
# COLLEGE OF HEALTH SCIENCE ANDSCHOOL OF MEDICINE SPECIALITY RESEARCH THESIS

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Accuracy of Visual Estimation of Intraoperative Blood Loss compared to calculated blood loss and factor which affect it In Adult Patients on elective surgical patients at Tikur Anbesa Specialized teaching Hospital (TASH), Addis Ababa, Ethiopia, 2023/24.

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# Contents

## Acronym and abbreviation

BL Blood Loss

CBL Complete blood loss

EBL Estimated Blood Loss

Hgb Hemoglobin

PPO1 Predicted postoperative day 1 hemoglobin value

QBL Quantity of blood loss

TASH Tikur Anbessa Specialized Hospital

VEBL Visual Estimated Blood Loss

# ABSTRACT

**Background:** -Visual estimation of blood loss has been the most commonly used method and sometimes, the only method available for assessing intraoperative blood loss simply because it is easy, quick, and convenient. Accurate assessment of intraoperative blood loss is an important aspect of perioperative management of patients undergoing surgery where blood loss is often dispersed. Under estimation of bleeding can pose a danger to the patient's recovery and sometimes also it can be a threat to life, especially when associated with hemodynamic instability (6-7).Over estimation of bleeding can lead to unnecessary blood transfusion, exposes the patient to needless risks such as infections, hemolytic and non hemolytic transfusion reactions(13).Improving visual estimation of blood loss is crucial step in management of surgical patients and decision of transfusing a patient should not always depend on estimation .

**Objective:** - to asses accuracy Of visual estimation of intraoperative blood loss compared to calculated blood loss in adult patients on elective surgical patients at Tikur Anbesa Specialized Hospital (TASH), Addis Ababa, Ethiopia, 2023/24.

**Method:** -institutional based prospective cross-sectional study was used from Jan to march 2024 the study was conducted in TASH on 243 patients .Data was collected by modified questionnaire. Data collection was done by anesthesiology resident, anesthetists and medical interns. Simple convenient sampling technique was used as sampling technique. Data was checked for completeness and data was entered cleaned and analyzed by SPSS 27.00 version statistical software. Descriptive analysis was done for socio-demographic values. The absolute mean error was also compared .and factors that affect the accuracy of VEBL was assessed by multiple regression

**Result:** visual estimation of blood loss is in accurate by average of 29.1 % from calculated blood loss .21.8 %( Anesthesia side) and 36.4 % (surgical side) among the factors amount of bleeding also had its own impact by ;for those bleeding ***< 500 ml*** absolute mean error is **136 ml** ,for ***501-1000ml*** absolute mean error is **145**, for ***1001-1500 ml*** absolute mean error is **297** for ***1501-2000 m***l absolute mean error is **265** and for those ***>2000 ml*** absolute mean error is **471** ml



Key word VEBL



**Conclusion** Visual estimation of blood loss is inaccurate and subjective. Both anesthesiologists and the surgical side underestimated based on visual estimation. However, anesthesiologists generally outperformed surgical teams in visually with their estimates being closer to the actual blood loss that was calculated blood loss from pre- and post-operative hematocrit values.

# CHAPTER 1 Introduction

## Background

Visual estimation of BL has been the most commonly used method and sometimes, the only method available for assessing intraoperative BL simply because it is easy, quick, and convenient. Accurate assessment of intraoperative BL is an important aspect of perioperative management of patients undergoing surgery where BL is often dispersed (1).

Clinicians face a regular challenge in estimating intraoperative blood loss as no method or approach currently exists as objective measurement. Despite the fact that visual assessment is inaccurate, intraoperative blood loss is still reported visually (2-3). There is currently no practical and precise procedure for measuring intraoperative blood loss. The eyeball method, in which an estimation of blood loss is through visual inspection of surgical sponges, suction canisters, and the operating room setting, is the most common method used by surgeons and anesthesiologists. Many authors have argued that this approach is ineffective (4-5). An accurate assessment of blood loss must be performed to be able to properly replace lost volume during surgery. Under estimation of bleeding can pose a danger to the patient's recovery and sometimes also can be a threat to life, especially when associated with hemodynamic instability (6-7). Over estimation of bleeding can lead to unnecessary blood transfusion, exposes the patient to needless risks such as infections, allergic complications, and both hemolytic and non-hemolytic transfusion reactions (13).

Combination of clinical evaluation of the patient's vital signs, visual estimation of bleeding, and laboratory tests will guide the selection of appropriate fluid administration and blood transfusion (15-16). Decisions about transfusion should be based on a set limit for hemoglobin (Hgb) concentration. Depending on the patient and his or her underlying diseases, the normal range is between 6 and 10 g/dL (60-100 g/L) (16).

Hematochrit estimation is a point of care testing which is relatively inexpensive and fast. The aim of this study is evaluation of Hct value and estimation of amount of blood loss, and to show appropriate visual estimation is crucial for patient management.

## 1.2 Statement of the problem

In clinical practice, the amount of blood lost is estimated by different members of the medical team (the surgeons, anesthetists and OR nurses). Even with repetitive studies showing the limitations and inaccuracies of visual estimation, visual method is the easiest and most common method of estimation of blood loss (18-19).

