 patients were requested to prepare 2,300 units of blood. Majority of the patients were female (59%) and 61% of the patients had undergone elective operation, while 39% had undergone emergency surgery. A total of 810 (35.2%) patients were transfused as shown in Table 1.

3.1Blood Requisition and Utilization in Respective Departments:

During the 24 months of study period, blood requisition was made to 1,285 patients undergoing surgery in surgical department and 1015 from gynecological and obstetrics department (Gyn/obs). From a total of 2,300 units of blood crossmatched, only 810 units were transfused. This indicated that 35.2% of total blood crossmatched was utilized, leaving 64.8% of the units crossmatched not transfused to the patient who prepared, that is, wasted. Surgery department was the department with the highest number of both patients crossmatched (55.9%) and transfused (55.7%).

Among 781 patients who underwent emergency operation, 790 units of blood were crossmatched and 290 patients received 450 units of blood transfusion. In case of patients who underwent elective operation, 1,510 units of blood were crossmatched, out of which only 110 patients received 360 units of blood for their procedures. Generally the highest crossmatched units were made for elective patients (1,510) as compared to emergency cases (790), as shown in Table 2.

3.2 Blood Utilization Indices of Operated Patients in the Respective Departments:

As shown in Table 3, generally the overall blood transfusion of the requested blood which was explained by indices of C/T ratio, %T, and TI were 2.8, 20%, and 0.40, respectively. These blood utilization indices showed a different value between each department. In department of surgery, for instance, overall C/T ratio was 2.8 with high ratio in elective than emergency (4.1 versus 1.9). In addition, the overall %T was 14.5% with 20.9% in emergency and 9.7% in elective patients. On the other hand, in department of gynecology and obstetrics, the overall C/T ratio was 2.8 with elective surgical patients having the highest C/T ratio (4.3) than emergency patients (1.6). Moreover, the overall %T and TI were 26.1% and 0.38, respectively.

TABLE 1: Sociodemographic and other characteristics of surgical patients at Ndola Central Hospital, Zambia, 2014 (N=2,558).

Characteristics	Total No.	Percent (%)
Sex		
Male	820	41
Female	1181	59
Type of operation		
Elective	1220	61
Emergency	781	39
Department/Cases		
Surgery	1050	52.4
Gynaecology/Cases	951	47.6

Total units of blood crossmatched	2300	
Total Units of blood transfused	810	35.2
Total units of blood wasted	1490	64.8

TABLE 2: Comparison between number of units crossmatched and transfused in operated patients at Ndola Central Hospital, Zambia, 2014.

Department	**Number of units** Crossmatched (N=2300)	Transfused (N=810)	**Number of Patients** Crossmatched (N=2001)	Transfused (N=400)
Surgery (N=1050)	N (%)		N (%)	N (%)
Elective (N=600)	820 (63.8)	201 (44.6)	600 (57.1)	58 (38.2)
Emergency (N=450)	465 (36.2)	250 (55.4)	450 (42.9)	94 (61.8)
Subtotal	1285 (55.9)	451 (55.7)	1050 (52.4)	152 (38)
Gynaecology and obstetrics (N=951)				
Elective (N=620)	690 (68)	159 (44.3)	620 (65.2)	52 (21)
Emergency (N=331)	325 (32)	200 (55.7)	331 (34.8)	196 (79)
Subtotal	1015 (44.1)	359 (44.3)	951(47.6)	248 (62)

N=Total number

TABLE 3: Blood utilization indices of surgical patients at Ndola Central Hospital, Zambia, 2014

	Blood Utilization indices								
Department	C/T ratio			%T			TI		
	N	**D**	**I**	**N**	**D**	**I**	**N**	**D**	**I**
Surgery									
Elective (N=600)	820	201	4.1	58	600	9.7	201	600	0.34
Emergency (N=450)	465	250	1.9	94	450	20.9	250	450	0.56
Subtotal	1285	451	2.8	152	1050	14.5	451	1050	0.43
Gynaecology and obstetrics (N=951)									
Elective (N=620)	690	159	4.3	52	620	8.4	159	620	0.26
Emergency (N=331)	325	200	1.6	196	331	59.2	200	331	0.60
Subtotal	1015	359	2.8	248	951	26.1	359	951	0.38
Total	**2300**	**810**	**2.8**	**400**	**2001**	**20.0**	**810**	**2001**	**0.40**

Abbreviations: N stands for numerator; D stands for dominator; I stand for index. C/T: crossmatch transfusion ratio, %T: the probability of transfusion, and TI: transfusion index.

