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RESEARCH ARTICLE

How Accurate Is the 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

The discrepancy between visually estimated blood loss and calculated blood loss after vaginal delivery was determined in this study. This was a comparative analytical study conducted at Imo State University Teaching Hospital, Orlu, Imo State Nigeria. Pregnant women who met the inclusion criteria were recruited through the labour ward of the hospital. The maternal height, weight, pre and post delivery packed cell volume were measured. These were used to calculate the blood loss. The calculated blood loss was derived by multiplying the maternal blood volume by the percentage change in pre and postpartum packed cell volume. This was compared with the visually estimated blood loss. Statistical analysis was done using SPSS version 16 to find out if there was significant difference between these two methods. Two hundred and seven women delivered during the period of the study but only one hundred and sixty one were eligible and were used for the study. They was gross overestimation and underestimation of blood loss during the first half of the study but the difference gradually decreased as the study progressed because improved estimation because the initial values differed remarkedly with clinical findings thereby leading to better judgement in subsequent estimations. There was significant statistical difference between the two methods and CEBL was more sensitive than VEBL in diagnosing PPH. Visual estimation of blood loss is inaccurate compared to calculated method of blood loss estimation after vaginal delivery. Repeated estimation can improve accuracy.

Keywords: Visual Estimation, Blood Loss, Vaginal Delivery, and Calculated Blood Loss.

1. Introduction

Postpartaum haemorrhage (PPH) is responsible for about 25% of maternal mortality worldwide, [1]reaching as high as 60% in some countries. PPH can also be a cause of long term severe morbidity. Approximately 12% of patients who survive PPH will have severe anaemia.[2] Also women who have severe PPH and survived are significantly more likely to die in the year following the PPH.[3]Approximately 140,000 women die annually from PPH worldwide and more than 50% of these deaths occur within the first 24 hour postpartum .[4] The WHO reports that in Sub-Saharan Africa, Obstetrics haemorrhage (OH) is by far the leading cause of maternal mortality accounting for more than 35% of cases in the region. [1]

It is because of this staggering statistics that international bodies like United Nations and WHO assigned a high priority to the control, prevention and treatment of postpartum haemorrhage so as to achieve a 75% decrease in maternal death by 2015. [5] It will not be possible to achieve the millennium developmental goal on maternal health without first reducing the incidence of postpartum haemorrhage. Studies done in many countries revealed that the commonest factor

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implicated in postpartum haemorrhage is substandard care which may result from inability to accurately quantify the extent of blood loss, inadequate replacement of blood lost or inability to recognize or tackle the cause of the bleeding as responsible for most maternal death due to PPH.[6]

Accurate management of postpartum haemorrhage starts from making accurate estimation of blood loss at delivery. Despite its numerous shortcomings, visual estimation of blood loss (VEBL) is the commonly used method in most clinical setting. [7,8] Studies have shown that it underestimates the actual amount of blood lost at high volume, with the magnitude of underestimation typically increasing with volume of haemorrhage. It also overestimates the volume at lower value. [5,9]

Inaccurate estimation of blood loss at delivery has adverse effect on the management of postpartum haemorrhage. Underestimation of blood loss will lead to delayed diagnosis and treatment which will contribute to increased in maternal mortality and morbidity. While overestimation of blood loss will lead to erroneous management causing overzealous blood transfusion with attendant increase in transfusion reactions and blood borne pathogens.

Traditionally, the amount of blood loss during a vaginal delivery is determined by the doctor's visual estimate of blood on drapes, sponges, floor. This invariably also contains urine and amniotic fluid. This as a method of determining blood loss can underestimate the true value by as much as 33%-50%.[55] Importantly underestimation occurs at higher blood volumes where adverse consequences of excessive blood loss are more likely.[56-59] Thus accurate estimation of blood loss at delivery will not only aid in appropriate and timely management of postpartum hemorrhage, but will also prevent some of the problems that may arise due to misdiagnosis. It will also facilitate timely resuscitation which will minimize the risk of complications like acute renal failure, disseminated intravascular coagulation (DIC) and haemorrhagic shock. It will also decrease admission into the intensive care unit (ICU) and maternal mortality. [9]

Several methods of determining blood loss at delivery have been described in the literature, each with its merits and demerits. These methods include Direct collection and measurement or weighing of blood, venous blood sampling, dye dilution technique for plasma volume measurement, red cell and plasma volume determination using radio opaque tracer elements. Other methods are estimation of blood loss by calculation and the sonographic measurement of the diameter of the inferior vena cava. [5,12]

In a bid to confirm the accuracy of the visual estimation of blood loss during vaginal delivery, many studies have been done in different centers by comparing visual blood estimation of blood loss with other more accurate methods with conflicting results.[55,56,57] Stratford I. Dildy et.al in their study compared visual blood estimation with calculated blood loss.[55] Patricia J. Habak, Kristen Patters et.al used three different methods to obtain calculated blood loss and compared it with visual estimated blood loss [56] and Ghadoro EP and vEnabudoso in their own study compared visual estimated blood versus change in pre and post delivery haematocrit.[57] Some of the results demonstrated that there is statistical difference between the methods used and visual estimated blood loss [55,57,59,61] while some did not observe such difference.