In Tikur Anbessa Specialized Hospital, anesthesiologist/ anesthesiology resident and surgical team often relies on visual estimation of blood loss alone to guide the transfusion of red blood cells in the perioperative period and this method of estimating blood loss has been frequently reported to be inaccurate and suffers from large inter observer variability. And it is common thing to have disagreement between the two professionals

The Hct estimation is a point-of-care testing which is relatively cheap and faster, with result readily available. Also, comparing visually estimated intraoperative blood loss with this direct method of Hct measurement will help to assess the level of accuracy of this method. This study is therefore set to investigate the accuracy of visual estimation of intraoperative blood loss when compared to postop Hct during elective surgical procedure.

## 1.3 Significant of the study

Visual estimation often leads to over or under-estimation of blood loss, and it becomes even more inaccurate when large amount of blood loss is involved or the blood gets mixed with other fluids. Visual estimation remains the commonest method of assessing intraoperative blood loss in most operating rooms despite several studies suggesting that it is inaccurate. This study identified VEBL is inaccurate especially when there is large amount of bleeding in a comprehensive specialized hospital

## CHAPTER 2: Literature review

Visual estimation of blood loss is a quick and inexpensive method of assessing blood loss without technical limitations. However, issues of inaccuracy must be overcome to enhance the reliability of such estimations. Before the acquisition of a postoperative hemoglobin (Hgb) level, the VEBL is commonly used to determine whether or not a patient will receive blood products intraoperatively.

Visual estimation of blood loss is inaccurate according to study done at Cleveland on August 2016, the study was done with precise known volume of blood in 3 categories (category 1, 50 ml, category 2, 300 ml and category 3, 900 ml) and the result was 95 % of the estimation had error more than 25 % in at least one category(42). In other study which done at Saudi Arabia on 150 patients shows visual estimation of blood loss under estimated by 30 % when it compared with gravimetric values(43) and in a systematic review and meta analysis done on 2020 on comparison of common methods of intra operative estimation of blood loss( colorimetric methods, gravimetric and visual estimation )with validated reference ( hemoglobin extraction assay) shows a highest correlation for colorimetric ( 0.93 95 % CI) then for gravimetric ( 0.77 95 % CI) and the least for visual estimation ( 0.61 95 CI)

There are different factors for inaccuracy of visual estimation of blood loss

1. The profession of a person who estimates the blood loss

An observational study done by Bose et al revealed that to determine the discrepancy between actual blood loss and visually estimated blood loss among anesthesia team and other professionals, they compared estimates given by 24 obstetricians, 9 anesthetists, 42 midwives, 11 gynecological nurses, 12 theatre nurses and 5 health care assistants. The results showed that the estimation by the anesthesia team was overestimation only by 4% and estimation by other professional groups was underestimation by 32% and, when compared to other professional groups the anesthetists tend to overestimate blood loss. However, the anesthetists were the most accurate estimators of blood loss (29).

A study done in south Africa shows no difference in accuracy of blood loss estimation between anesthetists and surgeons, the experiment was done by estimation of blood loss on swab by surgeons and nurse anesthetists in 104 practitioners and a general accuracy of 28.6 % and no difference in accuracy between different medical discipline (40).

2. Amount of blood loss

In a research done at Cleveland on august 20l6 on visual estimation of blood loss accuracy shows as the blood loss increased the accuracy will be decreased. The experiment was done in sixty practitioners and known amount of blood was (50 ml,300ml and 900 ml) was socked in to surgical pads and the result shows 52 %error in the first category ( in 50 ml), 61% in the second category( 300 ml) and 85 % in the third category( 900ml)(42 ).

A research done in the USA shows the correlation between the actual and predicted postoperative day 1 hemoglobin value (PPO1 Hgb) was better in the device group (which is by scanning all socked surgical sponge) ($R^2 = 0.519$, correlation = 0.720) than in the traditional group(visual estimation of blood loss) ($R^2 = 0.429$, correlation = 0.655) ($p = 0.005$). For patients in the device group where the estimated blood loss was >1,000 mL ($n = 53$), the PPO1 Hgb was also better correlated with the actual value ($R^2 = 0.319$, correlation = 0.565) than the predictions using visually estimated blood loss for those patients in the device group whose visual estimation was >1,000 mL ($n = 32$) ($R^2 = 0.035$, correlation = 0.187) ($p = 0.027$). From this study we can see the inaccuracy of the traditional method and this inaccuracy increases as the blood volume is high >1000ml (33).

A study on usefulness of visual estimation in determining the extent of perioperative hemorrhage revealed that the agreement was observed in 153 estimates (27.3%), underestimation in 42 cases (7.5%) and overestimation in 365 opportunities (65.2%). Overestimation was observed when comparing the mean of the estimated values with the actual amount of blood in the sponges and gauze Pads. Mean differences between estimated and actual values were smaller when the actual volume was less than 75 ml(36).

3. Presence of Field Bleeding

In a study done on bleeding estimation by visual methods for vaginal (bleeding on drapes and surgical sponge) and caesarian (bleeding in to suction and canisters delivery) shows EBL was inaccurate for vaginal delivery but the EBL was not affected by blood loss distribution or location of bleeding or by provider group (44) and the inaccuracy for vaginal bleeding is attribute to amniotic fluid contamination.

External blood loss estimation is associated with systematic error (under or over estimation) depending on the person making the estimation (45).

4. Experience of the personnel who estimates the blood loss

Observational study at King Abdul-Aziz Medical City, Riyadh, Saudi Arabia between January 1, 2011 and June 30, 2011. Hundred and twenty three health care providers were participated in 2 phase before and after training in estimation of post partum blood loss.

