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Cross Matching to Transfusion Ratios: Comparison between Menoufia University Surgical Departments, Egypt. Surprising Results

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ABSTRACT

Background: Patients underwent elective surgical procedures frequently need blood before or after their surgery. To give a safety margin in the case of an unanticipated hemorrhage, more units of blood are ordered than will be needed. Significant waste of blood, reagents, and human resources arises from excessive requests with insufficient usage. **Objective**: The current study aimed to assess the efficiency of blood ordering and transfusion processes at the Surgical Departments of Menoufia University.

Patients and methods: A retrospective study was conducted at the blood bank of Menoufia University Hospital, over a year. The cross matching (C)/transfusion ratio was calculated using the following formula: Number of units cross-matched/ Number of units transfused. Also, the Transfusion Probability (TP) formula, Transfusion Index (TI), and Cross matching/transfusion percentage were calculated. **Results**: cross matching was requested and done for 9458 patients admitted for doing elective surgeries, from them only 1240 patients were transfused, this indicates that only 13.1% of the total units cross matched were used and the 86.9% remained unutilized. Transfusion probability was 13.1%, the overall C/T ratio was 7.6, and the transfusion index was 0.13.

Conclusion: The Surgical Departments in our hospital exhibit ineffective blood ordering procedures. To better use blood units in our hospital and to minimize this huge loss, we must strictly adhere to restrictive blood transfusion procedures and the Maximum Surgical Blood Ordering Schedule (MSBOS).

Keywords: Cross matching to transfusion ratio, Elective surgeries, Ineffective blood ordering, MSBOS, Retrospective study, Menoufia University.

INTRODUCTION

Blood transfusions are crucial to the care and resuscitation of surgical patients in order to enhance tissue oxygenation [(1)]. The ordering of blood prior to surgery, particularly in elective surgery, frequently concentrates on worst-case scenarios, requiring enormous volumes of blood or overestimating expected blood loss, of which little is actually utilized [(2)].

In contrast to low income nations, which had a whole blood donation rate of 4.6 per 1000 people per year, high income countries had a rate of 32.1 per 1000 people per year [(3)]. It is obvious that, the need for blood units cannot be met with this deficient rate. Keeping this restrictive source in mind, we should stop haphazard ordering of blood units in different hospitals and institutes [(4)].

The stock in the blood centers is greatly affected by unnecessary blood ordering by surgeons because with each unnecessary request , inventory issues for blood banks and reduction in shelf life of blood units occur [(5)]. For instance, 7-10% of the blood ordered in South Africa, every year is wasted. Additionally, According to complaints from several nations, the blood bank's resources, such as blood units, reagents, and manpower waste, were misused unintentionally, placing a substantial burden on them [(6)].

Transfusion practises vary significantly among countries, organisations, and even between specific clinicians employed by the same company [(7)]. Numerous elements, such as differing opinions on the haemoglobin level below which a patient needs a blood transfusion, the distinctions between surgical and non-aesthetic procedures, and a failure to follow transfusion protocols, might affect transfusion rates [(6)].

Because most developing nations do not have evidence-based guidelines for blood transfusion, ordering and administering blood relies solely on clinical expertise and arbitrary judgement [(2)]. Developing quality indicators that help administrative authorities of blood banks to control blood ordering strategies according to the real needs was very mandatory. In the 1970s, Transfusion cross-matching was invented by Boral and Henry(C/T) ratio and proposed that a ratio of 2.5:1 or lower was appropriate for blood usage. The optimal ratio would be 1.0 (all cross matched blood is transfused) [(8)].

The probability of transfusion (TP), created by **Mead *et al.*** in 1980 for a certain procedure, was calculated as the proportion of patients who got transfusions to patients who were cross-matched, multiplied by 100 [(9)].

The Transfusion Index (TI), an alternative strategy, shows the typical number of units used per patient when they are cross-matched. A number of 0.5 or above indicates effective blood utilisation. It indicates whether or not the quantity of units that are cross-matched is appropriate [(10)].

These exact calculations were a huge help in deciding whether or not we had ordered an excessive amount of blood units, whether or not a transfusion would be required for a certain procedure, and whether or not the quantity of units ordered was sufficient.

The current study aimed to assess the efficiency of blood ordering and blood transfusion procedures in the Surgical Departments of Menoufia University and to

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determine precisely how distant or close we are from the real values.

