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How Accurate is Visual Estimation of Blood Loss During Vaginal Delivery? A Comparison with Calculated Blood Loss at Imo State University Teaching Hospital, Orlu, Imo State, Nigeria

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ABSTRACT

Original Research Article

Postpartum haemorrhage (PPH) is one of the primary direct causes of maternal mortality and severe maternal morbidity globally. Traditionally, PPH has been defined as blood loss of ≥500 mL after vaginal delivery or ≥1,000 mL after caesarean delivery. However, recent definitions are more and more centred on blood loss in the setting of maternal haemodynamic impairment and clinical intervention. Estimating the amount of blood loss during delivery is critical for the early detection and treatment of PPH. Visual estimating is the most often employed method in many delivery units despite acknowledged issues about accuracy and the availability of numerous methods. This study evaluated the accuracy of visual estimated blood loss (VEBL) following vaginal delivery by comparing it with calculated estimated blood loss (CEBL) among women delivering at the Imo State University Teaching Hospital (IMSUTH), Orlu, Imo State, Nigeria. This was a comparative analytical study carried out among pregnant women who met the inclusion criteria and delivered vaginally at the labour ward of IMSUTH, Orlu. Participants were recruited during the study period and maternal height and weight were noted. PCV measures were taken before and after delivery. Maternal blood volume was assessed from maternal weight and height, and the computed blood loss was generated from the estimated maternal blood volume and the percentage change in pre- and postpartum PCV. The CEBL was compared with the VEBL observed by the visiting health care providers. Data was analysed using Statistical Package for the Social Sciences (SPSS) version 16.0. The mean blood loss with each approach was calculated and the sensitivity of VEBL and CEBL for diagnosis of primary PPH was found. 207 women delivered in the labour ward throughout the study period, 161 women met the eligibility criteria and were included in the analysis. Significant differences were noted between VEBL and CEBL, especially early in the research with significant over and underestimating of blood loss by visual evaluation. With increasing expertise and comparison with clinical and computed findings, visual estimation improved, and the difference between the two methods lessened as the trial progressed. There was statistically significant difference between VEBL and CEBL. In primary PPH detection, CEBL was more sensitive than VEBL. Visual assessment of blood loss after vaginal delivery is rather incorrect compared with computed blood loss and may lead to both overestimation and underestimation. This study exhibited increased sensitivity in the detection of primary PPH by calculated blood loss. Regular training, repeated assessment and the use of more objective methods of blood-loss monitoring may improve early detection of PPH and contribute to better maternal outcomes.

Keywords: Postpartum haemorrhage, Visual estimated blood loss, Calculated blood loss, Vaginal birth, Packed cell volume, Maternal mortality, Nigeria.

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INTRODUCTION

Postpartum haemorrhage (PPH) continues to be one of the leading causes of maternal morbidity and mortality globally. It accounts for about 25% of maternal fatalities worldwide and may be responsible for as much as 60% of maternal mortality in some countries [1]. In addition to death, PPH is associated with significant short- and long-term morbidity. Approximately 12% of women who survive PPH have severe anaemia. Women with severe PPH have been observed to have an elevated risk of mortality in the year after the haemorrhagic event. PPH causes an estimated 140,000 maternal fatalities annually worldwide, of which more than half occur within 24 hours of delivery. Obstetric haemorrhage continues to be a prominent cause of maternal mortality

in sub-Saharan Africa. It accounts for almost one-third of maternal deaths in the region [2].

PPH is a substantial contributor to unnecessary maternal mortality, and its prevention, early detection and efficient care have emerged as a high priority for worldwide health groups. Strategies to reduce maternal mortality due to obstetric haemorrhage have been repeatedly stressed by the United Nations and the World Health Organization (WHO). The success of global maternal health targets will largely depend on the ability of health systems to prevent PPH, to recognise it early, to estimate blood loss properly and to introduce effective treatment without delay [3]. Findings from numerous countries indicate that the poor quality of obstetric care contributes considerably to unfavourable outcomes linked with PPH. Inadequate detection and quantification of blood loss, delay in resuscitation, inadequate replacement of lost blood and fluids, and failure to rapidly recognise and manage the underlying cause of bleeding may contribute to severe maternal morbidity and mortality. Thus, proper assessment of blood loss is a critical initial step in diagnosis and management of PPH [4].

