IJSCIA

International Journal of Scientific Advances
ISSN: 2708-7972
Volume: 5 | Issue: 4 | Jul – Aug 2024 Available Online: www.ijscia.com
DOI: 10.51542/ijscia.v5i4.19

Quantification of Blood Loss in Obstetric Haemorrhage: An Overview of The Gravimetric Method and Its Practical Application

Theophilus Ben Sabi MD[1*] & Gideon Nomafo Duku MD[2]

[1]Princess of Wales Hospital, Obstetrics,
Gynaecology and Sexual Health Department, Bridgend, Wales

[2]Greater Accra Regional Hospital, Obstetrics and Gynaecology Department, Accra, Ghana

E-mail: tbsaye@gmail.com; dongiddy@ymail.com

*Corresponding author details: Theophilus B. Sabi; tbsaye@gmail.com

ABSTRACT

Postpartum haemorrhage continues to plague the world and rob families and nations of their loved ones. Even though there has been a downward trend in the global burden of maternal mortality from postpartum haemorrhage, it continues to be the most common cause of maternal mortality especially in developing countries, though it is considered largely preventable. Ways of prevention of postpartum haemorrhage include adequate risk stratification of patients, early identification, and timely management of cases and their complications. Early identification depends mainly on the effective measurement of blood loss in the peripartum period. With advances in medicine and science, knowledge of the management of postpartum haemorrhage and access to drugs and transfusion services are more available. However, knowledge and application of accurate means of blood loss measurement have not seen the same level of adoption, especially in developing countries. This review intends to shed light on the strong evidence available for how accurate the gravimetric method is at the detection of blood loss in obstetric patients and provide a practical guideline to help institutions adopt it in their everyday practice.

Keywords: postpartum haemorrhage; quantitative method; gravimetric method

INTRODUCTION

One of the important goals of the United Nations Millennium Development Goals (MDG) and Sustainable Development Goals (SDG) is reducing maternal mortality[1,2], of which postpartum haemorrhage is an important cause.

According to the World Health Organisation (WHO), postpartum haemorrhage (PPH) has been defined as greater than 500 ml estimated blood loss at a vaginal delivery or greater than 1000 ml estimated blood loss at the time of cesarean section[3] or any blood loss after childbirth capable of causing hemodynamic instability and/or requiring blood transfusion for its control. Primary postpartum haemorrhage is bleeding that occurs in the first 24 hours after delivery, while secondary postpartum haemorrhage is defined as bleeding that occurs 24 hours to 12 weeks after delivery[3,4,5].

The Royal College of Obstetricians & Gynaecologists (RCOG), classes PPH as minor when estimated blood loss is between 500 and 1,000 ml and major PPH when estimated blood loss is more than 1,000 ml. Major PPH can also be divided into controlled, where blood loss, though major, is controlled and persistent, in cases of compromised health of the mother, such as to cause imminent danger to her life[3].

Postpartum haemorrhage (PPH) is the leading cause of maternal mortality and morbidity worldwide and about 25% of deaths that occur during pregnancy and the peripartum period are caused by PPH[5]. According to the global report on maternal mortality by the World Health Organisation, maternal mortality has decreased by almost 44% in the last 25 years worldwide: from 532,000 deaths in 1990 to 303,000 in 2015, with an estimated global maternal mortality ratio of 216 deaths per 100,000 deliveries, compared to 1990 when the global maternal mortality ratio was 385[5].

The decline in maternal death is due to improved care during the antenatal and peripartum periods [6].

99% of global maternal deaths occur in developing countries, with 66% of cases in sub-Saharan Africa alone. In these countries, the risk of maternal mortality caused by PPH is 1 per 1,000 deliveries, about 100 times higher than the rate observed in the western countries who have an average of 1 death from PPH per 100,000 deliveries[3,5,6,7].

BACKGROUND

With the burden of PPH on maternal mortality, there is no doubt that a focus on prevention and adequate management of PPH can reduce maternal mortality. One way of doing this is an adequate diagnosis of PPH. This is only possible with accurate measurement of blood loss. The most commonly cited diagnostic methods of PPH include visual estimation of bleeding, weighing of compresses and drapes-gravimetric method, use of graduated and calibrated collecting devices, and use of clinical parameters. In the past, blood loss has only been estimated using visual means. Now, there is a move away from estimation to measurement, using quantitative means.