PATIENTS AND METHODS

A retrospective study was conducted at the blood bank of Menoufia University Hospital, from January 1, 2021 to December 31, 2021. over a year. All patients who underwent elective surgery in one of the six Surgical Departments at Menoufia University Hospitals were included in an audit of the blood bank records in which cross-matching was performed. These departments include General Surgery, Orthopaedics, Urology, Neurology, Chest, Cardiology, and Gynaecology and Obstetrics, over a year. There were a total of 10278 recordings.

Inclusion criteria: Any patient within the time frame who underwent any type of elective surgery and for whom a request for whole blood or packed RBCs was made.

Exclusion criteria: Patients undergoing surgery for whom blood was requested for non-surgical purposes such as transfusion for medical conditions or anemia of diverse.

The following mathematical and conceptual definitions were used to the present investigation: [8,11]

The cross matching (C)/transfusion (T) ratio was calculated using the following formula: Number of units cross-matched/ Number of units transfused. When the ratio is less than 2.5, blood is being used efficiently.

Transfusion Probability (TP) formula: Transfused units number/ cross matched patients number × 100. A value of 30% and above indicates significant blood utilization.

Transfusion Index (TI) formula: Transfused units number/ cross matched patients number. A value of 0.5 or more indicates significant blood usage.

Ethical Approval:

This study was ethically approved by the Institutional Review Board of the Faculty of Medicine, Menoufia University. Written informed consent was obtained from all participants. This study was executed according to the code of ethics of the World Medical Association (Declaration of Helsinki) for studies on humans.

Statistical Analysis

The collected data were introduced and statistically analyzed by utilizing the Statistical Package for Social Sciences (SPSS) version 22.0 for windows. Qualitative data were defined as numbers and percentages. Quantitative data were tested for normality by Kolmogorov-Smirnov test. Normal distribution of variables was described as mean and standard deviation (SD).

RESULTS

The total numbers of patients admitted to undergo elective surgical procedures and were cross matched over of 2021 was 9458 patients, among them only 1240 were actually transfused (**Table 1**). Unfortunately, total C/T ratio was 7.6 (ranged from 2.4 to 10.8), transfusion probability (TP) was 13.1% (ranged from 9.2% to 41.3%), and transfusion index (TI) was 0.13 (ranged from 0.09 to 0.41).

The detailed C/T ratio, TP and TI for each department are shown in (**Table 2**). The worst C/T ratio was detected in Orthopedics Surgery Department (10.9) followed by Urological Surgery Department (9.03), while Cardiothoracic Surgery Department showed the best ratio (2.4). The greatest blood order value was found in the Orthopedics Surgery Division, followed by the General Surgery Division, which also had the largest number of transfused patients.

Table 1: Number of patients admitted for elective surgical procedure on each surgical department during 2021.

Month/2021	Gynecology and Obstetrics		Orthopedics Surgery		Neurosurgery		Urology Surgery		Cardiothoracic Surgery		General Surgery	
	C	T	C	T	C	T	C	T	C	T	C	T
January	84	19	296	20	64	9	144	7	32	31	250	29
February	90	19	270	24	48	10	137	8	20	4	267	33
March	75	18	291	23	84	7	125	9	35	8	223	43
April	77	20	281	24	92	5	111	13	33	19	248	26
May	87	13	265	26	57	3	146	7	25	2	234	31
June	91	15	241	25	42	9	114	7	23	7	275	43
July	85	19	284	21	65	8	122	21	17	3	217	34
August	83	15	220	24	58	11	134	22	15	9	211	29
September	87	8	256	24	67	7	135	18	22	4	220	22
October	80	10	204	25	51	5	112	21	22	12	256	43
November	65	11	240	29	63	8	123	25	16	3	206	28
December	76	12	260	24	59	12	115	10	21	14	214	33
Total	980	179	3108	289	750	94	1518	168	281	116	2821	394

C= No of crossmatched patients. T= No of transfused patients.

Table 2: Cross matching/transfusion ratio (C/T), Transfusion probability (TP) and Transfusion index (TI) in each surgical department.

Surgical Department	No of patients cross matched		No of patients transfused		C/T ratio	T%	TI
	No	%	No	%			
Orthopedics Surgery	3108	32.8%	289	23.3%	10.8	9.2%	0.09
General Surgery	2821	29.8%	394	31.8%	7.2	14%	0.14
Urological Surgery	1518	16.04%	168	13.5%	9.03	11.1%	0.11
Gynecology and Obstetrics	980	10.4%	179	14.4%	5.5	18.2%	0.18
Neurosurgery	750	7.9%	94	7.5%	7.9	13%	0.13
Cardiothorathic Surgery	281	2.9%	116	9.4%	2.4	41.3%	0.41
Total	9458	100%	1240	100%	7.6	13.1%	0.13

DISCUSSION

One of the top 10 most costly fluids is human blood. Despite being free supplied by the process of voluntary donation, all over the world, almost all health administrative authorities face the problem of its shortage either in major critical situations like wars, accidents and major natural disasters or for ordinary daily use to solve basic health problems. Perioperative blood ordering is another mandatory procedure done by all clinicians and anesthesiologists to ensure patient safety before, during or after the surgery [(12)].

