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COMPARISON OF 2 METHODS OF BLOOD LOSS CALCULATION AGAINST THAT BY VISUAL OBSERVATION BY ANAESTHETIST IN MAJOR SURGERIES

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ABSTRACT

Introduction: Accurate assessment of blood loss is a problem in specialities like neurosurgery and orthopaedic surgeries where large volume of fluid is used for irrigating wounds during surgery. Blood loss quantification remains unreliable and inaccurate and hence the debate between surgeons and anaesthetist pertaining to whether to transfuse or not and on what basis remains a problem.We studied 2 methods of blood loss calculation based on observation and calculation and compared them with visual blood loss. **Aims:** "Comparison of 2 methods of blood loss formula and their comparison based on visual observation by anaesthetist in major surgeries." **Objectives :**(1)Calculation of blood loss based on haematocrit. (2) Calculate blood loss based on haemoglobin (3)Persistence of anaemia based on lab haemoglobin values in patients pre and post operatively (4) Comparing formula 1 & 2 to find the appropriate formula for blood loss against visual loss on gauze and mops and suction. **Materials And Methods:** This randomised trial was conducted on 85 patients at Dr. D.Y.Patil medical college ,pune. Since different methods were used we defined 2 units measured blood volume loss which was calculated by the Blood volume loss formula and measured hemoglobin mass loss calculated by the hemoglobin mass loss formula. **Result:** The actual blood loss was assessed visually in terms of number of gauze pieces and mops used. In patients with preoperative hemoglobin less than 12g the mean actual blood loss is statistically similar to Blood volume loss formula while in patients with preoperative hemoglobin more than 12 the mean actual blood loss is statistically similar to hemoglobin mass loss formula **Conclusion:** The mean actual blood loss is statistically similar to Hemoglobin mass loss in patients with preoperative hb more than 12 and blood volume loss in patients with preoperative hemoglobin less than 12.

KEYWORDS : blood loss, heamoglobin, allowable loss, need to change.

INTRODUCTION

'ABC' that is airway,breathing and circulation are integral parts of anaesthesia practice. In order to monitor the circulation, it is important to understand the loss of blood intraoperatively. The accurate assessment of blood loss is not possible due to presence of variety of formulas as well as variation in opinion differing not only from surgeon to anaesthetist but also from surgeon to surgeon and anaesthetist to anaesthetist. Due to the variety of opinions considered, the need to transfuse blood also suffers and doctors end up transfusing based on clinical condition of the patient. However this leads to increase in morbidity and mortality of the patient due to blood loss.[1-3]

Assesment of blood loss suffers a further backfooting in certain specialties like neurosurgery, head and neck surgery , orthopaedics and urosurgery where large volumes of fluid is used for irrigating wounds during surgery. A similar problem is encountered when blood is mixed with body fluids pertaining to amniotic fluid as many others.[4] This futher fuels the debate as to when to transfuse blood and when not to further leading to chances of morbidity and mortality.

Inappropriate decision of transfusion may lead to low haemoglobin values with the potential of tissue injury.[5] The actual level of haemoglobin at which tissue injury starts to threaten tissue oxygenation is still not known. For many years, in daily clinical practice, the traditional 10/30 rule (hemoglobin 10 g/dL - hematocrit 30%) has been the most commonly used trigger for blood transfusions.[6]

Hence, estimation of blood loss is important in order to maintain oxygen delivery to the vital organs which also helps in taking decision of transfusion. Thus it acts as a guide to both timely management and further arrangement of cross matched blood during surgery as well as also avoid wastage of pre booked blood in the blood bank.[7]

In this study, we will attempt to find any relationship between haemoglobin (Hb), hematocrits (Hct) against values based on visual estimation of the blood loss by the anaesthetist by analysing the blood loss through mops, gauzes and suctions.

AIMS

To compare 2 methods of blood loss formula and their comparison based on visual observation by anaesthetist in major surgeries.

OBJECTIVES

1. Calculation of blood loss based on haematocrit
2. Calculate blood loss based on haemoglobin
3. Persistence of anaemia based on lab haemoglobin values in patients pre and post operatively
4. Comparing formula 1 & 2 to find the appropriate formula for blood loss against visual loss on gauze and mops and suction.

