



**ADDIS ABABA UNIVERSITY COLLEGE OF HEALTH SCIENCE
SCHOOL OF MEDICINE, DEPARTMENT OF
ANESTHESIA**

**ASSESSMENT OF BLOOD REQUISITION, TRANSFUSION PRACTICES AND
FACTORS ASSOCIATED WITH TRANSFUSION IN ELECTIVE SURGICAL
PROCEDURES AT TIKUR ANBESSA SPECIALIZED HOSPITAL, FROM
FEBRUARY 1, 2016 TO MARCH 31, 2016 ADDIS ABABA, ETHIOPIA**

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**A RESEARCH PAPER IN PARTIAL FULFILMENT OF THE REQUIREMENTS
FOR MASTER OF ANESTHESIA IN SCHOOL OF MEDICINE, COLLEGE OF
HEALTH SCIENCE, ADDIS ABABA UNIVERSITY.**

**June, 2016
Addis Ababa, Ethiopia**

ABSTRACT

Background: For elective surgeries preoperative over ordering of blood is very common practice and leads to holding up of the blood bank reserve, ageing of the blood unit and wastage of blood bank resources. That can be decreased by simple means of changing the blood cross matching and ordering schedule depending upon the type of surgery performed.

Objectives: To assess blood requisition, transfusion practices and factors associated with transfusion in elective surgical procedures at Tikur Anbessa specialized Hospital from February 1 to March 31, 2016 G.C.

Methods: An Institution based cross sectional study was conducted from February 1, 2016 to March 31, 2016 G.C at Tikur Anbessa specialized Hospital. Using sequential sampling technique and structured checklist data was collected from all elective surgical patients that came during the 2 months period. Blood utilization was calculated using cross match to transfusion ratio (C/T), transfusion probability (%T), transfusion index (TI) and Maximum surgical blood-ordering schedule (MSBOS) is formulated by Mead's criterion for common surgical procedures. Multivariate logistic regression analysis was conducted to identify significant predictors of transfusion based on p-value less than 0.05 with 95% confidence level.

Results: Among all 242 elective surgical patients 55 (22.7%) of patients were transfused with 107(20.4%) units of the prepared blood giving cross-match to transfusion ratio of 4.9, transfusion probability (%T) 22.7% and transfusion index of 0.44. The independent predictors of perioperative blood transfusion were being neurosurgery (craniotomy) [AOR= 5.868 (95%CI 1.364, 25.239)] (P=0.017), Hgb <11.0 g/dl [AOR=7.553 (95%CI 2.915, 19.576)] (p =0.00) and intraoperative blood loss of $\geq 15\%$ ([AOR=12.830, (95% CI, 5.613, 29.323)] (P = .000).

Conclusion and Recommendation: The amount of blood requested and cross-matched for patients undergoing elective surgery is much greater than the amount actually used. So blood ordering pattern needs to be revised and over ordering of blood should be minimized. This can be possible by implementing an updated, institution-specific MSBOS along with an Emergency Blood Releasing system.

ACKNOWLEDGMENT

First of all, I would like to thank the Almighty God, for everything. Next, I would like to express my heart-full gratitude and thanks to my advisor Mrs. MeronAbrar, for her invaluable support and comments.

Secondly to all of my precious friends I am grateful for you helping me in making this paper a reality and I would also like to thank the department for all the supports.

Last but not least I would like to thank, those authors and researchers of articles, and on-line information for the valuable works I have read and cited.

LISTS OF ACRONYMS

APR/AR:	Abdominoperineal excision/Anterior Resection of the Rectum
ASA:	American Society of Anesthesiologists
A-V fistula:	Artero–Vinous fistula
CABG:	Coronary Artery Bypass Grafting
CBD:	Exploration: Common Bile Duct exploration
C/T:	Cross match to Transfusion ratio
D&C:	Dilatation and Curettage
EBRs:	Emergency Blood Releasing System
GSH:	Group Save and Hold
Gyn/obs:	Gynecologic and Obstetrics department
FMOH:	Federal Ministry Of Health
HCT:	Hematocrit
Hgb:	Hemoglobin
ICU:	Intensive Care Unit
LOS:	Length-Of-Stay
LSCS:	Lower Segment Sectarian Section
MSBOS:	Maximum Surgical Blood Ordering Schedule
ORIF:	Open Reduction and Internal Fixation
PNL:	Percutaneous Nephrolithotomy
PSARP:	Posterior Sagittal Anorectoplasty
STSG:	Split thickness Skin Grafting

%T:	The probability of a transfusion for a given procedure
TAHBS:	Total Abdominal Hysterectomy & Bilateral SalpingOpherectomy
TASH:	TikurAnbessa Specialized Hospital
THE:	Trans Hiatal Esophagotomy
THR:	Total Hip Replacement
TI:	Transfusion Index
TURP:	Trans-Urethral Resection of Prostate
VVF Repair:	Vesico Vaginal Fistula Repair
WHO:	World Health Organization

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CHAPTER ONE

1. INTRODUCTION

1.1. Background

Blood transfusion no doubt plays a major role in the resuscitation and management of patients especially in surgical cases, but surgeons most of the time overestimate the anticipated blood loss thereby over-ordering blood¹. Many times blood requisition is made by force of habit that is “better-safe-than-sorry” approach. Analysis of the data indicated that the majority (77%) of operations will need no pre-operative preparations of blood². The demand for large quantity of preoperative cross-matching of blood for elective surgeries of which little is utilized causes wastage of valuable supplies and resources both in terms of technician time and reagents, not only that but also cross-matched blood is unavailable for others for 24 to 48 hours. During this time, 1 to 2 days is lost and the chance for outdated increases³.

To determine the efficiency of blood ordering and utilization system a number of indices are used. Boral Henry was the first that suggested the use of cross -match to transfusion ratio (C/T ratio) in 1975⁴. Consequently, a number of authors used C/T ratio for evaluating blood transfusion practice and ideally, this ratio should be 1.0, but a ratio of 2.5 and below was suggested to be indicative of efficient blood usage¹. The probability of a transfusion for a given procedure is denoted by %T and was suggested by Mead et al. in 1980⁵. A value of 30% and above has been suggested as appropriate¹. The average number of units used per patient cross match is indicated by the transfusion index (TI) and signifies the appropriateness of number of units cross matched. A value of 0.5 or more is indicative of efficient blood usage^{1,4}.

Introduction of evidence-based transfusion guidelines and strategies for improved blood utilization has been shown to be cost effective and safe⁶. Among those implementation of maximum surgical blood ordering schedule (MSBOS) has almost universally resulted in substantial reduction of direct and indirect costs⁷. The MSBOS, established in a hospital by a team of clinicians can reduce the over-ordering of blood, and the blood ordering pattern needs a time to time review for proper usage of blood⁸. The consultants and ASA members both agree regarding the use of a MSBOS, when available and in accordance with institutional policy, as a strategy to improve the efficiency of blood ordering practices⁹.

1.2.Statement of the Problem

Although much has been achieved and transfusion is safer today than ever, we are nonetheless recognizing new potential concerns with transfusion and we should undergo a paradigm shift in our attitudes, approach and patient management in regard to blood transfusion¹⁰.