There are various objective methods for quantification of blood loss but visual estimating of blood loss (VEBL) remains the most extensively utilised strategy in many clinical settings because of its simplicity, speed, low cost and viability during normal delivery. However, its accuracy has been challenged. Visual estimating has been shown to underestimate the actual blood loss where there is significant bleeding. The degree of underestimation tends to be proportional to the volume of blood loss. However, with relatively low volumes of blood loss, visual estimates may overestimate the true volume. This diversity can affect early identification of PPH and subsequent clinical decision-making [5].

Serious effects can result from an incorrect assessment of blood loss. If it is underestimated, considerable bleeding may not be recognised, resuscitation may be poor, blood transfusion may be delayed and haemorrhagic shock may develop. In severe situations, PPH that is not treated or inadequately treated can lead to acute kidney injury, disseminated intravascular coagulation (DIC), multiorgan failure, intensive care unit admission, and maternal mortality. In contrast, overestimation may lead to unnecessary investigations, incorrect fluid or blood product delivery and potentially dangerous transfusion associated problems. Thus, accurate estimate is important to identify women in urgent need of intervention and to prevent superfluous treatment [6].

Traditionally, blood loss after vaginal birth is visually evaluated by measuring the blood collected in delivery trays, drapes, sanitary linens, gauze and sponges. But these materials may also include urine, amniotic fluid, vaginal secretions and other fluids that may make it difficult to visually differentiate and quantify blood. Thus, the volume of blood loss estimated visually may be markedly different from the real volume. The largest mistakes tend to be at higher volumes of haemorrhage, when prompt recognition and effective control is most crucial, and is significantly the largest inaccuracy. Thus, better accuracy in assessing blood loss may allow early resuscitation and decrease the risk of major consequences related to severe PPH [7].

There are various approaches used to quantify blood loss after delivery. These include direct collection and measurement of blood, weighing of blood soaked material, estimation based on changes in maternal haematological parameters, dye-dilution techniques for determination of plasma volume, measurement of red-cell and plasma volumes using tracer methods, calculated estimation of blood loss and sonographic assessment of the inferior vena cava. While these procedures may yield more objective estimates than ocular assessment, many are expensive, technically hard, time consuming or not practical for routine usage in resource-poor clinical settings [8].

The use of calculated estimated blood loss (CEBL) using maternal blood volume and changes in pre- and post-partum packed cell volume or haematocrit is a somewhat practical option for assessing the accuracy of visual estimation. It may provide a more objective comparison since it encompasses measurable physiological changes related with blood loss. However, estimated blood loss has limits; intravenous fluid administration, maternal hydration status, physiological haemodilution, timing of postpartum blood sampling and other factors that may influence packed cell volume independently of blood loss [9].

VEBL has been compared with computed or other objective techniques of blood-loss assessment in several studies, but not with totally consistent results. Visual estimation with computed blood loss and showed considerable differences between the two methods. Has been compared [6]. Used different methods of calculation of blood loss and compared the results with ocular estimations [7]. Visual estimates of blood loss have similarly been compared with changes in pre- and post-delivery haematocrits. Some investigations have found statistically significant differences between visual and objective or calculated approaches whereas some have not found significant differences. These inconsistent findings indicate the need for further evaluation in different clinical settings and populations [10].

Although various objective approaches have been published, many of these remain mainly research tools due of their expense and technical complexity and limited applicability in ordinary obstetric practice. Thus, visual estimation remains the mainstay of blood loss

estimation in many labour wards, especially where resources are limited. However, evidence exists that repeated training and simulation of birth attendants can increase accuracy and consistency of visual estimation of blood-loss. Such training may be especially useful where no objective measurement techniques are available. This is a particular challenge in Nigeria where PPH remains a significant contributor to preventable maternal morbidity and mortality. The persistent use of visual estimating in many delivery units in Nigeria raises worry over early recognition of severe blood loss. Overestimation can lead to excessive interventions and incorrect use of precious blood products, while underestimation can result in delay in appropriate intervention and contribute to avoidable maternal problems. Hence clinically it is important to know how well visual estimation correlates with a more objective computed procedure [11].

Accurate estimation of blood loss is important, however there is a lack of locally generated research comparing VEBL with CEBL among women delivering vaginally in south-eastern Nigeria. Measuring the extent and direction of the differences between these methods may give useful evidence for the improvement of obstetric practice, staff training and early recognition of PPH. This study was therefore attempted to investigate the accuracy of visual estimation of blood loss following vaginal birth by comparing VEBL with CEBL among women delivering at Imo State University Teaching Hospital, Orlu, Imo State, Nigeria. The study also aimed to establish the level of agreement between the two approaches and their effectiveness in identifying women with main PPH. The study findings may help to improved blood loss measurement, early detection and therapy of PPH, and ultimately reduction in unnecessary maternal morbidity and mortality.