Many of these methods mentioned above are confined to researches and are not used for clinical purposes because of their complexity and non feasibility. Visual estimation method despite its numerous drawbacks is the commonest method used globally. It has also been shown that periodic simulation of birth attendants improves its accuracy. [5,7]

2. Literature Review

2.1 Overview of Maternal Mortality

About 140,000 women die each year in childbirth, mostly in developing countries. [13] Severe bleeding in the postpartum period is the single most important cause of maternal death worldwide. [14] Depending on the rate of blood loss and other factors such as preexisting anaemia, untreated postpartum haemorrhage can lead to hypovalaemic shock, multi organ dysfunction and maternal death within 2-6 hours of delivery. For every woman that dies, thirty or more suffer complications with severe or long lasting consequences.[16]

More than 99% of maternal deaths occur in developing countries.[17] These deaths are more common in Africa because of the prevalence of risk factors such as grand multiparity, poor antenatal care coupled with poorly developed Obstetrics services. Obstetrics haemorrhage (OH) is responsible for about 35% of the total maternal deaths. [18] Other contributing factors include infections (HIV), poor nutritional status and lack of easy access to treatment. [68, 69, 70] Nigeria contributes about 13% of global maternal death rates (GMDR) with an estimated 36,000 women dying in pregnancy or at childbirth per year.[22]

Accurate determination of the magnitude of maternal mortality and the progress made by nations is difficult. About 60% of nations do not have capacity to collect data and data collection varies from country to country in both quality and quantity.[19] Also civil registration where it exists, its accuracy is questionable. In some countries maternal mortality is under reported [20] Statistical measures of maternal mortality include maternal mortality ratio (MMR), maternal mortality rate (mmr) and lifetime risk of maternal death.

Maternal mortality ratio is the number of maternal deaths per 100,000 live births during the same period. It is only a broad indication of the level of maternal mortality. Maternal mortality rate is the number of maternal deaths in a given period per 100,000 women of reproductive age. Adult lifetime risk of maternal death is the probability of dying from a maternal cause during a woman's reproductive life span, it is 1 in 6 in Africa and in developed countries it is 1 in 2800. [21]

Maternal mortality is the death of a woman whilst pregnant or within 42 days of termination of pregnancy, irrespective of the duration or the site of the pregnancy from any cause related or aggravated by the pregnancy or its management but not from accidental causes. [16] Direct maternal deaths (DMD) are those resulting from Obstetrics complications of the pregnant state (Pregnanncy, delivery, incorrect treatment or from chain of events resulting from them). Indirect material deaths (IMD) are those deaths resulting from previous existing diseases or diseases not developed during pregnancy and which were not due to direct Obstetrics causes but aggravated by physiological effects of the pregnancy.

It is because most of these deaths can be prevented without high technology and at a relatively low cost that prompted several international bodies like the WHO to proffer evidence based and cheap interventions for preventing and treating the causes of maternal mortality. [23]

These intervention strategies include the safe motherhood initiative (SMI) which was launched by WHO in 1987 at a conference in Nairobi Kenya with the objective of reducing maternal deaths by at least half by 2000 AD but later extended to 2015.[16] The millennium development goal (MDG) initiative by the united nation (UN) general assembly which had reduction of maternal mortality by 75% in 2015 as goal number.[5],[23] In 2015 the WHO launched the global strategy for women's, childrens' and adolescent's health 2016 – 2030. This aims to end all preventable deaths of women, children and adolescents and create an environment which is conducive for the wellbeing of these groups. [24]

The major causes of maternal mortality include Obstetric haemorrhage, (OH) Eclampsia, infections, Obstructed labour (OL) and complications of abortions. In developing countries there are many underlying factors like poverty, illiteracy, malnutrition and ignorance that contribute to the high levels of maternal mortality. Also contributory to the high level of maternal mortality in the developing countries are the 3 "DELAYS". Delay in deciding to seek care, delay in reaching care in time and delay in receiving adequate care in time. [25] Each of these delays contributes adversely to services, goods, facilities and condition which are important elements of right to health.[2]

2.2 Postpartum Haemorrhage

Post partum haemorrhage (PPH) is the most common cause of obstetric haemorrhage and is the number one cause of maternal mortality in the hospitals in developing countries. It has been estimated that about 140,000 women die from postpartum haemorrhage yearly.[16] This translates to one maternal death every 4 minutes. Post partum haemorrhage may be primary or secondary. Incidence of 4.5% was recorded in Ilorin Nigeria by Adeniran AS Ijaiya MA, Balogun OR.[30]

Primary PPH is defined as loss of blood of 500ml or more from the genital tract after vaginal delivery or in excess of 1000mls after caesarean section.[27] Primary postpartum haemorrhage occurs in 4 – 6% of deliveries.[27] Secondary post partum haemorrhage occurs when there in abnormal bleeding from the genital tract after the first 24 hours of delivery up to 6 weeks post delivery. Another definition of postpartum haemorrhage is a decline of 10% of pre delivery haematocrit (HCT) level. [28] This definition is retrospective and may not reflect the current haematologic status of the mother.