Visual estimation of blood loss during childbirth was the main method of determining the amount of blood loss till recent times. However, visual estimation has been found to be subjective and very inaccurate. Most studies that have compared visual estimation to quantitative measurement have found that visual estimation is more likely to underestimate the actual blood loss when the volumes are high and overestimate when volumes are low[8,9,10]. To improve visual estimation of blood loss, visual tools for volume comparisons have been developed and studied.

These tools have failed to consistently improve the accuracy of visual estimation. One study demonstrated improved accuracy with visual estimation of blood loss through a training program, but a more recent study showed deterioration of skill within 9 months of training completion. Visual estimation of blood loss does not also appear to improve with health care provider specialty, age, or clinical experience[10,11,12].

Visual estimation has been compared to quantitative methods in both clinical and simulated scenarios and the accuracy of blood loss assessment has been shown to improve with quantitative measurement techniques[8,9,10]. In a prospective cohort study that included 150 women, the gravimetric method was compared to the visual estimation method. Visual estimation of blood loss was associated with an error of 30% compared with the gravimetric method [12]. Other studies have also shown that quantitative methods are more likely to diagnose postpartum haemorrhage[13,14,15].

This then aids in proper timely escalation which can affect clinical outcomes [16] and reduce the use of additional interventions such as uterotonics especially if used in real-time [17].

Aside from the benefit of diagnosing and managing PPH with quantitative methods, it has benefits for morbidity as well. One study found a significant reduction in length of stay between quantified blood loss and estimated blood loss [18].

Most studies that have been conducted have focussed on how accurate quantitative methods are rather than impact on maternal mortality and more studies are needed [15].

PRACTICAL APPLICATION

First introduced by Hercus and Associates in 1961- where they explored its use in various surgical procedures, it has grown to be a well-established and accurate means of measuring blood loss. It assumes that the 1g weight of blood is equivalent to 1ml of blood though in actual sense, 1ml of blood is 1.06g of blood.

There are different aspects to consider in order to institute properly, the gravimetric method. In low-middle-income countries, because of limited resources, A purely gravimetric model can be employed. However, most advanced hospitals use a combination of both models.

The important thing is the need to accurately measure blood loss actively in order to help put in a timely intervention. If the blood loss is given in real-time, it helps with good planning in the intrapartum and immediate post-delivery period.

Risk Assessment

Being aware if a pregnant woman is at risk of bleeding is very important as it puts you in an alert mode whenever bleeding becomes excessive and lets you act pro-actively. Measuring blood loss during and after delivery is important but being able to assess the risk of a pregnant woman even before delivery is as important in order to reduce the amount of blood you actually have to measure. An example of such risk scoring system can be found in Figure 1 below.

PPH RISK ASSESSMENT

STAGE 0

Most Recent Hb____ Plt ____

Antenatal Risk

Aneamia/Bleeding disoder(hb<95/plt<100)	
BMI <18 or >35	
>4 previous vaginal births	
Previous uterine surgeries	
Multiple pregnancy or EFW of >4.5	
Abnormal placentation	
Polyhydramnious	
Known abruption or antepartum haemorrhage	

Intrapartum Risk Factors

Suspicion of chorioamnionitis/sepsis	
Labour augmented with syntocinon	
Prolonged labour	
Instrumental delivery	
Retained Products of conception	

FIGURE 1: Adapted from the Obstetric Bleeding Strategy for Wales.

The Human Resource

Most facilities that would be looking for a change to the quantitative method would have been using the visual estimation method for a long time and there would need to be a shift in culture and participation of all cadre of health personnel involved delivery of women.

Every system needs a human resource to function. The human resource needs adequate training to be able to institute this well. There needs to be training of all the personnel involved. The evidence for how accurate the quantitative method is needs to come out. Because most maternal mortalities occur in less developed countries, with postpartum haemorrhage being a significant cause, it shouldn't be difficult to get the message across. Those who require training will include midwives, healthcare assistants, doctors, and anesthetists.