The participants' significantly under-estimated post partum blood loss. The accuracy was improved after training (p-value < 0.0001) and after analyzing each patient's clinical information (p-value = 0.042). The overall results were not affected by the participants' clinical backgrounds or their years of experience.

The conclusion of the study was simple education programmer can improve visual estimation of blood loss(46).

# Chapter 3: OBJECTIVES

## 3.1 General objectives

Accuracy of Visual Estimation of Intraoperative Blood Loss compared to calculated blood loss (determine from post op hematocrit) and factors associated with it In Adult Patients on elective surgical patients at Tikur Anbesa Specialized Hospital (TASH), 2023/24.

## 3.2 specific objectives

- 3.3.1 To identify factors that affects the accuracy of VEBL in adult patient undergoing elective surgery
- 3.3.2 Accuracy of Visual Estimation of Intraoperative Blood Loss compared to calculated blood loss (determine from post op hematocrit) In Adult Patients on elective surgical patients at Tikur Anbesa Specialized Hospital (TASH), Addis Abeba, Ethiopia 2023/24

# CHAPTER 4. Method

## 4.1 Study area

The study was conducted at Tikur Anbessa Specialized Hospital, Addis Ababa, Ethiopia. It is located in the Central part of Addis Ababa City Administration, the capital of Ethiopia. Tikur Anbessa Specialized Hospital is a tertiary hospital that gives services for referral cases from other specialized referral hospitals throughout the country. It has 11elective surgery operating rooms and 2 post anesthesia care units. An average of 200 elective surgeries is conducted per month.

**Study period**

The study will be conducted from jan2024 –mar 2024.

## 4.2 Study design

A single-center prospective cross-sectional observational study was conducted from Jan 2024 – march 2024

## 4.3 Population

### 4. 3.1 Source population

All adult patients who undergone surgery at Tikur Anbessa Specialized Hospital during the study period.

### 4.3.2 Study population

All patients who had undergo elective surgery who fulfilled inclusion criteria during the study period at TikurAnbessa Specialized Hospital.

## 4.4 Inclusion and Exclusion criteria

### 4.4.1 Inclusion criteria

- Patients undergoing elective surgery age >18 years and available during the study period
- Patient having a record preoperative hemoglobin/hct

### 4.4.2 Exclusion criteria

- Dehydrated patient
- Patient who has post operative collection before post operative hemoglobin is determined
- Patient who have minimal bleeding
- Patient Who have no post op HCT

## 4.5 Sample size

The sample size will be calculated by using the formula for single population is no similar study which was conducted in the study area as far as our knowledge and searching effort) with confidence level of 95% and degree of precision of 5%

- By using single proportion population formula

$$\text{ni} = \frac{z^2_{1-\frac{\alpha}{2}} \times \text{p} \times (1-\text{p})}{\text{d}^2}$$

Where

- ni = Initial estimated sample size
- Z = Confidence level (alpha, α)
- P = prevalence
- d = marginal error

- Since there is no previous study, our p value is 50% with confidence level of 95% and degree of precision of 5%
  - $\frac{z^2_{1-\alpha/2} \times \text{p} \times (1-\text{p})}{\text{d}^2} = \frac{(1.96)^2 0.50(1-0.5)}{(0.05)^2} \approx 384$

- Since the population is<10,000 which is 384. The correction formula will be used to get the final sample size
  - $nf = \frac{ni}{1+ni/N}$ Where nf – final sample size

*ni*– initial sample size

N – Sampled population

  - $nf = \frac{384}{1+\frac{384}{600}} = 234$

- $nf = 234$
- When we add, 10% non-respondent percentage, the final sample size will be**257**

## 4.6 Sampling method

All patients who fulfill the inclusion criteria.

## 4.7 Study variable

### 4.7.1 Dependent variable

Accuracy of visual estimation of intra-op bleeding

### 4.7.2 Independent variable

- Health provider level of education
- The profession of the person who estimates blood loss
- The volume of estimated blood loss
- The presence of field blood loss
- The presence of body fluid that contaminated with the blood

## 4.8 Operational definition

- Field Bleeding: The blood loss that disperses to the drapes and floors but not to the gauze and suction canister.

## 4.9 Data collection procedure

Preoperative and intraoperative data was collected by pretested questionnaire by document review, direct patient observation, and asking the surgeon, anesthesia team about the amount of blood loss by their observation. Data was collected immediately after procedure with a structured questionnaire which includes age, sex, physical status, type of surgery. The post operative hemoglobin/hct was collected after rise of the result and actual blood loss was calculated using the formula.

$ABL=BV\ (HCT_{(INITIAL)}-HCT_{(FINAL)}/HCT_{(initial)})$

Patient who had history of blood transfusion intraoperatively 1 unit increases HCT by 3%

## 4.10 Data Quality Control

The quality was maintained by checking the consistency, clarity, and completeness of the anesthetic sheet, registration books, individual patient chart and the principal investigator was

supervised and checked the completeness of the data daily. The data was entered and analyzed by SPSS 27.00 version statistical software. The assessment of mean VEBL and Hct as descriptive statistics by measuring. The cut point for Statistical significance will be P value < 0.05

### 4.11Data analysis procedure

Data was checked for completeness daily. Data was entered, cleaned, coded and analyzed using SPSS version 27 software for analysis. Descriptive analysis was done for continuous variables. Mean of VEBL was compared ( for both anesthesia and surgical side) with the actual blood loss and absolute mean error was calculated and compared  the factors affecting the accuracy of VEBL was assessed by multiple regression Then, the result was presented in frequency distribution tables and was summarized using tables graphs &/ pie charts.