Postpartum haemorrhage remains one of the leading causes of maternal death globally. About 50% of women die annually from Postpartum haemorrhage worldwide and many of these deaths occur in the first 24 hours post partum. Uterine atony contributes to 80% of primary postpartum haemorrhage. [28] Risk factors for uterine atony include bladder distension, contributions that cause uterine over distention like multiple gestation, polyhydramnois and fetal macrosomia. Other conditions are prolonged labour, precipitate labour, fibroids, placenta praevia,

high parity, use of oxytocin, prolonged rupture of membrane, abnormalities of coagulation like Von Willibrand disease (VWD), thrombocytopaenia and idiopathic thrombocytopaenia purpura (ITP). More than one of these can cause PPH and about 2/3 of women who have PPH have no risk factor.[11]

Postpartum haemorrhage is one of the few Obstetrics complications with effective preventive interventions. Active management of the third stage of labour (AMTSL) defined as intra muscular administration of 10iu of oxytocin, controlled cord traction (CCT) and rubbing up of the uterus after delivery of the placenta substantially reduce the risk of PPH.[29] It also reduces the need for blood transfusion and additional uterotonic medication. The WHO, FIGO and ICM recommend that skilled birth attendants provide active management of the third stage of labour (AMTSL) for all vaginal deliveries. [32]

Recognition of ongoing blood loss and also the clinical presentations associated with massive blood loss during child birth is very important in the management of postpartum haemorrhage. Increasing pulse rate (PR), decreasing blood pressure (BP) and pallor are early warning signs of massive blood loss although these can be masked by physiological adaptations in pregnancy and early puerperium in which there is disproportionate increase in plasma volume and red cell mass.[11]

Positive outcome in severe PPH depends on the health status of the patient and promptness of the diagnosis and effective treatment. Successful management depends on early recognition of excessive blood loss and immediate correction of the blood loss with simultaneous institution of medical and/or surgical therapy to prevent further blood loss.[11] Resuscitation and definitive treatment should be simultaneous. Accurate replacement of the quantity of blood loss will depend on accurate determination of quantity of blood lost and will help maintain haemodynamic stability and oxygen perfusion to the tissues.

Resuscitation for minor PPH is securing IV access with a 14 G cannula and commencing crystalloid infusion. Resuscitation of major PPH involve positioning the patient, maintaining the airway, breathing and circulation, Oxygen administration, infusion of crystalloid using more than one iv access with wide bore cannulae and transfusion of blood or blood products. Different methods of treatment have been outlined in the literature ranging from medical to surgical depending on the cause of the PPH and response of the patient to the treatment.[1]

Delay in making a diagnosis of postpartum haemorrhage and institution of immediate treatment is associated with increased morbidity and mortality and death is usually common within 4hrs of delivery.[28] Morbidity associated with PPH which are related to massive blood loss and hypovolaemic shock include adult respiratory distress syndrome (ARDS) acute tubular necrosis(ATN). Late complications include postpartum anaemia, hypopitutarism and complications related to treatment with blood transfusion reaction and transmission of infective agents like HIV and hepatitis B virus.[7] Uterine perforation, uterine synechiae, urinary tract injury, genitourinary fistula, bowel and vascular injury are other possible complications from treatment.[15]

All medical units involved in the management of pregnant women must have a protocol for the management of massive Obstetric haemorrhage because all pregnant women are at risk of PPH. The health care providers should also be drilled in recognizing and quantifying blood loss at delivery and instituting immediate and adequate resuscitation during deliveries because all pregnant women are at risk of PPH.

It has been revealed in many settings that substandard care is a major factor responsible for maternal mortality and morbidity due to PPH. Substandard care may result from delay or inability to quantify correctly the amount of blood lost, inadequate replacement of the quantity of blood lost or inability to recognize and treat the cause of the haemorrhage. This is further compounded in the developing countries by the delay in seeking for health care due to inability to recognize the problem because of illiteracy or ignorance or both, delay in reaching health care centers because of logistics problem and delay in receiving care at the health facilities due to non availability of health care providers or non availability of essential drugs.

Postpartum haemorrhage is an Obstetric emergency which is preventable. It can occur in a woman with no risk factors so Obstetricians must be prepared to manage this condition at every delivery. Strategies for minimizing the effect of postpartum haemorrhage include identifying and correcting anemia before delivery, treating malaria and eliminating routine episiotomy. AMTSL, reexamination of the patient's vital signs and vaginal blood flow before leaving the delivery room are useful postpartum practices that should be inculcated in every one carrying out child delivery.

2.3 Methods of Estimation of Blood Loss

Different methods of estimating blood loss during delivery have been described in the literature by different authors. These methods are divided into five categories and include visual estimation, direct measurement, gravimetric, photometry, and miscellaneous. Each of these methods has its strengths and weaknesses.

2.4 Visual Estimation

The current worldwide standard practice of postpartum blood loss estimation is visual assessment of blood loss (vEBL) after delivery. A Healthcare provider generally observes the amount of blood loss during delivery and makes a quantitative or semi-quantitative estimate. It is the most frequently practised method of determining blood loss during child birth in different clinical settings in our environment.[56] This method is used despite repeated studies showing its inaccurancy.[8,9,10] It is subjective and depends on the observer judgment and value is assigned based on the doctor's or midwife's observation.