MATERIALS AND METHOD

The observational study was carried out on 85 heamodynamically stable patients (assuming the mean SD from different studies and mean difference between both groups and entering the details in the WINPEPI Application) belonging to ASA (American Society of Anaesthesiologists) grade I and II, aged between 18 to 70 years, including either gender, and meeting all inclusion exclusion criteria scheduled for elective lower abdominal or lower limb surgical procedures including Orthopaedic surgeries, general surgeries,onco and gastrosurgeries , gynecological surgeries, urological surgeries(only Nephrectomies). Surgeries involving large amounts of irrigating fluid were avoided including arthroscopic procedures and TURP. The pre anaesthetic details, general and physical examination and laboratory invetigations especially pre operative heamoglobin and heamatocrit were noted and jotted down on a well designed proforma. The data collected was entered in Microsoft Excel and analysis was done. Categorical variable were expressed in terms of frequency and percentage and continuous variables in terms of mean and SD.

Inclusion Criteria

1. ASA grade I or II fit patients.
2. Ages between 18 and 65 years female and male patients.
3. Patients undergoing any perineal procedures.
4. Heamodynamically stable patients with all routine investigations within normal limits without any other co morbidities.
5. Availability of informed consent.

Exclusion Criteria

1. Patients with ASA physical status III or more.
2. Patients with major neurological, cardiac, respiratory, metabolic, renal, hepatic disease or with coagulation abnormalities.
3. Patients with contraindication for spinal anesthesia.
4. Patients with known allergies to the study drug.
5. Patients who are not consenting to the above study.
6. Patients below 18 years and above 65 years of age.
7. Patients with weight less than 40 kgs and height less than 150 cms.

8. Patients with atypical pseudocholinestarase and patients having genetic deficiency of plasma cholinesterase.
9. Pregnant females of any age group.

Material Required

1. Standard anaesthesia machine (Boyle's apparatus).
2. Monitoring equipment like pulse oximeter, ECG monitor, non-invasive blood pressure (NIBP) apparatus.
3. Intravenous cannula 20G.
4. Intravenous fluids-Crystalloids & Colloids.
5. Disposable syringes, disposable sterile gloves, sterile dry hand towel, sterile gown and dressing.
6. Sterile spinal tray having sterile gauze pieces, sponge holding forceps, fenestrated drape, preparation solution, sterile disposable syringes, 26 G Quinke's spinal needle and ampule of 1% 2-Chloroprocaine / 0.5% Injection Bupivacaine.
7. Drugs and equipment necessary for resuscitation. (Ephedrine and Phenylephrine)

Procedure:

Anaesthesia was performed in all cases. The intraoperative fluid protocol consisted of fluid requirement by Holiday – Seagar formula for fluid against NBM hours, maintainence fluid and replacement of blood loss (1:1 ratio of crystalloid: blood). If necessary, vasoactive agents were titrated to obtain a mean blood pressure >65 mmHg. Postoperative fluid therapy consisted of crystalloids (20 mL/kg/day). NBM was broken 8 hours from shifting into recovery room.

Demographics and clinically relevant data were recorded prior to the surgery. Blood samples were analysed at the central laboratory to assess haematocrit and haemoglobin concentrations before surgery and at 48 hrs post op. All samples were obtained from large arm veins using a standard protocol between 06:00 and 08:00 am.

Direct measurement of blood loss was calculated for all patients using the following formula:

- Estimated blood volume loss: estimation of blood loss in volume units, calculated by Gross equation
- Haemoglobin mass loss : estimation of haemoglobin mass loss, calculated by the haemoglobin mass loss formula described later.

➢ Measurement of blood loss

A) Visual Assesment of blood loss: Direct blood loss from suction cannisters was done as follows: Prior to the case, the whole suction unit was washed with a mixtures of 500 ml Norma Saline with 25000 IU Heparin. The total fluid used as for mist/ for wetting gauze pieces, etc was also documented on a rough paper. The total volume contained in the canister was measured after the end of the surgical procedure before giving a thorough wash by an experienced anaesthesiologist. The fluid used for heparinisation and for mist, etc was deducted from the total volume achieved in the container.