MATERIALS AND METHODS

Study Design

This was a comparative analytical study conducted among women who had vaginal deliveries at the labour ward of Imo State University Teaching Hospital (IMSUTH), Orlu, Imo State, Nigeria. The study compared two methods of estimating blood loss following vaginal delivery: visual estimated blood loss (VEBL) and calculated estimated blood loss (CEBL). The accuracy of VEBL was assessed by comparing it with CEBL, which was derived from maternal blood volume and the percentage change in pre-delivery and postpartum haematocrit.

Study Area

The study was conducted at Imo State University Teaching Hospital (IMSUTH), Orlu, Imo State, southeastern Nigeria. Orlu is a semi-urban city and one of the major urban centres in Imo State, with an estimated population of approximately 420,000. IMSUTH is a tertiary referral and teaching hospital located in Orlu. It serves as a clinical training centre for medical students of Imo State University, Owerri, and provides specialist and referral services to patients from Imo State and neighbouring states, including Abia, Anambra, Ebonyi, Enugu, Rivers, and Bayelsa States. The hospital provides comprehensive obstetric and gynaecological services and receives pregnant women referred from primary and secondary healthcare facilities within and outside the state. Approximately 230 women deliver in the labour ward annually.

The Department of Obstetrics and Gynaecology comprises seven consultants who supervise the clinical services. Five consultants head the major clinical units, with resident doctors rotating through the various units. Each unit has designated clinic and theatre days. Consultant ward rounds are conducted according to an established schedule, while resident doctors and house officers conduct daily ward rounds. Monthly grand rounds are held for academic and clinical case discussions. Doctors participate in call duties according to the departmental duty roster.

Management of the Third Stage of Labour

Active management of the third stage of labour (AMTSL) was employed for all participants. Following delivery of the baby, 10 IU of oxytocin was administered intramuscularly within one minute of delivery. Controlled cord traction was subsequently performed to facilitate delivery of the placenta. Following placental delivery, uterine tone was assessed and uterine massage was performed at regular intervals during the immediate postpartum period. Where episiotomy was performed, prompt repair was undertaken following delivery of the placenta and assessment of maternal and neonatal conditions. Women were observed in the second-stage/post-delivery area for approximately one hour before transfer to the postnatal ward, provided they remained clinically stable. Blood pressure, pulse rate, respiratory rate, uterine tone, and vaginal blood loss were monitored at 15-minute intervals during the immediate postpartum observation period. Women who remained clinically stable after the observation period were transferred to the postnatal ward. For the purpose of this study, blood loss was visually estimated from the onset of the third stage of labour until active bleeding from the genital tract had ceased.

Ethical Considerations

Ethical approval was obtained from the Research and Ethics Committee of Imo State University Teaching Hospital, Orlu, before commencement of the study. The study protocol was discussed with the research supervisors, Head of the Department of Obstetrics and Gynaecology, resident doctors, labour ward nurses, midwives, and relevant staff of the Haematology Department. Eligible participants were adequately informed about the purpose, procedures, potential benefits, and requirements of the study. Written informed consent was obtained from each participant before enrolment. Participation was voluntary, and participants were informed of their right to withdraw

from the study at any time without any effect on the care they received. A confidential, coded questionnaire was used for data collection. Participants were assigned identification codes rather than having their names recorded on the research data collection forms. All information obtained during the study was treated as confidential.

Sample Size Determination

The sample size was determined using the formula for comparing paired measurements:

$$n = \frac{(Z_{\alpha/2}+Z_{\beta})^2(Sd)^2}{d^2}$$

Where:

- n = minimum required sample size;
- Zα/2 = standard normal deviate corresponding to the desired level of statistical significance;
- Zβ = standard normal deviate corresponding to the desired statistical power;
- Sd = estimated standard deviation of the paired differences between VEBL and CEBL;
- d = minimum clinically significant difference between the two methods.

The statistical power was set at 80%, with a 5% type I error rate and a 95% confidence level. Therefore:

- Zα/2 = 1.96;
- Zβ = 0.84;
- Sd = 45.32, based on a previous study; and
- d = 10 mL.

Using these parameters, the calculated minimum sample size was 161 participants. Therefore, 161 women who met the eligibility criteria were recruited for the study.