Despite lots of endeavor by different stakeholders, till 80% of the world's population has access to only 20% of the world's "safe" blood that is properly collected and tested³.

Blood donation rates in Africa are generally very low (about 5 per 1000 population) compared with developed countries (47 per 1000 USA). Survey on blood safety and availability was collected by WHO from 40 of the 48 countries in sub-Saharan Africa indicated that 35 (87.5%) countries collect less than half of the blood needed to meet the transfusion requirements of their populations¹¹. The same is true in Ethiopia as the National blood Bank disclosed on September 2015 around 87,000 units of blood were collected, although the country needs 200,000 annually.

Paradoxically, despite a severely inadequate supply, blood is often transfused unnecessarily and it will exposes patients to the risk of HIV, hepatitis and other serious side-effects and increasing expense of monitoring and managing complications associated with blood transfusion¹¹.

Preoperative over-ordering of blood has been documented since 1973. Subsequently, a number of studies documented over-ordering of blood in the USA, Australia, Canada, England, Israel and Scotland revealed that percentage of cross-matched patients receiving transfusion for general surgical procedures range from 5% to 40%¹².

In Bir Hospital, Nepal 2009, the blood utilization was only 13.6%, consisting of 17.24% in the elective operations and 13.5% in the emergency operations¹³. Bellary, Karnataka, India, 2012, 26% of blood cross-matched was utilized, leaving 74% unutilized¹⁴.

In 2011 Egypt, Alexandria only 25.2% of total blood cross matched was utilized, leaving 74.8% unutilized¹⁵. In Nigerian University Teaching Hospital, 2014 of the total 1703 units of blood requested for 986 patients, 94.42% (1608) were cross-matched but only 34.51% (555) were transfused¹⁶. In Zambia 2015, 35.2% of total blood cross matched was utilized, leaving 64.8% of the units cross matched not transfused to the patient who prepared, that is, wasted. In case of patients who underwent elective operation, 1,510 units of blood were cross matched, out of which only 110 patients received 360 (23.8%) units of blood for their procedures¹⁷.

In University of Gondar hospital, 56.4% of the cross-matched blood was unutilized and in case of patients who underwent elective operation, 654 units of blood were cross matched, out of which only 77 patients received 238 (36%) units of blood for their procedures. Generally, the highest cross matched units but the least transfusion units were made for elective patients as compared to emergency cases¹⁸.

Above all Africa is in desperate need of a significant scaling-up of efforts to make safe blood available to all patients, whose survival and wellbeing depends on this treatment intervention. It is technically feasible, lacking only the political commitment and the financial resources¹¹. New reasons for change have emerged in recent years, meaning the need for change is now more pressing than ever. Factors necessitating change include: burgeoning cost of blood, blood supply challenges, safety issues, and patient outcome issues¹⁹.

From the studies of United States, Australia and Israel great saving of blood and resources made from rationalizing blood ordering habit²⁰. So change would require a cultural shift at all levels of the health system including clinicians, managers and policy makers²¹.

When we came to our country we lack not only institution specific guidelines but, even the magnitude of the problem was not investigated. Therefore, as a first step towards developing a Maximum Surgical Blood Ordering Schedule for Tikur Anbessa specialized Hospital; I conducted this study to assess the practice and efficiency of blood requisition and transfusion practices for patients undergoing different elective surgical procedures.

1.3. Significance of the Study

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 and institutions. Therefore, this study is very important:

To provide a rational and evidence based case specific practical framework on which blood cross match ordering, and preparation guided; to avoid unnecessary expense imposed on the patients and institutions thereby increase the availability of safe blood for those who is in real need.

It is also important to show the degree of unnecessary cross match ordering that we incurring on the patient and the institution; thereby triggering the institutions, blood bank and Red Cross societies to conduct further research, to reduce it at all levels of the healthcare system in the country, without compromising standards of quality and safety by providing guidelines and different strategies which helps to maintain a balance between blood requisition and transfusion practices.

To my knowledge, there was no such study conducted in my study area so that it can be used as a baseline data for researchers and policy makers.

CHAPTER TWO

LITERATURE REVIEW

Blood transfusion is an essential component of health care, which saves millions of lives each year. Every second, someone in the world is in need of blood for surgery, trauma, severe anemia or complications of pregnancy²².

Blood transfusion is a common procedure in which a donor's blood is infused into the patient's blood to replace missing blood due to illness and emergency cases. That is why; many health care organizations attempt to establish well organized blood transfusion services, which can provide sufficient and timely supply of safe blood to meet the transfusion needs of the patient population²³.

Effective blood transfusion is achieved by giving care to the best evidence that is available such as room temperature, ABO cross-match compatibility and the need for indirect anti-globulin test. The main risk of blood transfusion is receiving a blood of the wrong blood ABO group. To ensure that patients in need of blood transfusion receive the right blood, the clinical staffs make careful checks before administering a blood transfusion such as taking a blood sample for cross-matching from donors and recipients²⁴.

There are 2 basic tests performed to type blood, namely the group and save (G and S) and the cross-match tests. The G and S test is a method to identify the blood by the ABO group system. The serum is saved so that further blood typing can be performed if necessary. It is easier and faster to perform than a cross-match test and does not remove blood from the common pool. Cross-matched means to fully type a sample and a unit of red cells to look for cross-reactivity. Blood is ready to use, but it is removed from the common pool. Pragmatic guidelines from the British Society of Hematology (BSH) are based on a cross-match-to-transfusion ratio (C: T) of 2:1²⁵.

Beyond the importance and its risks blood transfusions also cost, and any strategy that reduces the use of blood transfusion reduces cost, and health care workers in all disciplines of medicine can assist in reducing unnecessary and inappropriate transfusion. The cost of transfusion can be direct and indirect costs include product (tubing, supplies, labor, transport, laboratory testing), as well as hospital Blood Bank (cross-matching, etc.), clerical, nursing. The cost of producing a unit

of red cells for Ontario, Canada has been estimated to be about \$450. But there is further resource use in increased ICU and hospital length-of-stay (LOS), treatment of complications, etc., with a large multicenter observational study showing that transfusion can increase hospitalization costs by 40% and estimated the total cost at ≈\$1200-1400/unit^{26,27}.

Limited availability and supply necessitates the rational use of blood and blood products and avoidance of unnecessary transfusion. In order to reduce unnecessary cross-matching, blood ordering schedule catering to surgeon and patient requirements is the need of the hour^{8,28}.

Study conducted in Mumbai (India, 2000), from patients who has cross-match, only 53% of patients were transfused with non-utilization of 76.86% of ordered blood. The surgeries where none of the three indices showed significant blood utilization were cholecystectomy (open / laparoscopic), thyroidectomy, urolithotomy, gastro -/cysto-jejunostomy, vagotomy / pyloroplasty, incisional hernia repair, varicose vein surgery and omentopexy. With the help of the indices and MBSOS the wastage was reduced in next 150 patients, i.e. from 76.86% to 25.26% and improved the utilization of blood, i.e. from 23.14% to 74.74%²⁹.