Studies have showed that simulations, education and evaluation of blood loss at various point during specific events may improve accuracy of blood loss estimation at delivery.[7,8] Glover reported accuracy in mid-wife estimation of blood loss during a simulated birth.[36] Maslovitz et al noted improved accuracy of postpartum blood loss estimation as assessed by simulation.[8] They recommended implementation of periodic estimation of blood by simulation to improve the accuracy of visual estimation.

The study done by Toledo et. al showed a 34% improvement of blood loss estimation by use of live and web based education of blood loss estimation.[31]. The limitation here is that these materials used in their study are not available in our environment where majority of postpartum haemorrhage occurs. Some researchers have focused their research on factors affecting accurate estimation of blood loss in other to minimize errors during visual estimation of blood loss.[7,32,33]

Edmonds et. al measured the threshold for excessive blood loss estimated in three groups of women attending antenatal care (ANC) in Bangladesh. [32] It was found that traditional birth attendants (TBA) in Bangladesh in estimating blood loss after vaginal delivery exceeded the upper limit of blood loss after vaginal delivery standard for PPH in their study. It was shown in the study done by Higgins et.al that the number of years of practice does not affect the accuracy of blood loss estimation among nurses.[33] The study also showed significant inaccuracy in estimation of small and large amounts of blood.

2.5 Direct Estimation

This is one of the oldest methods of the estimation of blood loss.[35] It involves the use of a tool to collect and measure blood loss. Different authors have used different tools to collect blood for estimation during delivery. The use of basins and copper funnels in front of the external genitalia have been described.[8] Strand et.al collected blood directly into a bucket through an opening in a cholera bed.[37] Has well described using an under buttocks drape with a graduated pouch for measurement. [38] Hill et. al reported a recovery of 99% of the blood loss, but how the recovery rate was calculated was not presented. [39]

Patel et. al compared measured estimate with a laboratory method for 10 women and found a correlation between the two methods.[10] However the number of subjects was not large enough to draw any conclusion. Prasertchaaroensuk et. al reported the inaccuracy of visual estimation when compared against measured blood loss after vaginal birth.[34] However the methodology was not clearly stated thereby making it difficult to validate. Zhong et. al in his study in 13 European countries noted that when compared to visual estimation of blood loss, the use of a collector bag did not reduce the rate of diagnosis of severe postpartum haemorrhage. [40] The study did not evaluate accuracy of use of collector bag and overall incidence postpartum haemorrhage.

Estimation of blood loss by direct method of measurement requires a container for collection of blood lost and a graduated container for measurement. The advantage of this method is that the result can be noted immediately and intervention if necessary be carried out at the delivery. The disadvantage of this method is that contaminations like urine and amniotic fluid can influence its value and lead to unnecessary interventions. Nelson et .al tried to solve this problem by using under buttocks drape with a pouch to collect blood and foreign fluid at the time of delivery and collected blood soaked sponges. The blood in the sponges was calculated by subtracting the weight of the sponge from the combined weight of the sponge and blood.[41]

2.6 Gravimetric Method

A variety of gravimetric methods to determine blood loss have been used. The method involves

determination of blood loss through pre and post delivery measurements of suction contents, pads, sponges, sheets, towels and cloths. Cormeau used a precision computerized scale system to weigh sponges and suction contents as they were place on a scale.[42] The machine could detect very large or small quantity of blood.

Lee et. al compared gravimetric and laboratory methods of quantifying intraoperative blood loss in animals during surgery.[44] A significant correlation was found between the two methods. However Johar and Smith did not find similar correlation.[45] Gravimetric method is less time consuming and cheap but is yet to be reproduced in man. AL kadiri et.al found a significant difference between the gravimetric method and visual estimation of blood loss.[43] In their study health care providers tended to underestimate blood loss by 30%.

The major advantage of gravimetric method is that it involves only collection of contaminated linens, pads, towels, swabs and weighing scale. However like in the direct method contamination by non blood fluids may affect the results. Fluid loss by evaporation may also affect the result. Its non suitability in emergency situation is another setback.

2.7 Laboratory Method

This method has been described as the gold standard in the estimation of blood loss during delivery.[35] It includes photometric method in which blood soaked materials are collected and the blood is estimated by automated extraction. The blood pigments are converted to haematin. The blended materials are passed through an optical density and read. The blood measured in the laboratory method demonstrated an error between 0% and 9.4%[46]. There is a positive relationship between laboratory method and simulation. Ducthie and Wilcox in their studies using radioactive chromium tagged red blood cell (RBC) technique validated these methods.[46] But both observed a tendency to underestimate when the blood loss was great. Razvi et. al[46] compared visual estimation and laboratory determination of blood loss during the third stage of labour. They observed inaccuracy of visual estimation especially at the extremes of blood loss. [47] The study noted over/underestimation of 64% and 34% respectively.