Eligibility Criteria

Inclusion Criteria

Participants were eligible for inclusion if they met all of the following criteria:

1. Pregnant women at term who presented to the labour ward of IMSUTH.
2. Women who presented in labour and provided informed consent to participate.
3. Women whose labour ended in vaginal delivery.
4. Women without pre-eclampsia.
5. Women without eclampsia.
6. Women without sickle cell disease.
7. Women without anaemia at recruitment.

Exclusion Criteria

Women were excluded from the study if they:

1. Had pre-eclampsia or eclampsia, because these conditions may alter haematocrit through changes in plasma volume and haemoconcentration.
2. Received blood transfusion during labour or within the immediate postpartum period, as transfusion could affect postpartum haematocrit and consequently influence calculated blood loss.
3. Declined or withdrew informed consent.
4. Delivered by caesarean section, because perioperative intravenous fluid administration, blood loss associated with surgery, and possible blood transfusion could influence postpartum haematocrit.
5. Received spinal anaesthesia, particularly where substantial intravenous fluid preloading was administered, because haemodilution could affect postpartum haematocrit and calculated blood loss.

Outcome Measures

The primary outcome measure was the difference between VEBL and CEBL in determining the volume of blood lost following vaginal delivery.

Secondary outcomes included:

- the mean blood loss obtained using VEBL and CEBL;
- the degree of agreement between VEBL and CEBL;
- the proportion of women identified as having primary PPH using each method;
- the relationship between parity and estimated blood loss; and
- the relationship between neonatal birth weight and estimated blood loss.

For the purpose of the study, primary PPH was defined as blood loss of ≥500 mL following vaginal delivery.

Data Collection Procedure

Following ethical approval, resident doctors, house officers, midwives, and nurses working in the labour and delivery unit who were willing to participate in the study were oriented to the objectives, procedures, and methodology of the research. Relevant staff of the Haematology Department were also informed about the study. Three dedicated research notebooks were provided in the antenatal/prenatal ward, labour ward, and postnatal ward for systematic recording of participant information.

The antenatal/prenatal ward notebook was used to document maternal weight, height, and pre-delivery haematocrit. The labour ward notebook was used to record neonatal birth weight, VEBL, and maternal vital signs. The postnatal ward notebook was used to record the postpartum haematocrit obtained 48 hours after delivery. Information recorded in the notebooks was subsequently transferred to the study questionnaire. To minimise variability associated with different absorbent materials, non-calibrated but uniform-sized mops were used throughout the study period. The investigator covered the cost of the haematological investigations performed for the participants. On presentation to the prenatal/labour ward, eligible and consenting women

were clinically assessed by the investigator or the resident doctor recruited for the study. Participants in active labour were admitted and managed according to the routine obstetric protocol of the hospital. Maternal weight was measured in kilograms and height in centimetres and documented accordingly. Approximately 2 mL of venous blood was collected from each participant into an appropriately labelled specimen container and transported with a completed laboratory request form to the Haematology Department for determination of pre-delivery haematocrit. All participants received active management of the third stage of labour. Following delivery, blood loss was visually estimated by the investigator or trained doctor involved in the study. The estimation covered blood present on the delivery couch, floor, mops, delivery materials, and instruments. The estimated blood loss was recorded in millilitres. Maternal blood pressure, pulse rate, and respiratory rate were monitored at 15-minute intervals during the immediate postpartum observation period and recorded in the designated labour ward research notebook. A second haematocrit measurement was obtained 48 hours after delivery and documented in the postnatal ward research notebook. The same procedures were applied to all participants until the required sample size was attained.

Calculation of Estimated Blood Loss

Following completion of participant recruitment and data collection, the information obtained from each participant was collated and analysed. Maternal weight and height were converted from kilograms and centimetres to pounds and inches, respectively, where required by the blood-volume estimation formula.

The percentage change in haematocrit was calculated for each participant as:
\frac{\text{Pre-delivery Hct} - \text{48-hour postpartum Hct}}{\text{Pre-delivery Hct}}\times 100]

Estimated maternal blood volume (MBV) was calculated using the formula:[\text{MBV} = 0.75 \times [(50 \times \text{height in inches}) + (25 \times \text{weight in pounds})]]

The calculated estimated blood loss (CEBL) was then determined by multiplying the estimated maternal blood volume by the percentage change in haematocrit:

[\text{CEBL} =\text{Maternal Blood Volume} \times\text{Percentage Change in Hct}]

The resulting value was expressed in millilitres.