Prospective observational audit by a team of anesthetists over 3 months in a multispecialty tertiary care teaching hospital (India, 2003), 1239 units of whole blood were requested for 831 adult patients undergoing elective non-cardiac surgery. A total of 140 patients were transfused with 212 units of blood showing an overall cross-match to transfusion (C: T) ratio of 6.6:1. The primary trigger for transfusion was low hemoglobin (72.1%) followed by hypovolemia (11.4%). In 16.5% of cases, blood was transfused despite the absence of any of these indications, on the advice of the anesthetist or surgeon responsible for the patient (clinician choice)³⁰.

A prospective survey on blood ordering practice for elective surgery over a 3-month period at a tertiary medical center in Malaysia (2001); One thousand four hundred and seventy four units were cross-matched for 538 cases, 297 units of blood were transfused. The overall CT 5 and many procedures were found to have a high CT ratio and a low transfusion index. Of the 538 cases operated they were able to trace 128 patients who had been transfused with red cells and had documented post transfusion Hgb levels. Of these patients 47.7% were over transfused³¹

A retrospective study conducted at Aga Khan University Hospital, (Pakistan 2001) majority (97.56%) of the patients had C:T ratios higher than 2.5 with only 21.11% of patients, had a

Transfusion Index (Ti) higher than 0.5. Following the introduction of MSBOS audit in 2009/2010 from 1,710 procedures performed in 2009, C: T ratio was 1 in 1,634 (95 %) procedures. Similarly in 2010, of 1,738 surgeries/ requiring transfusion, C: T ratio of 1 was seen in 1,668(95.9 %) procedures³².

Retrospective study conducted at University Hospitals of Leicester, (UK, 2013) in all elective general surgical procedures over a 6-month period. Over the study period a total of 507 units of blood were cross-matched and 238 units were used. The overall C: T ratio was therefore 2.1:1, which corresponds to a 46.9% red cell usage. Implementation of the updated recommended MSBOS and introduction of G and S for eligible surgical procedures is a safe, effective and cost-effective method to prevent preoperative over-ordering of blood in elective general surgery. Savings of GBP 8,596.00 per annum are achievable with the incorporation of updated evidence-based guidelines in this university hospital⁶.

A large scale study conducted at Johns Hopkins Hospital, Baltimore, (Maryland, 2014), using data acquired from an anesthesia information management system to evaluate whether the MSBOS, along with a remote electronic blood release system (EBRS), reduced unnecessary preoperative blood orders and costs. They found that the percentage of procedures with preoperative blood orders decreased by 38% [from 40.4% (7,167 of 17,740 patients) to 25.0% (3,869 of 15,476 patients), $P < 0.001$]. Among all hospitalized inpatients, the crossmatch to transfusion ratio decreased by 27% (from 2.11 to 1.54; $P < 0.001$) over the same time period. Based on the realized reductions in blood orders, annual costs were reduced by \$137,223 (\$6.08/patient) for surgical patients, and by \$298,966 (\$6.20/patient) for all hospitalized patients³³.

Despite lots of publication and investigation on the efficiency of blood usage, there was no clear demarcation which patients really need blood transfusion and how much units of blood required preoperatively due to variability in patient factor and set ups. To stratify surgical patients based on their risks and to have judicious blood management clinicians made ongoing auditing of the service.

During a retrospective audit at a specialized Scottish orthopedic hospital (200/01 the independent predictors of transfusion were patient age, preoperative hemoglobin band and the procedure performed. Factors strongly associated independently with transfusion were preoperative

hemoglobin 11g/dl [odds ratio: 13.92 (95% CI 7.77 -24.9) and revision hip surgery (OR: 17.80 (9.59 -33.02)).³⁴

Retrospective study conducted at Nottingham City Hospital (2003/04) on Analysis of blood transfusion predictors in patients undergoing elective oesophagectomy for cancer the overall crossmatch to transfusion ratio was 4:1. The independent predictors of blood transfusion include age >70 years, Hb level <11.0 g/dl, T-stage, presence of postoperative complications and anastomotic leak³⁵.

A prospective study conducted on liver transplant patients at Indraprastha Apollo Hospital, New Delhi (2010/11) ; the various hematological factors identified significant predictors of transfusion requirement were preoperative Hct ,Hgb, PLt, and INR. Among those preoperative Hct correlates with intraoperative requirement of PRBCs that is patients with low Hct consumed more PRCs intraoperatively³⁶.

In a study conducted at Kenyatta National Hospital 1995, showed that 18% and 78.6% of surgical patients with blood loss less than 500ml, and between 500- 1000ml respectively, had blood transfusion. While he indicated that blood loss was the major determinant of blood transfusion rate in surgery³⁷.

A prospective cohort study conducted at urologic units of Kenyatta national hospital, among the factors that were significantly related to the need for blood transfusion were the age of the patient, pre-operative systolic blood pressure, only the patients' age and positive history of pre-operative use of acetyl-salicylate or warfarin sodium showed a statistically significant relationship the degree of blood loss and the weight of resected prostatic tissue (P < 0.05)³⁸

CHAPTER THREE

3. OBJECTIVES

3.1. General Objective

To assess blood requisition, transfusion practices and factors associated with transfusion in elective surgical procedures at Tikur Anbessa specialized Hospital, from February 1, 2016 to March 31, 2016 GC.

3.2. Specific objectives

- To assess practice of blood ordering for elective surgical procedure at TASH.
- To assess practice of blood transfusion for elective surgical procedure at TASH.
- To identify factors associated with blood transfusion in elective surgical patients at TASH.

CHAPTER FOUR

4. METHOD AND MATERIALS

4.1. Study Area and period

This study was carried out at Tikur Anbessa specialized Hospital from February 1, 2016 to March 31, 2016 G.C. Tikur Anbessa specialized hospital is multi-specialist tertiary care teaching hospital in Ethiopia, opened since 1972 and, in 1998 transferred to school by FMOH since then it became a university teaching hospital. TASH is now the main teaching hospital for clinical and preclinical trainings of most disciplines. It is also an institution where specialized clinical services that are not available in other public or private institutions are rendered to the whole nation.

It has one Blood bank, about 700 beds, previously it had about 17 operation theatre and during the data collection period only 8 of them were functional since the hospital was on maintenance, and more than 900 health professionals in the different specialties dedicated to providing health care services, and the various department's residents under specialty training in the school of medicine also provide patient care in the hospital.

4.2. Study design

Institutional based cross sectional study design was employed.

4.3. Population

4.3.1. Source Population

The source population were all elective surgical patients at Tikur Anbessa specialized hospital.

4.3.2. Study Population

The study population were all elective surgical patients who undergo their surgical procedure in the specified time period.

4.4. Eligibility criteria

4.4.1. Inclusion criteria

Patients who had perioperative blood cross-match request.

4.4.2. Exclusion criteria

Patients with inadequate diagnosis, operative or transfusion details and surgeries cancelled excluded.

4.5. Sampling Technique and Sample Size Determination

4.5. 1. Sample population

All patients who fulfil the inclusion criteria in the specified time period were the sample population

4.5.2. Sampling technique

By using sequential sampling technique all consecutive patients who were posted for elective surgery and who had perioperative blood cross-match were included until the end of the study period.