### 4.12 Data quality assurance

The data collectors were trained before data collection and there were daily meetings during data collection to clear up if there is any ambiguity during data collection. Data was cleaned on daily basis.

### 4.13 Ethical statement

The data collection was carried after securing an ethical clearance letter from the ethical review committee of the school of medicine. Written consent was taken from the patients. Data anonymity was maintained by avoiding patient identifiers in the data extraction process.

## CHAPTER 5.Result discussion

### General characteristics

A total of 243 patients were involved in this study with response rate of 99.9%.  Half (50.2%) of the study participants were identified as male and The mean age of the study participants was 48.42 ± 14.465 years.. When it comes to work experience of the professional, 107 (44.0%) have less than 2 years of experience, whereas 136 (56.0%) have more than 2 years of experience in their respective fields.

**Table 4: General characteristics, 2024.**

| **Variables** | **Frequency** | **Percentage** |
|---|---|---|
| Sex | | |
| Female | 120 | 49.8 |
| Male | 123 | 50.2 |
| Work experience | | |
| < 2 years | 107 | 44.0 |
| > 2years | 136 | 56.0 |

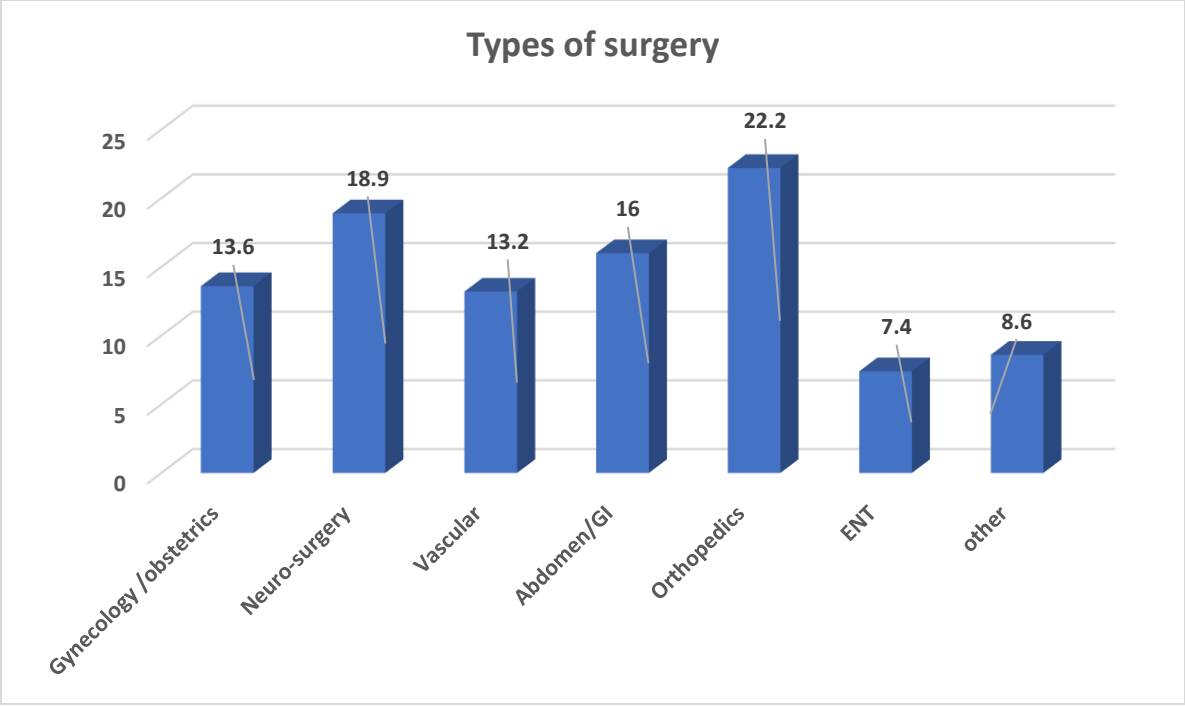


**Figure 1: Types of surgery**

**Table 5: Intra operative factors, 2024**

| Variables | Frequency | Percentage |
|---|---|---|
| Patient has field bleeding | | |
| No | 143 | 58.8 |
| Yes | 100 | 41.2 |
| Bleeding contaminated with body fluid | | |
| No | 227 | 93.4 |
| Yes | 16 | 6.6 |
| Intra-operation blood transfusion | | |
| No | 154 | 63.4 |
| Yes | 89 | 36.6 |
| Unit of blood does the patient transfused | | |
| Zero | 154 | 63.4 |
| One | 11 | 4.5 |

| | | |
|---|---|---|
| Two | 16 | 6.6 |
| Three | 30 | 12.3 |
| Four | 21 | 8.6 |
| Five | 4 | 1.6 |
| Six | 6 | 2.5 |
| Seven | 1 | .4 |

### Amount of blood loss

Based on the pre-operation and postop hematocrit, the calculated blood loss experienced during surgical procedures. Nearly half of the cases, 114 (46.9%), involved blood loss less than 500 milliliters followed by blood loss greater than 2000 milliliters, with 22.2%. The lowest frequency was observed for blood loss between 1001-1500 milliliters, with (5.3% falling within this range.