Estimation of blood loss by the laboratory method has its limitations. The materials needed are specialized and expensive and in most countries where postpartum haemorrhage is common, affordability is a problem. Error can also occur during blood collection, extraction of blood from pads, conversion of haemoglobin to haematin or during time of compression in the spectrophotometer.[35] Expertise is also needed to carry it out. All these shortcomings make it suitable for research and training and not for clinical use.

2.8 Calculated Blood Loss Method

Different researchers have used different methods to calculate blood loss at vaginal delivery. This method is the estimation of blood loss by calculating the maternal blood volume and multiplying it by the percentage change in haematocrit.[5] Pregnant women usually have increase in their blood volume of about 30-60%.[54] This is approximately 1-2 liters in an average sized woman. This means that she can tolerate without any significant decrease in postpartum haematocrit blood loss at delivery that approaches this volume she added during pregnancy assuming that she is not pre-eclamptic.

The calculated maternal blood volume (CBV) can be calculated using this formula.[5]

CBV(mls)=0.75x{maternal height in inches) x50}+{maternal weight in poundsx25}

Percent change in haematocrit ={pre delivery haemaotocrit – post delivery haemotorit}/pre delivery haemaotocrit. Thus blood lost during the third stage of labour can be calculated by multiplying calculated maternal blood volume by percent change in haematocrit. Strafford et. al compared visual estimation to calculated blood loss. They noted that the calculations can be inaccurate based on the hydration status of the woman or with pregnancy induced hypertension. Also they noted that maternal physiologic blood volume changes may alter the haematocrit values.[5]

Studies have been done to compare visual estimated blood loss with calculated blood loss with conflicting results. Dildy G.A and Clark S.T et. al[55] noticed that calculated estimated blood loss for operative vaginal delivery to be more than two fold higher than the visually estimated blood loss.[55] The same study also noticed that the visual estimated blood loss was significantly different from calculated blood loss greater than 1000mls.[55]

However Partrcia j.kristen patters in their own study at Maricopa Medical Center USA did not find similar result. The Mean Blood loss(MBL) in their study was not statistically different in the two methods,

although they cited that the difference may be due to the different methods used for the calculation.[56]

Gharoro EP and Enabudoso in their study in Benin, Edo state Nigeria on the relationship between visual estimated blood loss and postpartum change in haematocrit found that the postpartum haematocrit has a significant non linear correlation with the visually estimated blood loss.[57.]They noticed that in the absence of Post partum haemorrhage, majority of the patients have the same or increased haematocrit following vaginal delivery. They concluded that routine haematocrit estimation in parturient with visual estimated blood of less than 500mls barley confers any cost benefit.

Prasertcharoensuk et. al[33] compared visual estimation with direct method of blood during vaginal delivery. The incidence of PPH was underestimated in their study by 89% Brandt [60] and Duthie et. al[45] found that actual blood loss was higher than estimated blood loss during vaginal delivery. The underestimation increases as the quantity of blood loss increases. In contrast, Razvi et. al[46] found that estimated blood loss was 20% greater than the measured blood in loss 57% of vaginal deliveries.

The calculation method as a method of blood loss estimation has its own disadvantages. As a method of diagnosing PPH it is retrospective and may thus cause delay in the diagnosis. The method is also affected by any condition that affects the patient's Haematocrit like the hydration status of the patient, blood transfusion, eclmpsia or preeclampsia.

2.9 Miscellenous Method

Most of these methods are not practicable or reliable. Some women in East and Central Africa use Kangas which is a rectangular cotton only fabric measuring 100cmx155cm for various purposes. Prat et. al advocated the use of Kangas among traditional attendants (TBA) to decide when to refer patients for further managements.[48] The study reported that two fully soaked Kangas represented about 500mls of blood and should be the threshold for referral by TBAs.

Lyon et.al and Sefiddakht et. al[12] measured the diameter of the inferior vena cava(IVC) by ultra sound scan (USS) in trauma patients in the emergency room(ER) to determine if there was a relationship between the diameter of the inferior venal cava and amount of the blood lost. They noted decrease in the diameter of the inferior venal cava with large blood loss which predated other signs of shock.

Conn et. al[49] used serum specific gravity to determine blood loss. while Scalea et.al[51] demonstrated the high sensitivity of Central venous blood saturation as indicator of blood loss in animals.

Tagging red blood cells have been tried. Read and Anderton used radioactive tagged RBCs to determine change in the blood volume to calculate blood loss during Caesarean section.[51] while Holt et. al estimated blood loss through quantifying loss of radioactive tagged cells.[49] Both found that these methods had limited accuracy and reproducibility especially with small volumes. Most of the methods presented under miscellaneous method are not practicable and reliable. They are not suitable for usage in clinical practice and are thus confined to be used for research purposes.

It has been proposed that accurate determination of blood loss at the time of delivery could lead to earlier intervention and more effective treatment of postpartum haemorrhage, thus decreasing the risk of associated maternal morbidity[4,5,6] Visual estimation of blood loss is the commonest method used to estimate blood loss in clinical practice, because of this many studies have been done to estimate its accuracy by comparing it with other methods of blood loss estimation with conflicting results

3. Methods

3.1 Study Design

This is a comparative analytical study conducted in the labour ward of Imo State University Teaching Hospital (IMSUTH), Orlu. In the study, postpartum blood loss after vaginal delivery was analyzed using two different methods.