4.6. Study variables

4.6.1. Independent Variables

- Age
- Sex
- preoperative Hct/Hgb
- platelet count
- Antiplatelet and/or anticoagulant drugs
- Co-existing diseases
- ASA status
- Type of anesthesia
- Diagnosis/Type of surgery
- Intraoperative blood loss (ml)/% of EBV
- Number of units cross-matched
- Department/surgical units

-Transfusion time/place

- Number of units Transfused

4.6.2. Dependent Variables

Perioperative blood transfusion of patients

4.7.Data Collection

Structured check list was prepared in English which includes socio demographic data, physical characteristics of the patient, preoperative hemoglobin level, medical co-morbidities, units of blood cross-matched, and total estimated blood loss, units of blood transfused, time or place of transfusion, and type of surgery, type of anesthesia. The data collection were under taken by MSc anesthesia students who assigned at the respective operation room and the postoperative data collected by ward nurses at respective wards and the principal investigator supervise the completeness of the data daily.

4.8. Data Processing and Analysis

Data werechecked manually for completeness, coded and entered in to Epi Info version 7 and exported to SPSS version 20 computer program for cleaning, transformation and analysis.

Statistical analysis was performed using the SPSS version 20. The mean and median values were calculated for continuous and discrete variables respectively as required. Frequency and cross tabulation was conducted to describe relevant variables in relation to the outcome variables. Variables that demonstrated a significant relationship on univariate analysis ($p < 0.2$) were included in a multiple stepwise logistic regression analysis to identify the significant independent predictors of blood transfusion. The level of significance was set at p-value less than 0.05.

- Blood utilization indices were computed with the following equation:
- (i) **Cross-match to transfusion ratio (C/T ratio)** = number of units cross-matched/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 cross-matched $\times 100$. A value of 30% and above was considered indicative of significant blood usage.
- (iii) **Transfusion index (TI)** = number of units transfused/number of patients cross-matched. A value of 0.5 or more was considered indicative of significant blood utilization.
- (iv). **Maximal Surgical Blood Order Schedule (MSBOS)** = $1.5 \times TI$. Designed for the common surgical procedures that have ≥ 5 cases.

4.9. Data Quality Control and Assurance

Data collectors weretrained, pretest done for 2 days at each operation theatre and respective wards of TASH to test the data collection instruments. During data collection, regular supervision and follow up made. Principal Investigator cross check for completeness and consistency of data every day.

4.10. Dissemination plan

This study on completion could serve as a reference material to researchers, experts and policy makers for intervention. To reach these bodies the completed paper will be submitted to College of Health Sciences, Department of anesthesia. In addition, a copy of this material will be given to TASH, Addis Ababa University student research office, Ethiopian Association of Anesthetists, Ethiopian Red Cross society, Ethiopian ministry of health. The result will also be disseminated through publication in peer reviewed local and international journals and through presenting it in related workshops and seminars.

4.11. Operational definitions

Cancelled Surgery: surgery delayed from the scheduled date.

Elective Surgery: Scheduled surgeries included non-emergent surgical cases ordered to prepare blood perioperatively.

Cross-matched blood: units of blood ordered by the physician to be prepared perioperatively

Transfused units of blood: units of blood transfused either intraoperatively or postoperatively.

Perioperative Transfused patients: patients transfused either intraoperatively or postoperatively

Perioperative period: the day before the day of surgery to 72 hours of postoperative period.

Units of blood: A unit of whole blood or a packed RBC.

4.12. Ethical Consideration

Prior to the study, ethical clearance was obtained from the Departmental Research and Ethics Review Committee (DRERC) of, Department of anesthesia, School of Medicine, college of Health Sciences of Addis Abba University and the acquiescence was also obtained from the study institutions (Tikur Anbessa specialized Hospital). Moreover, full clarification about the purpose of the study was made to the Authorized person of the health facilities. A formal letter of cooperation was obtained from Tikur Anbessa specialized Hospital. The purposes of the study were also explained to the patients who was included in the study. Verbal consent from the patients were asked and Confidentiality of the information was assured by using code numbers and keeping questionnaires locked.

CHAPTER FIVE

5. RESULTS

5.1. Characteristics of surgical patients at TASH

A total of 242 consecutive patients were included in the study over the two month period with 153 males and 89 females (Male: Female ratio of 1.7:1). The median age was 31 (2 months–80 years), 75.5% above 15 years old with only 8(3.3%) cases age greater than 70. The mean preoperative hemoglobin (Hgb) was 12.9 ± 2.6 g/dl. Of the total 242 patients (26.4%) have Hgb < 11.0 g/dl and after adjustment for age and sex 39.7% from all cases were found anemic. Patients with coagulopathy problem accounts 12.1% of which 6.6 % of patients have a platelet count less than 150 and 5.5% of patents were on anticoagulant prophylaxis. Majority of cases lay on ASA status I (49.6%), II (41.7%) and III (8.7%); of all cases 10.3% of patients were come with additional co-morbidities. One hundred ninety (78.5%) of cases under go their surgical procedure under general anesthesia the remaining was done under regional anesthesia. The median operative blood loss was 9.4 (.0-57.4) % from their total blood volume with a mean of 11.8 ± 10.5 . One hundred seventy cases (70.2%) have intraoperative blood loss of less than 15% from those cases only 17 cases were transfused and 15(88%) of cases were transfused for preoperative anemia, 58 (24.4%) of cases have 15-30% blood loss with a transfusion probability of 43% and the remaining 5% of case have >30% blood loss with a transfusion probability of 83.3-100%. The median number of blood units cross-matched from the preoperative period to 72 hours of postoperative period were 2 (1-6) units with median number of blood transfused 2 (1-4) units. (Table 1&2).

Table 1. Socio-demographic and clinical characteristics of surgical patients at TASH Hospital, Ethiopia, 2016(N = 242).

characteristics		Frequency	Percentage %
Sex	Male	153	63.2
	Female	89	36.8
Age	<15	60	24.8
	≥ 15	182	75.2
Co-morbidities	Yes	25	10.3
	No	217	89.7

ASA status	I	120	49.6
	II	101	41.7
	III	21	8.7
Anticoagulant Treatment	Yes	14	5.8
	No	228	94.2
Platelets	<150	16	6.6
	≥150	226	93.4
Hemoglobin	<11	64	(26.4%)
	≥11	178	(73.6%)
Type of anesthesia	GA	190	78.5
	RA	52	21.5

Table 2: Descriptive of socio-demographic and clinical characteristics of surgical patients at TASH Hospital, Ethiopia, 2016(N = 242).