**Table 6:**

| **Actual blood loss calculated from hematocrits** | **2024** |
|---|---|

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| **Blood loss in milliliter** | Frequency | Percentage |
|---|---|---|
| < 500 | 114 | 46.9 |
| 500-999 | 45 | 18.5 |
| 1001-1500 | 13 | 5.3 |
| 1501-2000 | 17 | 7.0 |
| >2000 | 54 | 22.2 |

The study discovered differences between the actual blood loss calculated from pre- and post-operative hematocrit levels and the visual estimates made by anesthesiologists and surgical teams. Based on the mean blood loss estimate, while the average actual blood loss was 1042.93

ml.with anesthesiologists visually estimating a mean of 993.17 ml, which was 49.76 ml closer to the true figure than the surgical side's mean estimate of 730.04 ml, which was closer to actual blood loss 312.89 ml. However, anesthesiologists overestimated the median blood loss, expecting 600 ml, while surgeons underestimated with 500 ml, which was less than the actual median of 559 ml.

**Table 7: actual Blood loss, Visual estimation of anesthesiologists sides and Visual estimation of surgery side, 2024.**

| Blood loss | Mean | Median | St. deviation |
|---|---|---|---|
| Mean actual blood loss (calculated by pre and post operation hematocrit) | 1042.93 | 559.00 | 1037.31 |
| Visual estimation of blood loss from anesthesiologists' sides | 993.17 | 600.00 | 855.696 |
| Visual Estimation of blood loss by the surgical side | 730.04 | 500.00 | 645.265 |

## Comparison of absolute mean error

Report comparing the absolute mean error of surgical side, anesthesia side visual estimates of blood loss against calculated blood loss. Taking into account whether it was overestimated or underestimated in relation to the actual calculated blood loss from pre and post-operative hematocrit values. Based on the data, for blood loss of less than 500 ml, the surgical side overestimated by 94.36 ml (N=72), while anesthesiologists overestimated by 144.06 ml (N=101). And the mean calculated and in the 500-999 ml blood loss range, surgical overestimates had a mean inaccuracy of 140 ml (N=5), compared to 145.11 ml for anesthesiologists (N=23). Furthermore, the surgical side underestimates with a mean error of 212.26 ml (N=40) versus 138.09 ml for anesthesiologists (N=22).

Surgical underestimates (N=17) had a much higher mean error (684.24 ml) than anesthesiologists (N=11). Anesthesiologists overestimated losses of more than 2000 ml (N=5) by

an average of 295.4 ml. Surgical underestimates (N=54) exhibited a very high 1045.3 ml mean error, more than doubling the 489.24 ml mean error for anesthesiologists (N=49) in the 1501-2000 ml range. According to this study, anesthesiologists beat surgeons at visually estimating bigger amounts of blood loss. Their viewpoint and experience may help them assess larger blood loss quantities.

**Table 8: Comparison of absolute mean error among surgery side and anesthesiologists, 2024.**

| Blood loss in milliliter | Difference from actual blood loss (calculated by hematocrit) | | N | Mean | StD |
|---|---|---|---|---|---|
| < 500 | Overestimated as compared to actual | Absolute Error of surgery side estimation | 72 | 94.36 | 109.88 |
| | | Absolute Error of Anesthesiologists side estimation | 101 | 144.06 | 164.55 |
| | Under-estimated as compared to actual | Absolute Error of surgery side estimation | 42 | 65.51 | 60.85 |
| | | Absolute Error of Anesthesiologists side estimation | 13 | 81.38 | 58.12 |
| 500-999 | Overestimated as compared to actual | Absolute Error of surgery side estimation | 5 | 140.00 | 106.06 |
| | | Absolute Error of Anesthesiologists side estimation | 23 | 145.10 | 67.27 |
| | Under-estimated as compared to actual | Absolute Error of surgery side estimation | 40 | 212.26 | 116.29 |
| | | Absolute Error of Anesthesiologists side estimation | 22 | 138.09 | 69.10 |
| 1001-1500 | Overestimated as compared to | Absolute Error of surgery side estimation | 2 | 302.00 | 00.00 |

| | | | | | |
|---|---|---|---|---|---|
| | actual | Absolute Error of Anesthesiologists side estimation | 5 | 172.40 | 127.24 |
| | Under-estimated as compared to actual | Absolute Error of surgery side estimation | 11 | 437.27 | 238.49 |
| | | Absolute Error of Anesthesiologists side estimation | 8 | 321.00 | 149.84 |
| 1501-2000 | Overestimated as compared to actual | Absolute Error of surgery side estimation | - | -- | - |
| | | Absolute Error of Anesthesiologists side estimation | 6 | 228.33 | 76.52 |
| | Under-estimated as compared to actual | Absolute Error of surgery side estimation | 17 | 684.23 | 229.22 |
| | | Absolute Error of Anesthesiologists side estimation | 11 | 277.45 | 144.60 |
| >2000 | Overestimated as compared to actual | Absolute Error of surgery side estimation | - | - | - |
| | | Absolute Error of Anesthesiologists side estimation | 5 | 295.4 | 92.87 |
| | Under-estimated as compared to actual | Absolute Error of surgery side estimation | 54 | 1045.29 | 469.58 |
| | | Absolute Error of Anesthesiologists side estimation | 49 | 489.24 | 153.50 |

According to the data, anesthesia was found to provide a better visual estimation of blood loss with the least mistake when compared to surgical specialists. Almost half (48.6%) of the 118 respondents claimed that anesthesiologists had the lowest estimation error, whereas 94 (38.7%) surgical experts had the best estimation with the lowest error. However, 31 (12.8%) believed that both anesthetic and surgical workers were capable of accurately measuring blood loss.