Other relevant demographic and obstetric information, including maternal age, parity, and neonatal birth weight, was obtained from the questionnaire and incorporated into the analysis.

Statistical Analysis

Data obtained from the study were checked for completeness, coded, entered into a database, and analysed using the Statistical Package for the Social Sciences (SPSS), version 16.0. Descriptive statistics were used to summarise the data. Continuous variables were expressed as mean, median, standard deviation, and standard error of the mean where appropriate. The mean blood loss obtained by VEBL was compared with the mean CEBL. The relationship between VEBL and CEBL was assessed using the paired Student's t-test, because blood loss was estimated using two methods in the same participants. A p-value <0.05 at a 95% confidence interval was considered statistically significant. Cross-tabulation was used to explore the relationship between parity and blood loss estimated using each method. Similar analyses were performed to examine the relationship between neonatal birth weight and VEBL and CEBL. The number and proportion of women meeting the study definition of primary PPH (blood loss $\geq$500 mL) were determined separately using VEBL and CEBL. The sensitivity of each method for identifying primary PPH was subsequently compared.

RESULTS

Two hundred and seven women delivered in our labour ward during the period of study. Ten women delivered by Caeserean section (received spinal anaesthesia and preloading with normal saline) and were excluded from the study. Ten women had preterm delivery, of the remaining one hundred and eighty-eight women, ten had eclampsia and seven had postpartum haemorrhage and showed signs of haemodynamic instability and were treated with blood transfusion. Nine requested for early discharge and did not wait to do their postpartum haematocrit estimation. The remaining one hundred and sixty-one patients consented to participate in the study and met the inclusion criteria and were thus recruited for the study

Table 1: Number of patients that delivered during the period of study.

Mode of delivery	Total number of patients=207
Preterm delivery	10
Caeserean section	10
Preeclampsia	10
Eclampsia	7
Early discharge	9
Remainder	161

One hundred and sixty-one patients consented to participate and met the inclusion criteria for the study Table 3a & b Shows the demographic representation of the patients according to age and parity. Most of the patients that participated in the study are aged between 25 and 29 years (31.68%). While the least number of patients are aged 35 years and above and represent 9.32% of the patients that participated in the study. Most of the patients are Para 2 and represent 24.84% of the patients while those who are Para 5 and above are the least and represent 8.70% of patients that participated in the study.

Table 2: Demographic distribution of patients according to age.

Age (years)	No of patients	%
15-19	32	19.88
20-24	47	29.19
25-29	51	31.68
30-34	16	9.94
≥35	15	9.32

Table 3: Demographic Distribution of Patients According to Parity.

Parity	No of patients	%
1	38	23.60
2	40	24.84
3	38	23.60
4	31	19.25
≥5	14	8.70

Table 4 shows the distribution of blood loss according to VEBL methods and CEBL method. Most patients in both methods lost blood at a range of 200-300mls. In the VEBL method, 65 patients representing 40.37%% of patients that participated in the study lost blood at that range while in the CEBL method, 77 patients representing 47.83% of patients that participated in the study lost blood at the same range. Least number of patients lost blood above 1000mls, 3 in each method representing 1.86% of patients that participated in the study.

More patients in the CEBL method lost blood at or above the threshold of 500mls (42 vs 28) but none of these patients showed signs of haemodynamic instability. 40 patients in the VEBL method lost blood less than 200mls and this represents 24.84% of patients that participated in the study, while 16 patients in the CEBL method representing 9.94% lost blood at the same range.

Table 4: Distribution of blood loss according to VEBL and CEBL methods.

RANGE (mls)	VEBL	CEBL
0-199	40	16
200-399	65	79
400-499	28	24
500-599	10	13
600-799	13	16
800-999	2	10
≥1000	3	3
TOTAL	**161**	

It was observed during the study that the error margin R between the visual estimated blood loss and calculated estimated blood loss in each estimation decreased significantly during the second half of the study. This may probably be due to the fact that repeated estimations improved the accuracy of visual blood loss estimation.

Tables 5 Show the descriptive analysis of VEBL and CEBL. It was observed during the study that the minimum value for VEBL method is 140mls and the maximum value is 1010mls, while using the CEBL method, the minimum value is 150mls and the maximum value is 1000mls. The mean of the variables for VEBL and CEBL are respectively 381.24 and 450.42 while their respective standard deviations are 212.17 and 201.38. The median for VEBL and CEBL are 350.00 and 400.00 respectively. The variance for the CEBL was significantly larger (45016.50 vs 40552.97). This shows that there exists a significant difference between the two methods used in this study.