Characteristic	Mean± SD	Median	Mini-Max	Range	Total
Age	31.2±19.5	31	.1-80	79.9	-
Hemoglobin	12.9±2.6	13	6.3-20.0	13.7	-
Platelets	316.6±250	301.5	34-833	799	-
Units of blood cross-matched	2.17± .968	2.00	1-6	5	525
Units of blood transfused	2± .93131	2	0-4	4	107
Blood loss (%)	11.8±10.5	9.4	.0-57.4	57.4	-

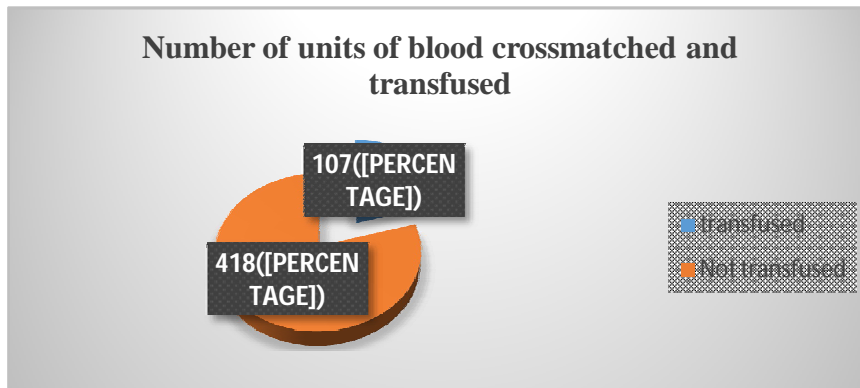


Figure 1.0 Comparison of units of blood cross-matched and transfused at TASH Hospital, Ethiopia, 2016(= 242).

5.2. Blood Requisition and Utilization in Respective Departments

During the two months of study period, blood requisition was made for 242 patients undergoing elective surgery in different departments and surgical units. Twenty six percent of the listed cases were from the Orthopedics, Pediatrics surgery (16.1 %), Neurosurgery (12.8%), cardiothoracic surgery (11.6%), General surgery (10.3%) and Gyn/Obs (7.4%) department.

A total of 525 blood units were cross-matched and 97% were prepared preoperatively and 3% during intraoperative period. One hundred seven (20.4%) units of blood were transfused giving an overall CT ratio 4.9. Of the 242 cases operated only 55 patients who had been transfused with PRBC or whole blood which gives a transfusion probability (%T) of 22.7% and transfusion index of 0.44 (Table 3).

5.2.1. Orthopedics

Orthopedic surgery took the largest share of patients 64(26.4%) of all cases with cross-matched blood of 121 units. Twenty five cases (39.1%) of those cases have a preoperative hemoglobin level below 11g/dl. Forty three cases (67.2%) of those cases have a blood loss of less than 15% the median blood loss was 10(0-40). Open reduction and internal fixation of femur was the most frequently done procedure 21 and from all only 3 cases were transfused giving cross-match to transfusion ratio of 6.8, transfusion probability of 14.3 with transfusion index of 0.3. So ORIF of

femur needs only GSH. The overall transfusion of orthopedic surgery depicts inefficient use of blood with transfusion probability of 26.6%, cross-match to transfusion ratio of 4.2 with transfusion index of 0.5.

5.2.2. Pediatrics surgery

Despite the second largest share of cases 39(16.1%) pediatrics cases has the second least amounts of transfusion probability 15.4 next to urologic procedures and giving the highest cross-match to transfusion ratio of 8.2 i.e. only 1 every 8 cross-matched units of blood were transfused with transfusion index of 0.5. Thirty three percent of cases were anemic (hemoglobin<11g/dl). Around eighty percent (79.5%) of those cases have a blood loss of less than 15% and the remaining 20.5% 15-30%. The median blood loss was 5.7(0-27.1). Pullthrough was the most frequently done procedure 8 and from all only 1 cases were transfused giving cross-match to transfusion ratio of 10, transfusion probability of 12.5 with transfusion index of 0.1. So Pullthrough needs only GSH.

5.2.3. Urologic surgery

From all 37 patients only 5 of the cases were transfused three of them were bladder cancer undergoing their procedure for TURBT of which all having preoperative hemoglobin less than 9. Over all the urologic cases have the least transfusion probability 13.5, cross-match to transfusion ratio of 5.8 with transfusion index of 0.5. Among the common procedures; pyelolithotomy (10), urithroplasty (7), URS (5) were account for 51 units of blood cross-match with none of the blood transfused for those patients which shows as irrational blood ordering.

5.2.4. Neurosurgery

From a total of neurosurgery cases 30(96.8%) of cases have hemoglobin level of above 11g/dl which is the lowest of anemic patients found from all department. Despite having the least anemic cases, Neurosurgery has the highest transfusion of blood which uses 29(27%) units from 107 units of blood transfused by all departments due to the highest intraoperative blood loss. More than half of the patients having above 15% of blood loss with a median of 15.4(3.3-57.4) from their total body blood volume. Craniotomy for brain tumor excision was the most frequently done procedure in this study with encouraging blood usage cross-match to transfusion of 2.9, transfusion probability 50% and transfusion index 1.1. Neurosurgery also have relatively efficient blood ordering and utilization; from a total of 31 cases 14 were transfused giving a

transfusion probability of 45.2, cross-match to transfusion ratio of 3 with transfusion index of 0.9.

5.2.5. Cardiothoracic surgery

Despite our expectation of high blood loss during thoracotomy only 4 of 28 patients were transfused giving transfusion probability of 14.3, cross-match to transfusion ratio of 8.1 with transfusion index of 0.3. Thoracotomy (for pneumonectomy, BPF repair and cystectomy) was common procedure 11 and none of those cases transfused their prepared blood and trans-hiatal esophaotomy (THE) 5, with a transfusion probability 28.6%.

5.2.6. General surgery

For a total of 25 cases 65 units of blood cross-matched of which only 10 units of blood were used leaving 85% of prepared units of blood unutilized with a transfusion probability of 14.3, cross-match to transfusion ratio of 8.1 and transfusion index of 0.3. Laparotomy (8) and thyroidectomy (6) were the common procedure with none of the thyroid cases transfused.