4. DISCUSSION

Blood and its component play a major role in the resuscitation and management of both elective and emergency surgical patients. Despite this advantage, currently there is a limited supply with increasing demand and underutilization of the requested blood worldwide [4]. 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. Preoperative over ordering of blood has been documented since 1976, when Friedman et al. published their findings. Subsequently, a number of studies have also showed over ordering of blood in different parts of the countries [1, 5]. Data from developing countries have shown irrational over ordering of blood in 40% to 70% of patients transfused [15]. Since the introduction of blood transfusion into clinical practice, its appropriate use has been the subject of debate. It has been reported that only 30% of crossmatched blood is used in elective surgery [7]. Generally the percentage of crossmatched patients receiving transfusion for general surgical procedures ranged from 5 to 40% [4].Therefore, it is essential that the usage of blood and blood products should be rationalized and saved for crisis situations. The current study revealed that 64.8% of the crossmatched blood was not utilized. This finding was almost comparable to that reported in a study conducted in Nigeria

where 69.7% of blood crossmatched was not utilized [23]. But it was relatively low compared to a study conducted in India (76.8%), Nepal (86.4%), and Egypt (74.8%) [1, 4, 15, 24]. This might indicate that this wastage in blood is very common in developing countries and Zambia is no exceptional. Boral Henry was the first, and a number of authors thereafter, used crossmatch to transfusion ratio [5] for evaluating blood transfusion practices. Ideally, this ratio should be 1.0, but a ratio of 2.5 and below was suggested to be indicative of efficient blood usage. According to this recommendation, the overall C/T ratio of 2.8 that was reported in the current study was considered to be indicative of inefficient blood usage. This ratio was comparable to that reported in Egypt (3.9) [24] and Malaysia (5.0) [25] but lower than that in reported by a study conducted in Nigeria (2.2) [4] and Indian (2.5) [26]. The present study also demonstrated that C/T ratio was similar across the emergency patients of surgical (1.9) and gynecology and obstetrics (1.6) departments. This was somewhat similar to that reported in Egyptian [24] and Nigerian studies [4]. In contrast, C/T ratio was high across elective patients of surgery (4.1) and gynecology and obstetrics (4.3) departments. This was similar with study conducted in northern India [26]. Disparities in rates of transfusion in the current study are due to the fact that there is a great tendency to request more units of blood for elective procedures than what is actually required in each department. 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 make excess orders of blood for crossmatch, which has been reported elsewhere [26]. Many feel that having more blood available is safer and this results in over-ordering. Mead et al. [18] suggested the probability of transfusion for a given procedure (%T), which indicates efficient use of blood. Accordingly, a value of 30% and above has been suggested to be appropriate and signifies the appropriateness of number of units crossmatched [18]. Based on what is recommended in the above literature, the results of the present study revealed an overall %T of 20.0%, which was indicative of inappropriate utilization compared to unit crossmatched blood. This finding was comparable to that reported in a study conducted in Indian tertiary care hospital where %T ranged from 11.1% to 25% [1] but lower than in a study done in Egypt where it was 36.9% [24]. Similarly, the probability of transfusion (%T) reported in different departments under the current study was considered inappropriate showing inefficient utilization in all the departments. Regarding transfusion index (TI), a value of 0.5 or more is indicative of efficient blood usage and signifies the appropriateness of number of units transfused [5]. The overall TI reported in the current study was 0.40. This finding was higher than that which has been found in a study conducted in Indian tertiary care hospital 0.36 [1] but lower than that reported in Egypt 0.69 [24]. . Transfusion index (TI) of emergency patients under the study was considered appropriate in both departments, this was in contrast to elective patients whose TI was lower in both surgery and gynecology and obstetrics than the recommended 0.5.

Blood ordering pattern especially for elective surgery patients need to be revised and over ordering of blood should be minimized. This can be possible by the estimation of MSBOS for each procedure and requisition as calculated. Many studies [1, 17] have shown that blood is generally over ordered and the implementation of MSBOS and the introduction of Type and Screen ("T and S") procedure have led to a safe, effective, and economic solution to ordering of blood. 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 Unit is capable of supplying blood on time when there is an urgent need for transfusion. It is recommended that the C/T ratio and the TI for each procedure be used as a guide to come up with the MSBOS. For continued improvement of transfusion practice, continuous surveillance of the utilization pattern is needed, especially since Ndola Central hospital has a large and changing surgical staff.

5. CONCLUSION

Results from this study have revealed over ordering of blood for crossmatching especially those for patients undergoing elective surgery. Developing a blood ordering policy, which is a guide to expect normal blood usage for surgical procedures, can decrease over ordering of blood thereby reducing unnecessary compatibility testing, returning of unused blood, and

wastage due to outdating. It also allows for a more efficient management of blood inventory. In this respect, the hospital blood transfusion committee should formulate maximum surgical blood order schedules for selected cold surgical procedures, conduct regular auditing about effectiveness of the blood requesting policy using the crossmatch to transfusion ratio, and offer periodic feedbacks to improve blood ordering, handling, distribution, and utilization practices of this scarce resource.

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