B) 1*1 inch gauze pieces used were approximated for around 1 ml of blood loss and 4*4 inch mops used were designated for 10 ml blood loss as per the standardized ratio and various studies.

➢ Haemoglobin mass loss estimation formula

The haemoglobin mass loss formula mainly consists of two parameters during euvolemic state of patient: patient's estimated blood volume and pre- and postoperative haemoglobin concentrations. It is given by

$HB_{(EBL)}=100\times(Hbpreop-Hbpostop)\times BV$

where

Hb_{EBL} (g) is the estimated haemoglobin mass loss,

Hb_{preop} (g/dL) is the patient's preoperative haemoglobin concentration,

Hb_{nadir} (g/dL) is the patient's lowest postoperative haemoglobin concentration, and

BV (mL) is the patient's estimated blood volume.

Blood volume is calculated by Nadler's Equation as follows:

- Men: Blood Volume = (0.3669 × H^3) + (0.03219 × W) + 0.6041
- Women: Blood Volume = (0.3561 × H^3) + (0.03308 × W) +0.1833.

However to avoid discrepancies and for ease of study, the simplified version of The Nadlers equation as given in all Anaesthesia textbooks was used which is as follows:

Average blood volume = Patient weight (kg) * (Average blood volume in mL/kg)

Whereby, the average blood volume per demographic (mL / kg) is:

- Adult male = 75
- Adult female = 65
- Infants = 80
- Neonates = 85
- Premature neonates = 95.

The estimated blood loss in our study was calculated prior to the cases considering Heamoglobin of 9 as trigger heamoglobin for transfusion.

➢ Blood loss calculation using Gross Equation:

The Gross equation is amongst the few groups of formula used to calculate the estimated blood loss prior to surgery. The equation mainly comprises of blood volume calculated bt Nadirs equation and Heamatocrit prior and post operative time. The equation is a follows:

$V_{losstotal} = BV \times (Hct_{preop} - Hct_{postop})$

Where,

Hct is Heamatocrit preoperative and postoperative,

BV is the blood volume.

Blood volume in this is calculated by Nadler's Equation as follows:

- Men: Blood Volume = (0.3669 × H^3) + (0.03219 × W) + 0.6041
- Women: Blood Volume = (0.3561 × H^3) + (0.03308 × W) +0.1833.

However to avoid discrepancies and for ease of study, the simplified version of The Nadlers equation as given in all Anaesthesia textbooks was used as above.

OBSERVATIONS AND RESULTS

In our study, there were 85 study participants who were included. The mean age of our study participants was 54.4 years with range from 39 to 70 years. Most of them were males (69.4%) The most common comorbidities reported in our study was diabetes (n=40,47.05%) hypertension (n=36,42.4%), cardiovascular disease (n=11,12.9%), and cerebrovascular disease (n=3,3.5%).

Table 1: Age and gender distribution of study participants

	Mean	SD	Range
Age (years)	54.4	9.3	39-70
Height (Cms.)	168.4	10.41	152-195
Weight (kgs)	63.3	16.4	48-98
Pre-operative Hb	12.6	1.6	10.8-16.7

The actual blood loss was assessed visually in terms of number of gauze pieces and mops used. We calculated the amount of blood-loss after surgery in all patients using two calculation methods. First method used was Gross equation method and the other being Hb-balance method. The results of blood-loss volume for each calculation method are shown in Table 2.

Table 2: Blood loss volume calculated by two methods

Method of blood loss estimation	Mean volume	SD
Actual blood loss	1126.6	11.2
Gross equation method	1005.3	81.4
Hb-balance method	1056.6	88.04

Table 3 shows the comparison of mean blood loss in patients with pre-operative hemoglobin less than 12gms. The mean actual blood loss is statistically similar to gross equation in patients with preoperative hemoglobin was less than 12. Bland-Altman plots of percentage differences per formula, for the analysis of the agreements' consistency in shown in figure 1.