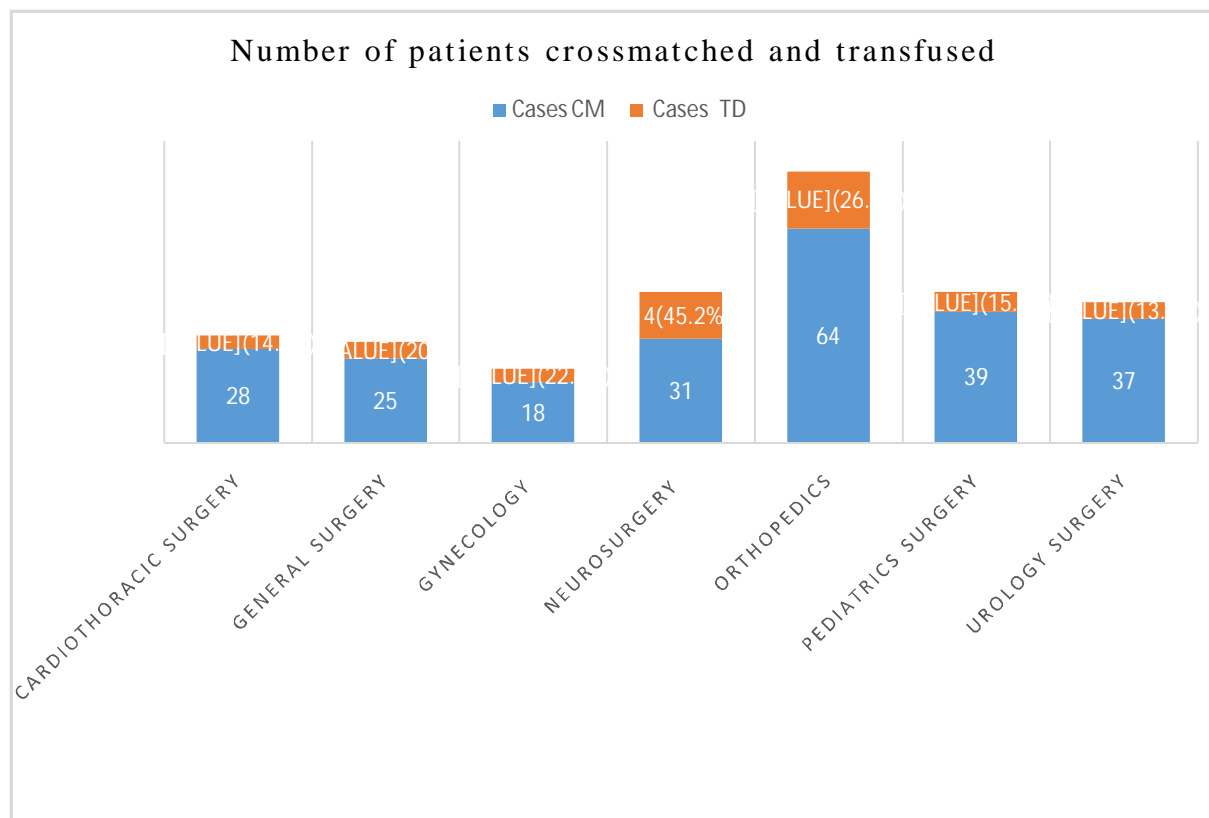
5.2.7. Gynecologic and obstetrics

Gynecology department has 18 patients having only 4 transfused cases with a transfusion probability of 22.2, cross-match to transfusion ratio of 4.7 and transfusion index of 0.6. TAH was frequently done procedure with a transfusion probability of 25%.

Table 3. Blood ordering and utilization indices of different surgical departments of TASH from February 1, 2016 to March 31, 2016 G.C. (N=242).

Department	Cases CM	Cases TD	Units CM	Units TD	C/T	%T	TI
Cardiothoracic surgery	28	4	73	9	8.1	14.3	0.3
General surgery	25	5	65	10	6.5	20	0.4
Gynecology	18	4	47	10	4.7	22.2	0.6
Neurosurgery	31	14	89	29	3	45.2	0.9
Orthopedics	64	17	121	29	4.2	26.6	0.5
Pediatrics surgery	39	6	49	6	8.2	15.4	0.5
Urology surgery	37	5	81	14	5.8	13.5	0.4
Total (N)	242	55	525	107	4.9	22.7	0.44

*CM=cross-matched, TD=Transfused



*CM-Cross-matched,TD-Transfused

Figure 2.0 number of cases cross-matched and transfused across different surgical department of TASH from February 1, 2016 to March 31, 2016 G.C. (N=242).

Table 4. Magnitude of Intraoperative blood loss across surgical departments of TASH from February 1, 2016 to March 31, 2016 G.C. (N=242).

Department	Blood loss in %			
	<15	15-30	30-40	≥40
Cardiothoracic	19(67.9%)	8(28.6%)	0.0%	1(3.6%)
General surgery	21(84.0%)	4(16.0%)	0%	0%
Gynecology	9(50.0%)	5(27.8%)	2(11.1%)	2(11.1%)
Neurosurgery	15(48.4%)	10(32.3%)	3(9.7%)	3(9.7%)
Orthopedics	43(67.2%)	19(29.7%)	1(1.6%)	1(1.6%)
Pediatrics	31(79.5%)	8(20.5%)	0%	0%
Urology	32(86.5%)	4(10.8%)	0.0%	1(2.7%)
Total	170(70.3%)	58(24%)	6(2.5%)	8(3.3%)

Table 5. Blood ordering and utilization indices of various surgical procedures with their respective MSBOS for TASH from February 1, 2016 to March 31, 2016 G.C.

Procedure	Patients CM	Patients TD	Units CM	Units TD	C/T	%T	TI	MSBOS
Craniotomy	24	12	75	26	2.9	50	1.1	2
Excision *	5	1	8	1	8	20	0.2	GSH
Exploration*	8	2	15	2	7.5	25	0.3	GSH
Laparotomy	8	2	21	5	4.2	25	0.6	GSH
ORIF of Femur	21	3	41	6	6.8	14.3	0.3	GSH
PNL	5	0	10	0	-	0	0	GSH
Pullthrough	8	1	10	1	10	12.5	0.1	GSH
Pylolithotomy	10	0	19	0	-	0	0	GSH
TAH	12	3	32	6	5.3	25	0.5	GSH
THE	7	2	20	4	5	28.6	0.6	GSH
Thoracotomy*	11	0	25	0	-	0	0	GSH
Thyroidectomy	6	0	14	0	-	0	0	GSH
TURBT	5	3	14	9	1.6	60	1.8	2-3
Urithroplasty	7	0	12	0	-	0	0	GSH
Urithroscopy	5	0	9	0	-	0	0	GSH

*thoracotomy = {pneumonectomy, BPF repair, cyst removal }, Excision (of soft tissue mass) Exploration (for biliary and renal stone) ,PNL=percutaneous nephrolithotomy, TAH=Total abdominal hysterectomy, THE=trans hiatal esophagotomy, TURBT=transurethral bladder tumor resection

TABLE 6. Transfusion indices in terms of blood loss at TASH from February 1, 2016 to March 31, 2016 G.C.

blood loss (%)	Cases CM (%)	Cases TD(%)	Units CM	Units TD	C/T	%T	TI	MSBOS
<15	170	17	334	31	10.8	10	0.18	GSH
15-30	58	25	141	39	3.6	43	0.67	GSH-1
30-40	6	5	17	13	1.3	83.3	2.2	3-4
>40	8	8	33	24	1.4	100	3	4-5
Total	242	55	525	107	4.9	22.7	0.44	