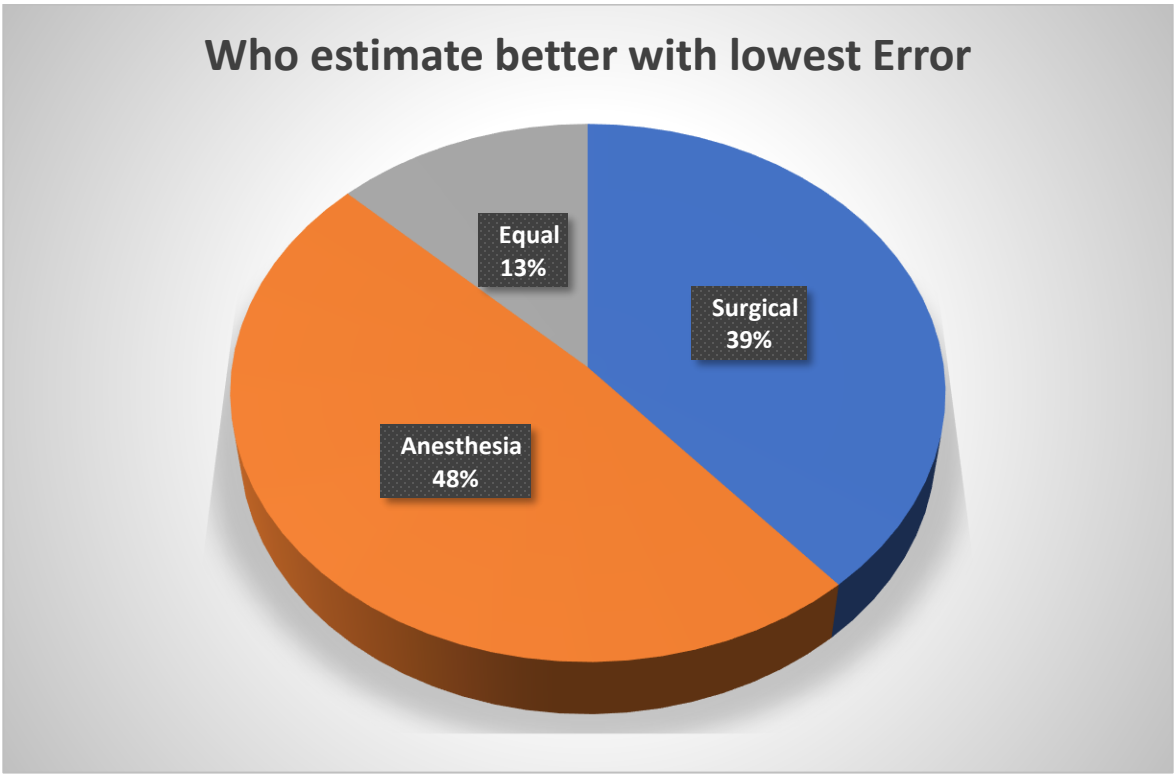


**Figure 2 Who estimate better with lowest Error, 2024**

| Blood volume | Mean actual blood loss | Mean VEBL anesthesia side | Mean VEBL surgical side | Mean error anesthesia side | Mean error surgical side |
|---|---|---|---|---|---|
| <=500 | 225 | 343 | 260 | 136 | 87 |
| 501-1000 | 763.85 | 771.3 | 590 | 145 | 213 |
| 1001-1500 | 1380.1 | 1235.4 | 995.8 | 297 | 446 |
| 1501-2000 | 1785.4 | 1668.1 | 1090 | 265 | 694 |
| >=2000 | 2726.7 | 2310 | 1681 | 471 | 1054 |
| Error Percent | | | | 21.8% | 36.4% |

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## 4. Predictors of absolute mean error of visual estimation

### Model assumptions for multiple regression

Multiple linear regressions was employed to identify Predictors of absolute mean error of visual estimation. Before fitting into a regression model, essential assumptions such as Multicollinearity, model good of fitness, residual normality, heteroscedasticity and linearity were evaluated. To evaluate multicollinearity, all variance inflation factor (VIF) values were assessed and they were less than 10. This suggests that there is no major Multicollinearity concern among independent variables. The assumption linearity and homoscedasticity were evaluated using scatter plot and the variance in each of the point is randomly distributed and the pattern is indicative of a situation in which the assumptions of linearity and homoscedasticity have been met. The assumption of normality was evaluated the distribution using the histogram and normal probability plot of the data the distribution is roughly normal (although there is a slight deficiency of residuals exactly on zero) indicating the data is slightly normally distributed.

**Model fitness**

The above model summary table provides the R value and the R square values. The R value represents the simple correlation and is (0.883) which indicates a strong degree of correlation. The R square value is indicated how much of the total variation in the dependent variable sales performance can be explained by the independent variable (informative, persuasive and reminder advertising and it is (0.766) which is 76.6% (Table 7)

**Table 9:** Model fitness and explained variation of the variables, 2024.

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate | |
|---|---|---|---|---|---|
| 1 | .883[a] | .766 | .436 | 147.90553 | |
| | | | | | |

| |
|---|
| Predictors: (Constant), Weight of the patient, Bleeding contaminated with body fluid, Unit of blood does the pa<br>the patient, ENT surgery, Vascular surgery , Year of experience, gynecology/Obstetrics , Abdomen/GI surgery , C<br>patient, Patient has field bleeding, Neuro-surgery[a]<br>Dependent Variable: Absolute Mean Error Anesthesi[a] |