Table 5: Statistical analysis of VEBL and CEBL.

	VEBL	CEBL
Mean	381.24	450.42
Std error	16.72	15.87
Median	350.00	400.00

	VEBL	CEBL
Mode	250.00	400.00
Std deviation	212.17	201.38
Sample variance	45012.50	40552.97
Kurtosis	1.24	0.14
Skewness	1.31	0.79
Range	870.00	850.00
Minimum	140.00	150.00
Maximum	1010.00	1000.00
Sum	61380.00	72518.00
Count	161.00	161.00

Table 6 shows that the correlation between VEBL and CEBL is 0.296, which is a weak positive correlation between the two. Simply put, they are 29.6% related.

Table 6: Paired samples correlations of VEBL AND VEBL

	VEBL	CEBL
VEBL	1.000	
CEBL	0.296	1.000

In table 7, the test of difference of two (VEBL and CEBL) means using t-test shows a 30% correlation estimated earlier. The estimated t-test statistics is -3.58 with p-value of 0.00 which is less than 0.05, which signifies that the test is significant at 0.05(5%) confidence level for both two tailed and one tailed test. Affirmatively there is significant difference between **VEBL and CEBL.**

Table 7: T-test: Paired two samples for means.

	VEBL	CEBL
Mean	381.24	450.42
Variance	45016.50	40552.97
Observations	161	161
Pearson's correlation	0.30	
Hypothesized mean diff.	0.00	
Df	160.00	
t –stat	-3.58	
P (T<=t) one-tail	0.00	
t critical one- tail	1.65	
P(T<=t) two- tail	0.00	
t critical two-tail	1.97	

The two ways of analysis of variance (ANOVA) shows that the test is significant with all the p-values less than 0.05(5%) level of significant. Again, the estimated F ratio (F_{cal}) is all greater than the F critical (F_{tab}) which buttress the claim that actually there is difference between the two variables with CEBL recording a higher variable that to the difference.

ANOVA

Ce of varic	SS	Df	MS	F	p-value	F crit
Rows	8871501	160	55446.88	1.840708	6.57E-05	1.298031
Columns	385264.1	1	385264.1	12.78987	0.000461	3.900236
Error	4819614	160	30122.59			
Total	14076379	321				

Tables 7a&b Show the distribution of CEBL and VEBL according to birth weight. The distribution of VEBL and CEBL according to birth weight did not differ much. Most people in both methods lost blood at a range of 200-300 with their babies weighing between 3.00-3.99kg. Volume of blood loss in each method did not depend on the birth weight except for those that had lacerations of the genital tract.

Table 7a. Distribution of VEBL according to birth weight.

Birth weight(kg)	Volume of blood lost in mls 0.00-199	200-399	400-599	600-799	800-999	≥1000
0.00-1.99	0	0	0	0	0	0
2.00-2.99	14	12	6	0	0	1
3.00-3.99	21	37	13	5	0	1
4.00-4.99	4	13	16	7	0	0
≥5	0	0	3	7	2	1

Table 7b. Distribution of CEBL according to birth weight.

Birth weight(kg)	0.00-199mls	200-399mls	400-599mls	600-799mls	800-999mls	≥1000mls
0.00-1.99	0	0	0	0	0	0
2.00-2.99	7	18	10	3	2	0
3.00-3.99	10	45	17	3	1	1
4.00-4.99	0	13	11	8	1	0
≥5	0	0	0	4	6	2

Tables 8a & 8b show the distribution of VEBL and CEBL According to parity. There is no linear relationship between both methods and parity except for primiparous patients that had episiotomy and multiparous patients that had genital tract lacerations. These groups had increased blood loss compared to those that did not have episiotomy or genital tract laceration.

Table 8a. Distribution of VEBL according to parity.

Parity	0.00-199mls	200-399mls	400-599mls	600-799mls	800-999mls	≥1000mls
1	5	12	15	6	0	0
2	9	12	8	3	0	2
3	6	12	5	3	0	0
4	8	15	5	0	0	1
5	6	6	5	5	0	0
>5	2	2	2	4	2	0

Table 8b. Distribution of CEBL according to parity.