CM-cross matched, TD-transfused

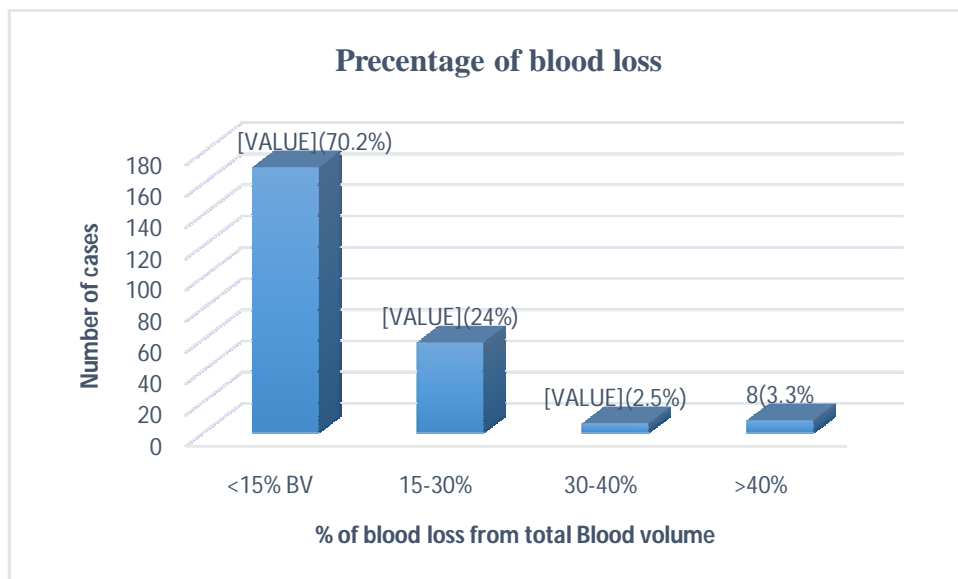


Figure 2. Magnitude of blood loss among surgical patients blood at TASH from February 1, 2016 to March 31, 2016 G.C. (N=242). (N=242)

5.3. Factors associated with perioperative blood transfusion

In Multivariate analysis, when 95% CI for the adjusted odds ratios were calculated among these variables, perioperative transfusion of patients showed statistically significant association with preoperative hemoglobin <11 g/dl (p=.000), intraoperative blood loss $\geq 15\%$ (p=0.000), and Neurosurgery(craniotomy) (p=0.017) of the study groups.

Those study subjects, who had preoperative hemoglobin <11 g/dl are 7.553 times more likely to have perioperative transfusion than those who had preoperative hemoglobin ≥ 11 (AOR=7.553; CI 2.915-19.576).

Those who develop intraoperative blood loss $\geq 15\%$ are 12.830 times more likely to have perioperative transfusion than those who had <15% (AOR= 12.830; CI 5.613-29.323), and among surgical procedures region who has craniotomy surgery has 5.868 times more likely to have perioperative transfusion than thoracotomy, abdominal ,extremity, genitourinary, gynecologic and other procedures (AOR=5.868 ; CI 1.364-25.239) . However age and preoperative anticoagulant medication were not significant factors of perioperative transfusion on multivariate logistic regression (Table 7).

Table 7. Peri-operative patient characteristics and clinical factors associated with blood transfusion at TASH from February 1, 2016 to March 31, 2016 G.C. (N=242).

Variables		Patient transfused		Odds Ratio		P-Value	95% C.I
		Yes	No	Crude	Adjusted		
Age	<70	52	182	1	1	.060	.930,39.03
	≥70	3	5	2.1	6.02		
Hemoglobin levels	<11	23	41	2.559	7.553	.000*	2.915,19.576
	≥11	32	146	1	1		
Anti-coagulant	Yes	6	8	2.740	2.606	.230	.546,12.441
	No	49	179	1	1		
Region of surgery	Abdominal	8	30	1.800	1.037	.857	.216, 6.333
	Extremity	17	46	2.495	1.281	.642	.319,6.372
	Genitourinary	8	43	1.256	1.349	.807	.237,6.355
	Gynecologic	4	14	1.929	.872	.191	.015,2.307
	Head*	13	14	6.268	5.868	.017*	1.364,25.239
	Others	1	13	.519	.906	.938	.074,11.051
	Thoracic	4	27	1	1	-	-
Blood loss	<15	17	153	1	1	.000*	5.613,29.323
	≥15	25	33	.009	12.830		

*head =craniotomy, others (Thyroid, disc prolapse and sacrococegal mass)

CHAPETR SIX

DISCUSSION

In this study we found out that 77.3% of elective surgical patients didn't need blood transfusion in agreement with as stated by other study 77% of operations will need no pre-operative preparations of blood².

This study revealed that only 20.4 % of the cross-matched blood was utilized which is almost comparable to that reported in, Nepal 2009, where 17.24 % and Zambia 2015, (23.8%) of blood cross-matched was utilized ^{13, 17}. But the utilization was relatively low compared to a study conducted in Bellary, India, 2012(26%) ¹⁴, Egypt, 2011 (25.2%) ¹⁵, Nigerian, 2014 (34.51%) ¹⁶, in University of Gondar hospital, Ethiopia, 2013 (36%) ¹⁸. Despite the disparity in the degree all might depicts that the problem is common worldwide especially in developing countries including our Ethiopia

To determine the efficiency of blood ordering and utilization system a number of indices are used. Boral Henry was the first that suggested the use of cross -match to transfusion ratio (C/T ratio) in 1975⁴. Consequently, a number of authors used C/T ratio for evaluating blood transfusion practice and ideally, this ratio should be 1.0, but a ratio of 2.5 and below was suggested to be indicative of efficient blood usage¹. According to the recommendation a cross-match to transfusion ratio of 4.9 is unacceptably high which is twofold times the recommended. Despite this, the result is comparable with Malaysia, 2002 (5)³¹ and better compared with Nepal (11.7)¹³, and India tertiary care teaching hospital, 2000 (6.6)³⁰. On the other hand it shows significant wastage of blood compared with Egypt (3.9)¹⁵, Zambia (2.8)¹⁷ and in our country atuniversity of Gondar hospital (2.6 and 2.9 in elective surgical and gynecologic patients) ¹⁸.

Study in Westerns and some other countries showed their transfusion indices are becoming near to the standard even to the ideal; Aga Khan University Hospital, Pakistan 2001,majority (97.56%) of the patients had C: T ratios higher than 2.5 latter in 2009/10 for procedures performed, C: T ratio was 1 in (95 %) procedures³². While in Leicester, UK, 2013(2.1)⁶, Baltimore, Maryland,2014 (1.54 ± 0.07)³³ this was achieved through continuous auditing and formulation of MSBO^{6,32,33} where as in developing countries like Ethiopia even the magnitude of the problem is yet not exploited. So this study is an eye-opener where we should focus in

addition to awareness creation on blood donors to address the alarmingly increased demand of blood requirement and supply challenges.

The probability of a transfusion for a given procedure is denoted by %T and was suggested by Mead et al. in 1980⁵. A value of 30% and above has been suggested as appropriate¹. Based on what is recommended in the above literature, the results of the present study revealed an overall %T of 22.7% which was indicative of inappropriate utilization compared to units of blood cross-matched. This study is almost near to Zambia (20%)¹⁷ and higher than study conducted in Nepal (13.5%)¹³, Indian tertiary care hospital where %T ranged from (11.1% to 25%)³⁰ and on the other hand it is lower than Egypt where it was 36.9% and Nigerian (34.51%)¹⁶.

The average number of units used per patient cross matched is indicated by the transfusion index (TI) and signifies the appropriateness of number of units cross matched. A value of 0.5 or more is indicative of efficient blood usage^{1, 4}. The overall TI reported in the current study was 0.44 which is near to Zambia 0.40. This finding was higher than that which has been found in a study conducted in Indian tertiary care hospital 0.36³⁰ but lower than that reported in Egypt 0.69¹⁵.

From this study none of the transfusion indices showed efficient blood utilization which is ordering large amount of blood become a culture than necessity. Thus ordering large quantities of cross-matched blood for surgical patients of which little is ultimately utilized, incurs an artificial shortage in the reserves, wastes valuable technical time and squanders expensive reagent.