**One way ANOVA**

ANOVA in the linear regression can indicate whether the model is significantly better at predicting the outcome than using the mean as a 'best guess'. Specifically, the *F*-ratio represents the ratio of the improvement in prediction that results from fitting the model, relative to the inaccuracy that still exists in the model. Thus, the ANOVA table below show that there is significant difference between independent variables regarding dependent variable (absolute mean error). The F-value for this model from this study is F(13, 242) = 15.368, P<0.001), as a result, the model is a good fit (Table 8)

**Table 10:** ANOVA for model fitness, 2024.

| ANOVA[a] | | | | | | |
|---|---|---|---|---|---|---|
| Model | | Sum of Squares | df | Mean Square | F | Sig. |
| 1 | Regression | 4370537.478 | 13 | 336195.191 | 15.368 | .000[b] |
| | Residual | 5009614.335 | 229 | 21876.045 | | |
| | Total | 9380151.812 | 242 | | | |
| a. Dependent Variable: Absolute Error of Anesthesia team | | | | | | |
| b. Predictors: (Constant), Others, Weight of the patient, Bleeding contaminated with body fluid, Unit of blood does the patient transfused, Age of the patient, ENT surgery, Vascular surgery , Year of experience, gynecology , | | | | | | |

| |
|---|
| Abdomen/GI surgery , Sex of the patient, Patient has field bleeding, Neuro-surgery |

## Multiple linear regression

In this model, no other variables, such as patient sex, age, weight, years of experience, bleeding characteristics, or other operation kinds, were statistically significant predictor

**Model Summary**

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate |
|---|---|---|---|---|
| 1 | .687[a] | .473 | .464 | 144.17719 |

a. Predictors: (Constant), calculatedbloodloss, bodyfluid, exprience, fieldbledding

**ANOVA[a]**

| Model | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| 1 | Regression | 4432830.814 | 4 | 1108207.703 | 53.312 | <.001[b] |
| | Residual | 4947320.999 | 238 | 20787.063 | | |
| | Total | 9380151.812 | 242 | | | |

a. Dependent Variable: VAR00001

b. Predictors: (Constant), calculatedbloodloss, bodyfluid, exprience, fieldbledding

**Coefficients[a]**

| Model | | Unstandardized Coefficients | | Standardized Coefficients | t | Sig. |
|---|---|---|---|---|---|---|
| | | B | Std. Error | Beta | | |
| 1 | (Constant) | 111.670 | 87.904 | | 1.270 | .205 |
| | exprience | -13.437 | 18.657 | -.034 | -.720 | .472 |
| | fieldbledding | 15.220 | 23.111 | .038 | .659 | .511 |
| | bodyfluid | -14.145 | 37.326 | -.018 | -.379 | .705 |
| | calculatedbloodloss | .134 | .011 | .708 | 12.212 | <.001 |

a. Dependent Variable: VAR00001

s.

## Discussion

Blood loss during surgical procedures is a critical factor that can significantly affect patient outcomes, necessitating accurate assessment and management approaches. The goal of this study was to evaluate the visual estimation of intraoperative blood loss with post-op hematocrit in adult patients undergoing elective surgery, to determine discrepancies in visual blood loss estimation between surgical and anesthesiology teams, and to identify potential predictors of visual estimation accuracy.

**ACCURACY**

The present study reported the mean actual blood loss, obtained from calculation based on pre and post-op hematocrit level of patients was 1042.93 ml it is nearly 1 litter blood loss occur during elective surgery. Regarding visual estimation of blood loss, the mean blood loss through visual estimation of blood loss from anesthesia sides was 993.17 ml and the mean blood loss visual estimation of blood loss by the surgical side was 730.04 ml. The current study found that there are variations between the actual blood loss measured from the patients' hematocrit and the visual assessments. Previous research has emphasized the unreliability of visual estimation methods in assessing blood loss during surgical procedures, indicating a consistent report. (39, 43, 46).

This study reveals that both anesthesiologists and the surgical side underestimated based on visual estimation. However, anesthesiologists generally outperformed surgical teams in visually with their estimates being closer to the actual that was calculated blood loss from pre- and post-operative hematocrit values. However, visual estimation differs for both groups depending on the patients' blood loss. Thus, both the surgical and anesthesiologists groups tended to overestimate blood loss under 1000 ml and underestimate losses beyond 1500 ml, with the degree of underestimating increasing significantly for amounts greater than 2000 ml.

**PROFFESTIONS**

Based on the current study report, anesthesiologists had better visual estimation than surgeons in which surgery sides' estimation have larger deviation from actual blood loss. The perspective and experience of anesthesiologists may offer them an advantage in assessing bigger blood loss amounts thus the mean visual estimation of blood loss was closer to the actual mean blood loss. The finding is consistent with other previous reports (48, 49, 50). The difference could be the fact that surgeons' primary focus is within their surgical field, and therefore, they may over look blood on the field and suction canisters, this discrepancy may be attributed to the unique vantage point and experience of anesthesiologists in monitoring fluid dynamics and patient status. Similar to other studies report, surgery side professionals underestimate the blood loss than anesthesiologist (48, 49). Underestimating blood loss can have serious consequences, such as delayed diagnosis of significant bleeding, inadequate fluid resuscitation, and potentially negative results. (51, 52). Applying quantitative measurement methods, and strengthening interdisciplinary coordination between surgical and anesthesia teams can all contribute to better blood loss estimation and faster interventions. But In this study for blood loss less than500ml surgical side have good accuracy than the anesthesia side