Students who rotate through the department will be exposed to this method for their benefit but for new workers who may not have experienced this method, they will need to have training in order to be at par with the rest of the team. This training can be delivered as part of a multi-professional training program or can be given on an individual basis.

The Logistical Aspect

The dry weight of all swabs and mops should be known-both large and small. This can then be compiled into a list and put in the delivery rooms and operating theatres. A cumulative chart, that allows the addition of any measured blood loss that occurs can also be developed. An example is shown in Figure 2. We suggest getting a scale that is accurate to at least 2 decimal places (Figure 3).

Measured Blood Loss (MBL) **Date:** 10/07/2024

(To be completed for ALL births wherever possible)

Type of birth: SVD LSCS – Emergency/ Elective Instrumental- Vent / Forceps Time of birth: 9:26

Time	Type (small swabs, suction, inco etc)	Gross Weight (g)	Dry Weight (g)	Blood weight (ml)	Cumulative Loss (ml)
9:20	Small swab	8	4	4	4
9:32	large mop	250	204	46	50
9:48	large mop	264	204	60	110
9:55	Small swab	7	4	3	113
+	Suction Jars up to 2 litres	----------	QTY in mls =	200	313
Total					313

To calculate blood loss: Gross Weight - Dry Weight

TOTAL MEASURED BLOOD LOSS =...313...ml

- MBL > 500ml, call for help and commence Stage 1 of the PPH Management Checklist
- MBL > 1000ml commence Stage 2 of the PPH Management Checklist
- MBL > 1500ml commence Stage 3 of the PPH Management Checklist and activate massive haemorrhage protocol

FIGURE 2: Cumulative Summary of Blood Loss Can Be Recorded- Adapted From the Obstetric Bleeding Strategy for Wales.

The first thing recorded is the time it was measured, then what was measured. With the gravimetric method, the dry weight of all swabs will be known already so that is inputted in the dry weight section. The difference between the gross weight and the dry weight in grams is the measured blood loss in millilitres (ml).

FIGURE 3: Example of A Weighing Scale Used for The Gravimetric Method.

The Process

Implementation of a quantitative assessment of blood loss includes the following two items: 1) use of direct measurement of blood loss (quantitative blood loss) and 2) protocols for collecting and reporting a cumulative record of blood loss post-delivery [19].

Methods differ for vaginal and caesarean section

For vaginal deliveries, there wouldn't be much blood loss before delivery of the baby unless it is a case of Antepartum haemorrhage or an episiotomy is given. Swabs used in these circumstances need to be considered for weighing. Following delivery, the amniotic fluid usually gathers in a collecting basin or an underbuttock drape. Immediately after the delivery of the baby and cutting of the cord, the underbuttock drape would have to be changed and considered for measurement if there is a lot of blood mixed with liquor. The delivery of the placenta would in no doubt result in some bleeding and any clots expelled unto the underbuttock drape would have to be weighed. If there is a perineal tear that requires suturing, then those swabs used during this time would be kept for weighing. Depending on how brisk the bleeding is, the underbuttock drape may have to be changed once or twice in order to get accurate real-time measured blood loss.

During a caesarean section, swabs used during the start of the caesarean section need to be put away for weighing, immediately before the incision of the uterus in order to prevent them from being soaked with amniotic fluid. Once the uterus is incised and the baby has been delivered, the amniotic fluid needs to be sucked away from all accumulation around the surgical field. Once this is done, if a 2-canister suction tube is being used, then it can simply be switched to the empty canister. In the case where only one canister suction tube is being used, then the amount of fluid in it needs to be noted so any additional fluid will be recorded as blood loss. All swabs used afterward are also weighed.

In both vaginal and caesarean sections, one person needs to be dedicated to the measurement and recording of blood loss.

In special circumstances where a quick turnaround time in measurement is needed, like in the case of a placenta praevia, then the scrub nurse may have to weigh it by herself. This means a sterile set-up with the weighing scale will have to be put in place before the start of the case.