Managing blood bank resources and establishing blood ordering methods that result in effective utilisation and minimal loss of blood products is essential due to the prevalence of haphazard blood ordering procedures brought on by a lack of adherence to stated blood transfusion standards, especially in developing countries.

The aim of this study was to evaluate the effectiveness of blood ordering and blood transfusion procedures in Menoufia University Surgical Departments. Unfortunately, this study found that the overall C/T ratio was 7.6 ranging from 2.4 in Cardiothoracic Surgery Department to 10.9 in Orthopedics, and to 86.9% Urological of cross matched blood remained unutilized. These findings are comparable to those of **Zewdie *et al*.** [(13)] who conducted a study to evaluate the practise of blood utilisation in the largest tertiary hospital in Addis Ababa, Ethiopia. They discovered that the overall cross match to transfusion ratio was 7.6, and that only 62 of the 406 (15.3%) cross matched patients received transfusions, leaving 84.7% of the available blood unutilized.

Studies in Egypt and India estimated same results of elevated percentage of blood units wastages 74.8% and 83.9% respectively [(6, 11)]. Previous studies from different countries' hospitals conducted around the world revealed that many nations like Malaysia, Zambia and Tanzania had unsuitable blood utilization (C/T ratios >2.5) [(6,14-16)]. However, Ethiopia and Nepal showed noticeably better usage, with C/T ratios of 2.3 and 2.5, respectively [(17, 18)].

TP denotes the probability of transfusion for a given department, 30% or above value indicates appropriate numbers of cross-matched units [(10)]. According to this value, our total TP was 13.1% indicated inappropriate cross matched blood units except for Cardiothoracic Surgery Department (41.3%). In contrast to an Egyptian study conducted at an Alexandria University Hospital, which found an overall TP of 36.9% indicating an appropriate value, and an Ethiopian study estimated their TP to be 47% indicating an appropriate value, these findings are consistent with those of an Indian study conducted at an Indian tertiary hospital, where TP varied from 11.1% to 25% [(6, 17,19)].

Regarding TI, a value of more than 0.5 means effective blood transfusion [(10)]. Overall TI (0.13) in this study is lower than this standard value indicating ineffective blood transfusion practice. This insignificant result comes in agreement with studies from Ethiopia (0.29), Zambia (0.4) [(13,15)], while significant values were seen from Egypt (0.69) and north Ethiopia (0.77) [(6,17)]. These inappropriate values among our Surgical Departments forced us to search thoroughly about the exact causes which rely behind them. Menoufia University Hospital is a tertiary center lies in Menoufia governorate, Egypt.

Around 18000 surgical operations were done annually according to recent hospital statistics including emergent and elective operations. Patients who were cross matched and prepared to undergo elective surgeries in 2021 were 9458 patients according to our blood bank`s records.

With this high rate of surgical operations, surgeons and anesthesiologists request many and many blood units to ensure adequate blood supply when needed regardless of accurate patients' clinical data which determine their exact blood demands. By revising some clinicians` strategies, we found that there no standardized rules to request blood units, and all strategies used based only on clinician`s experience and no certain guidelines are strictly followed. Another factor, which may complicate this problem, is the frequent cancellation or postponing of the surgical operations as a result of the long waiting list in some departments in our hospital like Orthopedics, Urology surgery and Neurosurgery departments.

The efficacy of blood conservation measures depends on the trust, confidence, and cooperation of surgeons and anesthesiologists with blood bank employees, all of which are necessary to reduce this malpractice of blood ordering. The formation of a transfusion committee at our hospital would substantially improve communication between the various surgical departments and enable for more efficient management of blood inventory through the creation of a maximum blood ordering schedule (MSBOS) for elective procedures.

CONCLUSION

The Surgical Departments in our hospital exhibit ineffective blood ordering procedures. To better use blood units in our hospital and to minimize this huge loss, we must strictly adhere to restrictive blood transfusion procedures and MSBOS.

DECLARATIONS

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