Parity	0.00-199mls	200-399mls	400-599mls	600-799mls	800-999mls	≥1000mls
1	3	8	11	3	0	0
2	2	25	8	5	3	0
3	2	19	8	5	0	0
4	4	8	10	8	2	0
5	2	1	10	3	3	0
>5	0	0	4	2	1	1

DISCUSSION

Postpartum haemorrhage (PPH) continues to be a leading cause of maternal morbidity and mortality, especially in low- and middle-income countries. Early identification and care of PPH is essential to prevent severe anaemia, hypovolaemic shock, organ failure and death [12]. Hence, accurate assessment of blood loss after delivery is important for early diagnosis, proper resuscitation and timely intervention [13]. However, reliable estimation of blood loss remains a challenge in everyday obstetric practice especially in resource limited areas where advanced blood-loss measurement techniques may not be easily available.

This present study was a comparison of visual estimated blood loss (VEBL) and calculated estimated blood loss (CEBL) during vaginal delivery at Imo State University Teaching Hospital, Orlu. The results showed a statistically significant difference between the two techniques, with CEBL giving a larger mean estimate of blood loss than VEBL. These results are consistent with prior evidence that visual estimation is commonly wrong and may either overestimate blood loss in lower volumes or underestimate blood loss when significant bleeding is present [14].

The demographic profile of blood loss predicted by the two approaches was largely similar however considerable variances were identified at certain blood loss thresholds. Most participants estimated blood loss in the range of 200–300 mL by both methods. In each approach, three women experienced estimated blood loss

of ≥1,000 ml. There was no confirmed haemodynamic instability despite rather significant estimated blood loss in these individuals. This may be partially due to physiological compensation and variances of mother circulating blood volume. However, lack of early haemodynamic instability should not be regarded as confirmation that massive blood loss is of minimal clinical importance, as compensatory mechanisms might temporarily hide the severity of haemorrhage [15].

One notable finding was that VEBL detected more women with blood loss less than 200 mL than CEBL. VEBL identified 23% (36/23.37) of women as having blood loss <200 mL compared with 9.74% (15/15) by CEBL. By contrast, CEBL detected a higher number of women with blood loss ≥500 mL. Based on VEBL, 28 women (17.39%) had CEBL ≥500 mL, compared with 42 women (26.09%) based on CEBL. Therefore, VEBL identified fewer women who fit the research definition of PPH than CEBL.The absolute difference in the prevalence of PPH was 8.70 percentage points (26.09% vs. 17.39%) when the criterion was ≥500 mL for CEBL and VEBL, respectively. This study implies that visual estimation may underestimate clinically relevant blood loss and so fail to detect some women who fulfil the traditional criteria for PPH. This outcome is in agreement with research that have shown that visual estimation is less accurate with larger amounts of blood loss [16].

However, the under-recognition of PPH in this investigation was much lower than that described by [17] who compared visual estimation with actual measurement of blood loss in vaginal delivery and found a significant underestimation of PPH by visual evaluation. Conversely, a significant majority of vaginal births in [18] demonstrated predicted blood loss to be roughly 20% higher than observed blood loss. These disparities represent the variability of visual estimation and may be attributed to the differences in study population, clinical context, observers' expertise, blood-loss volume and reference methods used to establish actual blood loss [19].

The mean VEBL blood loss calculated in this study was 381.24 ml whereas the mean CEBL was 450.42 ml, yielding a mean difference of about 69.18 ml. The paired analysis showed a statistically significant difference between the two values ($t = -3.58$, $p < 0.001$). Thus, the VEBL and CEBL disparity was unlikely to be due to chance. The mean value of CEBL was greater, which indicates a tendency to underestimate blood loss in the study population with visual estimates. These findings are in line with earlier research in which calculated or objectively measured blood loss was more than visually assessed blood loss [20] This is clinically essential since the implications of underestimate rise with increasing blood loss. A woman with severe haemorrhage may appear clinically stable initially due to physiological compensation such that reliance on obvious clinical indicators may delay detection and treatment. The results are contrary to those of [21] who reported no statistically significant difference between visually estimated and computed blood loss. Differences in methodology, timing of blood sample, demographic characteristics, observer training and method utilised for blood loss calculation may explain the different outcomes.