It is important to measure the swabs as soon and feasible as can be, in order to prevent evaporation of fluid from the swabs. During the measurement, folding the swabs so the centre of gravity is in the middle of the swabs is also important in order to get an accurate weight.

In the immediate postpartum period, measurement of blood loss can continue as long as there is ongoing active bleeding or if the patient is unstable[20,21].

Challenges

Even though the quantitative measurement of blood loss is very accurate, it presents some challenges. In some cases, not all bleeding is quantifiable by weighing. Some under-sheets may be stained by amniotic fluid and later by blood and may not represent an accurately measured blood loss therefore visual estimation may have to be relied upon. Also, during a caesarean section, after the incision of the uterus, when there are active vessels that are bleeding, especially from the uterine angles, they mix with the amniotic fluid which is eventually suctioned and visual estimation may be needed to subtract the blood from the suctioned amniotic fluid. It may also be difficult to change a very soaked under a sheet during a caesarean section and get an accurate live measured blood loss.

There needs to be regular maintenance of logistics including the weighing scale to manufacturer standard.

Also, Procurement of swabs will have to be from the same supplier. A system needs to be developed such that if a different kind of swab is supplied, it will trigger an alert system because the dry weight will change. In financially challenged facilities, they tend to develop their own swabs. Machine cutting of the swabs to produce a consistent weight of swabs is ideal.

Patients also can't be allowed to bring their own undersheets to the hospital as they would purchase different brands of undersheets and there would be inconsistencies in dry weights

CONCLUSION

Postpartum haemorrhage continues to burden the world. Early diagnosis is an important measure in prevention because it allows timely intervention. The evidence for the accuracy of the gravimetric method in obstetric blood loss is strong and can prove pivotal when adopted. More research is however needed to provide evidence as to how its use translates to a reduction in maternal mortality.

AUTHOR'S CONTRIBUTIONS

Each named author has substantially contributed to the underlying research and has approved the manuscript.

CONFLICT OF INTEREST

This manuscript has not been published and is not under consideration for publication elsewhere. We have no funding and none of the authors have any conflict of interest, financially or otherwise.

REFERENCES

[1] United Nations. United Nations Millennium Development Goals and Beyond 2015. Available at: http://www.un.org/millenniumgoals/matenal.shtml

[2] United Nations. United Nations Sustainable Development Goals. Available at: https://www.un.org/sustainabledevelopment/health/

[3] Say L, Chou D, Gemmill A, Tunçalp Ö, Moller A-B, Daniels J, et al. Global causes of maternal death: a WHO systematic analysis. Lancet Glob Health. 2014;2: e323–333. PubMed id:25103301 https://doi.org/10.1016/s2214-109x(14)70227-x

[4] World Health Organization, United Nations Children's Fund, United Nations Population Fund. Appropriate Storage and Management of Oxytocin–a Key Commodity for Maternal Health. https://www.who.int/publications/i/item/WHO-RHR-19.5

[5] The DHS Program. Demographic and Health Surveys Program. 2022 https://doi.org/10.59350/6cvkt-8hs45

[6] WHO. World Health Organization. Recommendations for the Prevention and Treatment of Postpartum Hemorrhage. Geneva: World Health Organization, 2012. https://www.who.int/publications/i/item/9789241548502

[7] Haeri S, Dildy GA 3rd. Maternal mortality from haemorrhage. Semin Perinatal. 2012 Feb; 31(1); 48-55. doi; 10.1053/j.semperi.2011.09.010. PubMedID: 22280866 https://doi.org/10.1088/1475-7516/2011/09/010

[8] Larsson C, Saltvedt S, Wiklund I, Pahlen S, Andolf E. Estimation of blood loss after cesarean section and vaginal delivery has low validity with a tendency to exaggeration. Acta Obstetricia Gynecologica Scandinavia 2006; 85: 1448– 52. https://doi.org/10.1080/00016340600985032

[9] Hancock A, Weeks AD, Lavender DT. Is accurate and reliable blood loss estimation the "crucial step" in early detection of postpartum haemorrhage: an integrative review of the literature. BioMed Central Pregnancy Childbirth 2015; 15: 230. https://doi.org/10.1186/s12884-015-0653-6