1. Traditional visual estimation (VEBL) of blood loss and
2. Calculated method of blood loss estimation (CEBL).

3.2 Study Area

Orlu is a Semi-urban town in Imo State, Southern Nigeria. It is the second largest city in Imo State after Owerri. It has an estimated population of about 420,000. Imo State Teaching Hospital (IMSUTH) is a referral tertiary hospital that is located in Orlu and in Imo State, Nigeria. It serves as a teaching hospital for medical students of Imo State University (IMSU) Owerri and also as a referral center for hospitals in Imo State surrounding states like Anambra, Abia, Ebonyi, Rivers, Enugu and Bayelsa States. About 230 women deliver in its labour unit annually.[61]

They are seven consultants in the department of Obstetrics and Gynaecology of the hospital. Five consultants heads the five units. The consultants are permanent in the unit while the resident doctors rotate through the unit. Each unit has its specific day for clinic and theater. Each consultant has a specific day for his ward rounds, while ward rounds for residents and house officers are daily. Grand rounds are done monthly. Calls are taken according to call duty roster.

3.3 Management of the Third Stage

Active management of the third stage of labour (AMSTL) was used in the management of the patients that participated in the research. IM 10iu of Oxytocin was given within one minute of delivery of the baby. This was followed by controlled cord traction (CCT) to deliver the placenta. Uterine rubbing was done every fifteen minutes for two hours. In those given episiotomy, prompt repair was done before cleaning the patient. The patient was observed for the next one hour in the second stage room before admission to the postnatal ward.

The maternal blood pressure, pulse rate, and uterine blood loss were monitored every 15mins and at the end of one hour she was discharged to the postnatal ward if found stable. Blood loss was visually estimated from the onset of the third stage of labour till the stoppage of active bleeding from the genital tract.

The research was conducted after obtaining approval from the ethics and research committee of the hospital. The subjects that met the inclusion criteria and gave consent were recruited for the study. All the subjects that gave their consent filled the survey instrument (confidential questionnaire). See appendix 1. This was number coded to match the characteristics.

3.4 Sample Size Determination

Using the formula

$n=[\ \{(Z_{\alpha/2} + Z_{\beta}) \text{ X } (Sd)^2\}/d^2\ ]$[67]

Where n =Sample size.

$Z_{\alpha/2}$ = standard normal deviate corresponding to the probability of a type 1 error.

Z_{β} = Standard normal deviate corresponding to the probability of a type 2 error.

Sd. Estimated standard deviation of paired response differences(ie standard deviate of the difference in the means between visually estimated blood loss and the calculated blood loss)

d-effect or the difference between the means between visually estimated blood loss and calculated blood loss that will be considered clinically significant.

The power of the study is set at 80% with a type 1 error rate of 50%.

Then $Z_{\alpha/2 =}$ 1.96 and Z_{β} = 0.84.

Sd estimated from previous study is = 45.32 and d = 10.

The n= 161

Thus the sample size for this study is 161 women.

3.5 Data Analysis

Having obtained consent from the ethical committee of the hospital and with the knowledge of my supervisor. Willing resident doctors, house officers, midwives and staff nurses that work in the labour and delivery unit of the department of Obstetrics and Gynaecology were recruited for the study. The staffs of haematology department were informed about the study. Those recruited for the study were educated about the research and its methodology. Also made available were three notebooks one each in the prenatal ward, labour ward and postnatal ward for recording necessary patients' information relevant to the study.

The notebook in the prenatal ward was used to record each patient's weight in kg, height in cm and pre delivery haematocrit. The notebook in the labour ward was used to record the birth weight in kg, visually estimated blood loss in mls and patient's vital signs. The notebook in the postnatal ward was used to record each patient's 48 hours haematocrit level. Later the information gathered was transferred to the questionnaire (see appendix 1). I also made available non calibrated but fixed size mops which were used for the entire period of the study. I also paid for the haematological tests that were done during the entire research.

On arrival at the prenatal ward, eligible and consenting patients were briefly clerked and examined by me or the resident doctor recruited for the research on duty. Those in active phase of labour were admitted in the prenatal ward. Those that are eligible and consented to the study were given confidential questionnaire containing information necessary for the study(see appendix) to fill, after that their weight and height were measured and the values were recorded in kg and cm respectively and documented in the notebook made available for the research.

About 2mls of blood was collected from the patient with a syringe and transferred into a properly labeled specimen container and sent to the haematologists together with appropriately filled laboratory request form for the determination of patient's pre delivery haematocrit. The values were recorded in the notebook in the prenatal ward made available for the research. Active management of labour was employed in the management of the patients.

The quantity of blood lost from the onset of the third stage of labour till the stoppage of active bleeding from the genital tract was visually estimated by me or the doctor recruited for the research and the values were measured in mls and documented in the notebook in the labour ward made available for the study. This included blood on the delivery couch, floor, mops and delivery instruments. The patient's blood pressure, pulse rate and respiratory rate were measured every 15 minutes and the values documented in the notebook made available for the study. Active management of the third stage of labour was applied in the management of all the patients.