Above all, we have blood supply challenge; collected less than half of the national requirement which necessitates the judicious use of blood and blood products.

On the contrary, despite lots of publication and investigation on the efficiency of blood usage, there was no clear demarcation which patients really need blood transfusion and how much units of blood required preoperatively due to variability in patient factor and set ups. To stratify surgical patients based on their risks and to have rational blood management clinicians made ongoing auditing of the service. Most clinical studies found that the main predictive factor for perioperative blood transfusion were hemoglobin less than 11g/dl, indication of the procedure³⁴ and increased blood loss (factors that increase intraoperative blood loss such as age greater than 70 and preoperative use of anti-coagulant)^{35,37,38}. In agreement with these results, we found out

that statistical significant independent predictive factors of transfusion were preoperative hemoglobin level less than 11g/dl, indication for surgery specifically neurosurgery or craniotomy for brain tumor resection and intraoperative blood loss greater than 15%. However, we did not found statistical significant association with age in spite of numerical or percentage differences from age, <15(16.7%) and age >70(37.5%) cases transfused compared to 22.7% of the average.

Nevertheless, studies found that Patients who were preoperatively on anticoagulant medication as independent predictors of perioperative transfusion and 42.9% of these patients were transfused in our study compared 21.5% of those who were not on anticoagulant on logistic regression it was not statistically significant. So despite age and anticoagulant medication were not independent predictor of transfusion it is better to give consideration for those cases and further assessment needs with representative sample.

As we found out the main determinant of blood transfusion rate in surgery were preoperative Hgb <11 g/dl, indication for surgery/craniotomy and blood loss \geq 15%; other factors also need to be incorporated to determine a comprehensive policy that would govern judicious and rational use of blood perioperatively. Strategies like timely and adequate preoperative assessment of risk, optimized baseline hemoglobin, intraoperative techniques to minimize blood loss should be introduced.

CHAPTER SEVEN

7. STRENGTH AND LIMITATION OF THE STUDY

7.1 Strength of the Study

To my knowledge this is the first study in my study area that specifically assesses the efficiency of blood ordering, utilization and find outs predictor of transfusion in elective surgical patients; so it can be used as a baseline data for researchers and policy makers.

7.2. Limitation of the Study

It is a single center study, therefore, our results cannot be generalized to other centers that follow different transfusion and technical protocols for different surgical procedures.

A large scale prospective study could not conducted because of time constraint which limits us from formulation of maximum surgical blood ordering schedule (MSBOS) to all types of surgery.

CHAPTER EIGHT

8. CONCLUSION AND RECOMMENDATION

8.1. Conclusion

In our hospital the amount of blood requested and cross-matched for patients undergoing elective surgery is much greater than the amount actually used. This high rate of unnecessary cross-matching of blood prior to surgery; leads wastage of resources, increased workload and financial costs, at most it will incur blood supply challenges which necessitate changes in the pattern of blood requisition.

The independent predictor of perioperative blood transfusion in this study are preoperative hemoglobin less than 11g/dl, intraoperative blood loss greater than 15% from the total body blood volume and craniotomy surgery should be considered while blood cross-match is ordered.

8.2. Recommendation

Blood ordering pattern for elective surgery patients need to be revised and over ordering of blood should be minimized. This can be possible by implementing an updated, institution-specific MSBOS along with an EBRS.

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. The transfusion index (TI) calculated for each procedure in this study can be utilized to recommend a GSH for those procedures with low TI.

For continuous improvement of transfusion practice, regular surveillance of the utilization pattern and periodic feedback is needed.

In the surgeries which have insignificant blood loss, only blood grouping of the patient should be done and cross matching can be avoided which can not only be rational and cost effective, but also hasten the time lost in waiting for surgery. However, one must confirm the availability of blood for emergency situation before starting the surgery.

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ANNEX I

Date ___/___/___

Check list

Code _____

Addis Ababa University College of Public Health and Medical Science

School of Medicine Department of Anesthesia

A data collection format, for patients that has perioperative blood requisition who underwent elective surgical procedures, in Tikur Anbessa specialized hospital, Addis Ababa.

Instructions:

- A. Fill the blank space provided.
- B. Encircle the alternatives when necessary.
- C. Check the questions for completeness.

Part 1. Identification:

1.1. Ward _____ 1.2. Bed no. _____ 1.3. Patient MRN _____ 1.4. Age (in year) _____ 1.5. Sex: A. Male B. Female 1.6. Body weight _____ Kg and EBV _____ ml

Part 2. Cross-match request:

2.1. Clinical area/department that requested the cross-match _____

2.2. Type of request: A. scheduled (preoperatively) B. Extreme urgency, without cross-match (Intra) C. Extreme urgency, with cross-match (Intraop)

2.3. How many units were requested? A. 1 B. 2 C. 3 D. 4 E. ____

2.4. How many units of the requested blood prepared? A. 1 B. 2 C. 3 D. 4 E. ____

Part 3. Preoperative evaluation

3.1. Diagnosis _____ procedure _____

3.2. Coexisting disease: A. DM B. Hypertension C. Pulmonary TB

D. Bronchial asthma E. Hepatitis / HIV/AIDS F. Other (Specify) _____

3.3. Preoperative Hgb _____ g/dL or Hct _____% and platelet count _____

3.4. Did the patient on antiplatelet and/or anticoagulant drugs? A. yes B. No

3.4. ASA status: A. I B. II C. III D. IV

4. Intraoperative evaluations

4.1. What type of anesthesia is used?

A. GA B. RA C. Both D. other specify _____

4.2. Does the patient transfused Intra operatively? A. Yes B. No

4.3. If the above question is yes how much unit of blood?

A. 1 unit B. 2 units C. 3 units D. above _____

4.4. Is there any change of the intended procedure? A. yes B. No

4.5. If yes for the above question, what is the changed procedure_____

4.5. Intraoperative blood loss (ml) _____or _____% of EBV

4.6. The primary trigger for transfusion:

A. low hemoglobin B. hypovolemia C. clinician choice

5. Postoperative evaluations:

5.1. Does blood transfusion ordered postoperatively? A. yes B. No

5.2. If the above question is yes, how much unit of blood?

A. 1 unit B. 2 units C. 3 units D. above _____

5.3. Does the patient transfused postoperatively? A. Yes B. No

5.4 .If the above question is yes, where and how much unit of blood?

A. PACU (how much) _____B. Ward (how much) _____Hour/day from end of operation_____.

Name of data collector_____

Status/profession

Signature_____

Thank you!!!

ANNEX II

ASSURANCE OF PRINCIPAL INVESTIGATOR

The undersigned agrees to accept responsibility for the scientific ethical and technical Conduct of the research project and for provision of required progress reports as Per terms and conditions of the Research Publications Office in effect at the time of Grant is forwarded as the result of this application.

Name of the student: _____

Address: email asfaw.57@gmail.com phone number
+251912768325/+251923216501

Date. _____ Signature _____

Approval of the primary Advisor

Name of the primary advisor: _____

Date. _____ Signature _____