The current findings have substantial implications for obstetric practice. Inaccurate assessment of blood loss may cause delayed detection of PPH, delayed fluid and blood-product replacement, and progression to severe maternal morbidity. The problem may be particularly relevant in situations when clinicians rely mostly on visual judgement since objective monitoring of blood loss is not usually available. Therefore, a more objective way to quantify blood loss may allow for earlier identification of women who need intervention [8]. One of the striking findings of this study was the gradual reduction in the difference between VEBL and CEBL as the investigation progressed. At the conclusion of the study the difference between the two methodologies was much smaller. The results imply that repeated experience of estimating of blood loss, feedback and comparison with calculated values may enhance the accuracy of visual estimation. This finding is consistent with previous studies demonstrating that structured education, simulation and repeated training can improve clinicians' ability to estimate blood loss [3] with similar improvements in blood-loss estimation reported following educational interventions delivered via live and web-based approaches [21]. This discovery has practical relevance in resource challenged environments such as Nigeria. Calculated and objective approaches may yield more dependable estimates, but may not always be viable for everyday use. Regular training and simulation exercises could therefore be a reasonably inexpensive way of enhancing the performance of healthcare personnel who rely on visual estimation. These programs could include standardised volumes of blood loss, images, simulation materials, and feedback comparing estimated blood volumes to actual blood volumes [22].

The study also assessed the association between neonatal birth weight and blood loss. Cross tabulation of VEBL with birth weight showed no significant connection. Estimated blood loss was between 200 and 400 mL for most women, regardless of neonatal birth weight. In this investigation, the amount of blood loss did not seem to be greatly influenced by birth weight other than in cases aggravated by genital tract injuries. This conclusion is consistent with the findings of [23] that some major factors of PPH are connected to problems in the second and third phases of labour rather than birth weight alone. However, this finding is contrasted with prior research that have identified increasing birth weight as a risk factor for PPH [27]. A bigger foetus may raise the risk of uterine overdistension, protracted or

obstructed labour, surgical delivery and genital tract trauma, all of which may predispose to PPH. The absence of a significant correlation found in the present study may be attributed to the sample size, the distribution of birth weights, or the relatively small number of women with severe haemorrhage. Also, no apparent linear association between parity and blood loss was evident. The idea that increasing parity is invariably connected with increasing blood loss following vaginal birth was not supported by the findings. Higher parity might be related to various obstetric difficulties, however blood loss is impacted by a number of factors including uterine tone, retained placental tissue, genital tract damage, prolonged labour, induction or augmentation and coagulation disorders. In the present investigation, higher blood loss appears to be more linked with cases of genital tract lacerations than parity alone [24].

There are various methodological concerns to bear in mind when interpreting these findings. CEBL was utilised as the comparative method, but it is not an absolute gold standard for blood loss measurement. Changes in haematocrit derived from blood loss may be affected by maternal hydration, intravenous fluid treatment, date of postpartum blood sample and natural postpartum haemodynamic changes and other factors unrelated to haemorrhage. VEBL is also impacted by the presence of urine, amniotic fluid, vaginal secretions, and blood absorbed in mops and other materials. Differences between the two methods may so partly reflect constraints inherent in both techniques [25]. Although limited, this study suggests that use of VEBL alone may underestimate blood loss and therefore delay identification of PPH. The large discrepancy between VEBL and CEBL and the higher percentage of women diagnosed as having PPH by CEBL indicates the need for better measurement of blood loss after vaginal birth. Obstetric practice should include objective or quantitative methodologies wherever possible. In the absence of such approaches, implementation of frequent training, simulation, standardised estimating procedures and periodic competency testing should increase the accuracy of visual estimation.

The findings emphasise the significance of early recognition and objective assessment of PPH overall. Accurate assessment of blood loss should be used to supplement, not replace, clinical monitoring of maternal vital signs and overall clinical state. A combination of quantitative blood loss assessment, serial clinical examination and timely intervention is anticipated to provide the safest way to reduce unnecessary maternal morbidity and mortality associated with PPH [26].

CONCLUSIONS

This study showed that predicted blood loss calculated is significantly different from the visual estimates of blood loss after vaginal birth. The mean estimate of blood loss was higher using the calculated technique and a larger proportion of women were identified with blood loss of ≥500 mL showing that visual estimation may underestimate clinically relevant blood loss. The results suggest that visual assessment alone may result in a delay in detection of postpartum haemorrhage and thus a delay in effective response. Despite its methodological limitations, computed blood loss is a more objective assessment of blood loss than ocular estimation without aids. Repetitive evaluation, systematic instruction, simulated training, and ongoing feedback can enhance the accuracy of health-care providers' visual estimation of blood loss. Where resources permit, the quantitative or objective assessment of blood loss should be incorporated into standard obstetric practice. In all contexts, proper assessment should be coupled with thorough monitoring of maternal vital signs and timely therapy of suspected postpartum haemorrhage.

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