Postpartum haematocrit was checked 48 hours after delivery and the values were documented in the notebook in the postnatal ward made available for the study. The above procedure was repeated for all the patients that participated in the study until the number of patients required for the research was attained.

The second part of the study was the collation of the results obtained from the patients that participated in the research. The unit of each patient's weight and height was converted from kg and cm to pounds and inches respectively. The percentage change in haematocrit was obtained for each patient by subtracting the 48 hours postpartum haematocrit from the pre delivery haematocrit and then divided by the pre delivery haematocrit. The value obtained is multiplied by 100.

Total maternal blood volume(mbv) was calculated from the formula =0.75 x (maternal height in inches x 50) +(maternal weight in pounds x 25)}. The calculated estimated blood loss in mls is the product of multiplying percent change in haematocrit with maternal blood volume. The calculation was done for each patient after the collection of data from all the participants to determine their corresponding calculated estimated blood loss. Other information from each patient necessary for the study like the age, birth weight and parity were also obtained from the questionnaire.

Data obtained from procedures for each patient were recorded and stored in the data base. The mean, median and standard deviation was determined for each method. The standard error was also determined. Statistical analysis of the data collected was done with the statistical package for social sciences (SPSS).

Statistical relationship between the two methods was explored using the paired t test and a p value of less than 0.05 at 95% confidence interval was considered statistically significant.

Cross tabulations tables was plotted between the parity and visually estimated blood loss and calculated blood loss to explore the relationship between them. This was also repeated between the birth weight and estimated blood loss from the two different methods.

The number of patients in each method that met the criteria for post partum haemorrhage (blood loss equal or more than 500mls) was determined and the percentage calculated.

4. 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*

Total number of patients=207. Mode of delivery	
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

The Tables 3a and 3b 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.

Table 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.

The 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}) are 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 variables 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				

The Tables 7a and 7b 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

The 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

5. Discussion

Delayed diagnosis and poor management of postpartum haemorrhage are associated with increased mortality and morbidity.[39] The challenge especially in developing countries is to improve management through accurate quantification of blood loss after delivery and its replacement.[9]

Studies have shown repeatedly that visual estimation of blood loss after vaginal delivery is inaccurate (overestimating blood loss at low volume and underestimating blood loss at high volume).[5,45,46]

Many studies have been done to determine the accuracy of visually estimated blood loss after vaginal delivery. Visually estimated blood loss has been compared with other more accurate methods of blood loss estimation to determine its accuracy. Many of these studies documented the inaccuracy of the visually estimated blood loss method as a method of determining blood loss after vaginal delivery.[55,56,57,59]

Some of these studies compared it with laboratory techniques such as colorimetric evaluation of blood saturated materials or photospectrometric evaluation of collected fluids or tagged red blood cells.[45] Others have compared it with direct measurement of blood loss.[33]

This study compared visual estimation of blood loss with the calculated method of determining blood loss after vaginal delivery. The calculated method used here used simple tools like weighing scales, tapes and sphygmomanometer which can be made available in every hospital in developing countries where most of maternal mortality and morbidity due to postpartum haemorrhage occur.

The demographic representation of blood loss after vaginal delivery using the two methods in this study did not differ much. The standard error for both methods shows that there exists a weak positive correlation between estimates. Most patients in both groups lost blood at a range of 200-300mls. Three patients in each method lost blood at or above 1000mls. There was no evidence of haemodynamic instability in these patients. Large maternal blood volume in these patients compensated for the loss.

More patients in the VEBL group experienced blood loss less than 200mls (36) representing 23.37% of the patients that participated in the study while 15 patients in the CEBL lost blood less than 200mls representing 9.74% of the patients. This shows that more people in VEBL method lost blood at low volume in this study. Also more patients in the CEBL (42) representing 26.09% of the patients that participated in the study lost blood at higher volume (at or higher than 500mls . This is not in agreement with other studies that stated VEBL overestimates blood loss at low volumes and underestimates it at high volume.[4,5,45,46] The difference may be due to the different method used in the comparison.

More patients in the CEBL method lost blood at or above 500mls (42 vs 28) thus meeting the definition of

PPH. Prevalence of PPH in this study (defined as blood loss of at or more than 500mls) estimated with CEBL was 26.09% against 17.39% by visual estimation, an underestimation by 8.67%. The observed rate of underestimation of primary PPH in this study is however lower than that reported by Prasertcharoensuk et al.[33] who compared visual estimation with direct measurement of blood loss during vaginal births. He observed in his study that the incidence of PPH was underestimated in the visual estimation by 89%. In contrast, Razvi et al found that estimated blood loss was 20% greater than the measured blood loss in 57% of vaginal birth.[46] The smaller value in prevalence of PPH found in this study may be due to the different method used in the comparison.

The mean blood loss was compared across the two methods using analysis of variance. Mean blood loss for VEBL was 381.24 and 450.42 for CEBL (difference of 69.18mls). However statistical analysis shows that there is significant difference among the estimate.

This is supported by the test of difference of the two (VEBCL and CEBL) means which shows a 30% correlation in affirmation of the correlation estimated earlier. The estimated t – test static 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 even for both two tailed and one tailed test. Affirmatively, there is significant difference between VEBL and CEBL.