[10] Andrikopoulou M, D'Alton ME. Postpartum hemorrhage: early identification challenges. Seminars in Perinatology 2019; 43: 11– 7. https://doi.org/10.1053/j.semperi.2018.11.003

[11] Toledo P, Eosakul ST, Goetz K, Wong CA, Grobman WA. Decay in blood loss estimation skills after web-based didactic training. Simulation in Healthcare 2012; 7: 18– 21. https://doi.org/10.1097/sih.0b013e318230604f

[12] Al Kadri HM, Al Anazi BK, Tamim HM. Visual estimation versus gravimetric measurement of postpartum blood loss: a prospective cohort study. Archives of Gynecology and Obstetrics 2011; 283: 1207– 13. https://doi.org/10.1007/s00404-010-1522-1

[13] Lertbunnaphong T, Lapthanapat N, Leetheeragul J, Hakularb P, Ownon A. Postpartum blood loss: visual estimation versus objective quantification with a novel birthing drape. Singapore Medical Journal 2016; 57(6): 325– 328. doi:10.11622/smedj.2016107.https://doi.org/10.11622/smedj.2016107

[14] Rubenstein AF, Zamudio S, Al-Khan A, Douglas C, Sledge S, Tully G, et al. Clinical experience with the implementation of accurate measurement of blood loss during cesarean delivery: influences on hemorrhage recognition and allogeneic transfusion. American Journal of Perinatology 2018; 35: 655– 9. https://doi.org/10.1055/s-0037-1613675

[15] Katz D, Wang R, O'Neil L, Gerber C, Lankford A, Rogers T, et al. The association between the introduction of quantitative assessment of postpartum blood loss and institutional changes in clinical practice: an observational study [preprint]. International Journal of Obstetric Anesthesia 2019; DOI:10.1016/j.ijoa.2019.05.006.https://doi.org/10.1097/01.aoa.0000732444.00795.35

[16] Powell E. James D. Collis R. Collins P.W. Pallmann P. Bell S. Introduction of standardized, cumulative quantitative measurement of blood loss into routine maternity care. Journal of Maternal-Fetal & Neonatal Medicine. 2020; (Advance online publication): 1-7 https://doi.org/10.1080/14767058.2020.1759534

[17] Hire M.G. Lange E.M.S. Vaidyanathan M. Amour K.L. Toledo P. Effect of quantification of blood loss on activation of postpartum hemorrhage protocol and use of resources. Journal of Obstetric, Gynecologic, & Neonatal Nursing. 2020; 49: 137-143 https://doi.org/10.1016/j.jogn.2020.01.002

[18] Ayala M, Nookala V, Fogel J, Fatehi M. Visual estimation of blood loss versus quantitative blood loss for maternal outcomes related to obstetrical hemorrhage. Proc (Bayl Univ Med Cent). 2023 Mar 13;36(3):341-345. doi: 10.1080/08998280.2023.2187248. PubMed ID: 37091754; PMCID: PMC10120519. https://doi.org/10.1080/08998280.2023.2187248

[19] Main EK, Goffman D, Scavone BM, Low LK, Bingham D, Fontaine PL, et al. National Partnership for Maternal Safety: consensus bundle on obstetric hemorrhage. National Partnership for Maternal Safety, Council on Patient Safety in Women's Health Care [published erratum appears in Obstet Gynecol 2015;126:1111]. International Journal of Gynaecology and Obstetrics 2015; 126: 155– 62. https://doi.org/10.1097/aog.0000000000000869

[20] Postpartum hemorrhage. Practice Bulletin No. 183. American College of Obstetricians and Gynecologists. Obstet Gynecol 2017; 130: e168–86.https://doi.org/10.1097/aog.0000000000002351

[21] American Academy of Pediatrics, American College of Obstetricians and Gynecologists. Guidelines for perinatal care . 8th ed. Elk Grove Village (IL): AAP; Washington, DC: American College of Obstetricians and Gynecologists; 2017. https://doi.org/10.1542/9781610020886-appendix_h