Volume of blood loss

As the bleeding amount increase the accuracy is decrease which can clearly seen in this study? for instance for blood loss <500 the mean error is 136 ml ,for 501-1000 ml the mean error is 145,for 1001-1500 ml the mean error is 297,for 1501-2000 the mean error is 265 ,for>2000ml the mean error is 471.29 This findings are in consistent with the previous studies(33,36,42)

**Experience, field bleeding and bleeding contamination with body fluid**

This three factors has no association with accuracy of blood loss in this study, in previous study years of experience also has no association with accuracy of visual estimation of blood loss(46) but field bleeding and body fluid contamination has negative association which is inconsistent with this study(44,45)

## Limitation of the study

- The study didn't include other professions like midwifes and nurses

- The increment of Hct with each unit of blood is not standardized for all group of patients
- Calculating of actual blood loss from Hct is not the gold standard way of estimation of blood loss
- Absolute mean error doesn't tell us whether the estimation is over estimation or under estimation

## Strengthens of the study

- Adequate sample size
- Absolute mean error can give full meaning regardless of outlier

Conclusion and recommendations

### Conclusion:

This study has shed light on the critical issue of accurate blood loss estimation during surgical procedures.

The absolute mean error of visual estimations was significant. These findings highlight the difficulty of visually gauging significant bleeding and the importance of developing standardized methods or tools to improve blood loss assessment accuracy across various surgical interventions, given its critical role in guiding clinical decision-making and optimizing patient outcomes.

### Recommendations

Based on the findings of the study, the following recommendations were forwarded:-

To hospital administrators, risk management, and leadership:

- Because visual estimation differs between professions, the hospital should prioritize the development and implementation of standardized, multidisciplinary blood loss assessment protocols that include input from surgical teams, anesthesiologists, and other relevant healthcare professionals. This strategy will take use of their collective knowledge and opinions, ensuring a thorough and accurate assessment process.

- Implement consistent monitoring and analysis of blood loss estimation data, identifying areas for improvement and applying evidence-based measures to increase accuracy and reduce the hazards associated with erroneous assessments.

To medical and nursing educators:

- To close the estimation gap between different sides, educators should provide and incorporate comprehensive blood loss assessment training, including visual estimation techniques, objective quantitative methods, and interdisciplinary collaboration, into medical and nursing curricula. This will provide future healthcare professionals with the necessary skills and knowledge from the start of their career.

To surgical, anesthesiology, and healthcare teams:

- Encourage and engage in interdisciplinary training programs and simulations designed to improve visual estimation abilities and promote successful communication during surgical procedures. These activities should include feedback mechanisms and benchmarking against objective measures to promote a culture of continual improvement.

To researchers and academic institutions:

- Future research should look into integrating objective quantitative tools to establish more reliable benchmarks for blood loss assessment, as well as developing standardized protocols with multidisciplinary input from surgical, anesthesiology, and other relevant departments.
- Prioritize collaborative research efforts among surgical, anesthesiology, and other relevant disciplines to better understand the factors impacting blood loss estimation accuracy and create novel ways, such as the use of objective quantitative techniques and modern technology.
- Advocate for the inclusion of blood loss assessment competences in medical and nursing curricula, ensuring that healthcare workers receive thorough training in this critical area from the start of their studies

## Annex1: Questioner ID_____

Date of the interview_____ Hospital_____

Department_____

1. Sex of the patient ☐ M ☐ F

2. Age of the patient _____

3. weight of the patient in KG_____

4what is your department

Anesthesiology resident bAnesthetist

5 year of experience

A. Two years and less B Above two years

6 pre op hematocrit of the patient _____

7 type of surgery

A. gyni
B. Neurosurgery
C. Vascular
D. Abdomen and GI
E. Orthopedics

F Other ( )

8 total visual estimation of blood loss in ml_____

9 does the patient has field bleeding

A. Yes B no

10 does the bleeding contaminated with body fluid

A. Yes B no

11 does the patient has intraop transfusion

A. Yes B no

12 if your answer is yes( 11 ) how many unit of blood does the patient transfused? _____

13 estimation of blood loss by the surgical side in ml_____

14 post op hematocrit _____

## Annex 2: Subject information sheet

Addis Ababa University

School of medicine

Subject information sheet

Hello, my name is ----------, I am here in behalf of Dr. Abeba hisho, a student in Addis Ababa University School of medicine. she is conducting a research on "Assessment of visual estimation of blood loss by post op hemoglobin level on adult elective surgical patients at Tikur Anbesa Specialized Hospital (TASH), Addis Ababa Ethiopia." she has received permission from Addis Ababa University School of medicine and Tikur Anbessa Specialized Hospital officials to conduct the study.

You are selected to participate in this study because you are currently admitted to the hospital and elective surgery has done for you. Your participation in this study will only be based on your willingness to participate. You have the right to choose not to take part in this study. If you are willing, you have the right to stop at any time or withdraw without giving any reason which you will not be subjected to any ill-treatment. There will be no direct benefit by participating in this study but in future information gathered by this study will help policy makers, programmers and researchers to give appropriate attention on issues of interest and design specific treatment options.

The information that you provide will be kept confidential by using only code numbers and locking the data. Only the members of the study team will have the access to the non-coded data

and the data will not be used for purposes other than the study. Your willingness and active participation is very important for the success of this study.

If you need any further information or explanation regarding to the study, you can have this address to contact.

Name: Dr. Abeba hishoTel- +251-919191123 Email- fiyori@gmail.com

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