The two way analysis of variance(ANOVA) shows that the test is significant with all the p value less than 0.05(5%) level of significant. Also the estimated F ratio(F_{cal}) are all greater than the F critical(F_{tab}) which buttress the point that actually there is difference between the two variables with CEBL recording higher variables that amount to the difference.

This is in agreement with other studies in which it was found that the actual blood loss was higher than the visually estimated blood loss.[57,59] but it is not in agreement with the study done by Habak PJ et al, in which the mean value of blood loss did not differ significantly between VEBL and CEBL.[56]

This study adds to the evidence that the visual estimation of blood loss in clinical settings is not reliable and can lead to misdiagnosis of postpartum haemorrhage. This has serious implication because of the fact that most of the cases of maternal mortality due to PPH indicate that delay in recognition of PPH is a contributing factor in maternal death.[56]

Because of this, many researchers have included rapid identification and treatment of PPH as a means to reduce maternal mortality and morbidity. Postulated method of rapid identification of PPH include calculation or quantification of blood loss, but there is limited studies to assess its feasibility, effectiveness and consequencies.[56]

Observed in this study was that the difference in blood loss estimation between visual estimated blood loss method and calculated method was found to decrease as the study progressed such that it was almost insignificant at the end of the study. This showed that repeated estimations can improve accuracy. This was in agreement with the study done by Hanan MA et.al in which it was shown that a simple and consistent education program can help to overcome typical blood loss estimation inaccuracies.[66] Toledo et al in a study that assessed live and web based education on the accuracy of blood loss estimation also recorded the same observation.[30]

The relationship between the covariates (birth weights and parity) and the blood loss was explored.

Cross tabulation between visually estimated blood loss and birth weight did not show any significant relationship. Most of the patients lost blood in both groups between 200-400mls. In this study, the volume of blood loss did not depend on the birth weight except in situations where they were genital tract lacerations. Birth weight did not have any effect on the visual estimation of blood loss after vaginal delivery in this study. This is in agreement with the study done in Latin American population by Claudio G. Sosa et al.[65] In which it was shown that many of the risk factors of postpartum haemorrhage are related to complications of the second and third stage. However it is in disagreement with many previous studies where it have been cited that increasing birth weight is an important risk factor for postpartum haemorrhage.[62,64]

Cross tabulation between the visually estimated blood loss and Parity did not show any linear relationship in this study. This was contrary to the belief that increasing parity causes increasing blood loss.[63] This was only observed in situations where they were associated genital tract lacerations.

6. Conclusion and Recommendations

Visual estimation of blood loss after vaginal delivery is inaccurate when compared with calculated blood loss method but there exists a weak positive correlation

between the two methods in estimating blood loss after vaginal delivery.

Regular education and training may assist clinicians in every day practice to more accurately estimate blood loss and recognize patients at risk for haemorrhage related complications as appearance of clinical signs due to blood loss may be too late.

It was also observed in this study that repeated estimations can improve accuracy of visual blood loss estimation after vaginal delivery.

Recommendations

Active management of third stage of labour should be routinely employed in our labour wards for all deliveries in other to minimize blood loss after vaginal delivery since there is no perfect or near perfect method available in our center to accurately determine blood loss after vaginal delivery.

Every doctor or midwife delivering a pregnant woman should understand that visual estimation of blood loss is inaccurate. Other measures like use of measuring tools and calibrated drapes should be used in the labour wards during deliveries instead of non calibrated drapes. This can help minimize error in visual estimation.

Regular education of caregivers on the estimation of blood loss using simulations will also help reduce the error margin.

Strengths and Limitations of the Study

Strengths of the study

Relative ease in carrying out the study.Well organized labour and delivery unit with experienced midwives. Large number of patients delivering in the labour ward. Potential benefit to the hospital in developing a protocol for diagnosing postpartum haemorrhage. Relatively inexpensive to carry out.

Limitations

This is a hospital based study, therefore patient's characteristics and findings may not properly represent the entire population. Lack of true gold standard in measuring blood loss since the calculated blood loss method may be affected by hydration status of the patient. Contamination of blood by body fluids may give error in the data collection. Maternal physiologic blood volume change may change haematologic values. Interpersonal error may arise during data collection.

Contribution to knowledge

Visually estimated blood loss after vaginal delivery when compared with calculated method is inaccurate. Knowledge of this should guide the health worker to anticipate this and be proactive in the management of postpartum haemorrhage by anticipating it and making early diagnosis so that prompt action will be taken.

Declarations

Confidentiality

Confidentiality of information exchange with the subject was observed and will remain with the subject and the researcher. The result of this study will be submitted to the National postgraduate medical college of Nigeria in part fulfillment of the requirement for the award of fellowship of the National postgraduate medical college of Nigeria. It may also be published in a medical journal for improvement of knowledge.

Study hazards

A universal precaution was observed all through the period of this study. Some patients experienced mild pain during the venepuncture**.**

Potential benefits

There was no financial reward to the subjects.

Declaration of conflict of interest

There was no conflict of interest in this study.

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