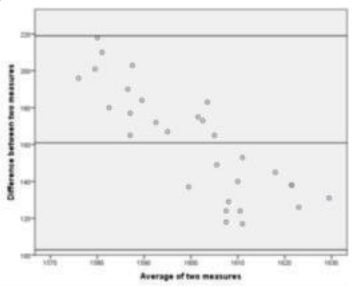

Figure 1: Bland-Altmann Plot for actual blood loss and Hb-balance method

Table 3: Comparison of mean blood loss in patients with pre-operative Hb<12gms

	Preop Hb<12			
	Actual blood loss	Gross equation method	Actual blood loss	Hb-balance method
Mean	1120.77	1118.6	1120.77	959.8
SD	5.73	1.24	5.73	28.4
P value	0.052		<0.001	

Table 4 shows the comparison of mean blood loss in patients with pre-operative hemoglobin more than 12gms. The mean actual blood loss is statistically similar to Hb-balance method in patients with preoperative hemoglobin was more than 12. Bland-Altman plots of percentage differences per formula, for the analysis of the agreements' consistency in shown in figure 2.

Table 4: Comparison of mean blood loss in patients with pre-operative Hb≥12gms

	Preop Hb≥12			
	Actual blood loss	Gross equation method	Actual blood loss	Hb-balance method
Mean	1129.04	943.13	1129.04	1126.8
SD	10	32.24	10	1.99
P value	<0.001		0.122	

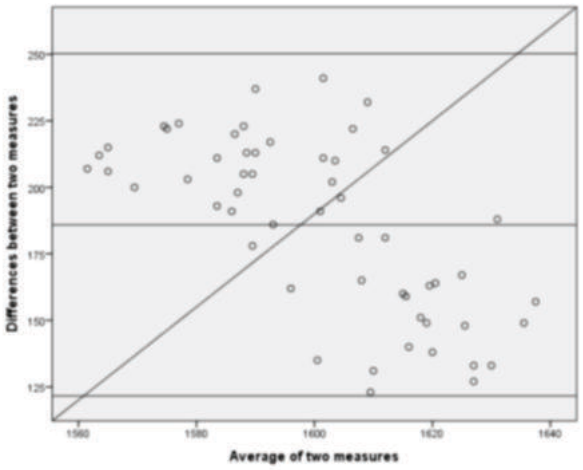

Figure 2: Bland-Altmann Plot for actual blood loss and gross equation method

DISCUSSION

Blood loss is a regular occurrence during major surgery. The operating team is responsible for identifying the blood loss, preventing future bleeding, and replacing the blood volume as quickly as possible. The disparities between the two approaches for calculating blood loss after surgery were discovered in this study. The Hb balance and the Gross equation yielded different results. In terms of the quantity of gauze pieces and mops used, we compared the gross equation and hemoglobin balance with actual blood loss visually. We found that the blood loss was equal to gross equation in patients with preoperative hemoglobin less than 12 gms. and the mean blood loss estimated by hemoglobin formula was similar to actual blood loss in patients with preoperative hemoglobin ≥12 gms.

In clinical trials involving Patient Blood Management, quantifying perioperative blood loss is a critical metric. Although the transfusion rate and other clinical outcomes may have a bigger clinical impact, blood loss, when precisely quantified or estimated, might be a more reliable parameter since it is less affected by confounding factors (e.g., transfusion threshold haemoglobin mass contained in the RBC units, etc.)[8-11]

The estimations of blood loss after primary TKA using the four approaches indicated considerable variations, according to Fu Qiang Gao et al.[12] The approaches were Hb balance, OSTHEO formula, Hb dilution, and Gross equation, in descending order of combined correlation coefficient based on computed blood loss. The results for Hb balance and the Gross equation were identical, they said. They were discovered to be significantly different from the other approaches, though. The OSTHEO formula resulted in the most calculated blood loss, whereas the Hb dilution approach resulted in the least. The Hb balancing approach, out of the four calculation methods, may be the most reliable for calculating blood loss after TKA.[12]

Alexandre Tran et al. conducted a comprehensive review that included 26 research covering 3,297 patients. They discovered that visual estimating was the strategy that has been investigated the most. Furthermore, visual procedures produced lower predicted blood loss estimates than formula-based estimation or other techniques, however this effect was not statistically significant in pooled analyses.[13]

CONCLUSION

The mean actual blood loss is statistically similar to Hb-balance method in patients with preoperative hemoglobin was more than 12 and to gross equation in patients with preoperative hemoglobin was less than 12

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