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Accuracy of Blood Loss Determination after Vaginal Delivery: Visual Estimation versus Calibrated Measurement

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Authors' contributions

This work was carried out in collaboration with all authors. Authors CAT, DNMO and WKBAO conceived the idea, designed the study, wrote the protocol, managed literature searches, wrote the first draft of the manuscript and revised the manuscript. Authors CAT and DNMO performed experiments and author WKBAO managed the experimental process. All authors read and approved the final manuscript.

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ABSTRACT

Background: The ability to determine accurately, the blood loss during childbirth is of extreme importance in the diagnosis and management of primary postpartum haemorrhage (PPH).
Aims: In this study, we evaluate the effectiveness of visual estimation of blood loss, as a method of diagnosing primary postpartum haemorrhage.
Methodology: A cross-sectional study on 271 participants was conducted between April and October 2012, at the Komfo Anokye Teaching Hospital. Women who went through spontaneous

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vaginal delivery were monitored and blood loss after delivery was visually estimated and then measured with a graduated receptacle, up to 1 hour post-delivery. The paired t-test and Bland-Altman plot was used to compare outcomes of the two methods. P<0.05 was considered significant.

Results: Mean age of study participants was 27.7±5.7. As per visual estimation, most participants were reported to have lost <200 ml of blood (45.0%) as opposed to that of measured losses where most participants had lost between 200-500 ml of blood (48.7%). The mean measured blood loss was 306.09±218.39 ml against a 250±188.78 ml mean visually estimated blood loss (P < 0.0001). Prevalence of primary PPH as estimated with measured blood losses was 20.3% (55/271). Visual estimation, however gave a prevalence of 15.9% (43/271), an underestimation by 4.4%. A Bland-Altman plot showed a clinical bias large enough to cause significant differences in diagnosis of primary PPH.

Conclusion: This study adds to existing evidence that the visual estimation of blood loss in clinical settings underestimates losses and is not reliable. This can lead to misdiagnosis of primary PPH and thus an underestimation of the condition. Health care workers should therefore base diagnosis on calibrated measurement methods.

Keywords: Visual estimation; calibrated measurement; blood loss; vaginal delivery.

1. INTRODUCTION

Morbidities of pregnancy and childbirth are among the leading causes of maternal mortality in the world, and most of these deaths occur in developing countries [1,2]. Among the various causes of maternal mortality, postpartum haemorrhage (PPH) has historically been the single most important and still is today [3].

PPH is defined as a loss of 500 ml or more of blood during and after vaginal delivery or a blood loss greater than 1000 ml through a caesarean section. If it occurs within 24 hours postpartum, it is known as primary PPH [4,5].

It is however noteworthy that there are challenges associated with the definition, as it is based on a cut-off blood loss of 500 ml or more. This means that any amount of blood loss below this volume is tolerable and does not constitute PPH. However, this is contentious, as in certain areas where prevalence of anaemia and hypertension in pregnancy are high, women who lose as little as about 250 ml of blood may constitute a serious clinical problem [5,6]. Conversely, in the developed world, women may lose about this same amount and face no significant morbidity. As such, any amount of blood loss during childbirth that compromises the haemodynamic status of the patient also constitutes PPH.

By definition, the ability to determine accurately, the blood loss during childbirth is of extreme importance in the diagnosis and management of PPH [7]. Traditionally, blood loss is visually estimated by a health care provider, who makes a quantitative estimate, but this is liable to subjective variations [8]. Measurement methods are used in clinical settings but have not been widely adopted, as they need more effort, time and cost. It has been suggested that visual estimation of the exact amount of blood loss is subjective and hence there is no gold standard method for estimation in most facilities [7,9]. This can lead to underestimation of PPH by up to 50% [5].

In this study, we sought to evaluate the accuracy of visual estimation, compared to a graduated measurement, as methods of postpartum blood loss measurement and in the diagnosis of primary PPH.

2. METHODOLOGY

2.1 Study Design, Site and Participants

This cross-sectional study was conducted between April and October 2012. Two hundred and seventy-one (271) pregnant women who were on admission to deliver at the Komfo Anokye Teaching Hospital (KATH), Kumasi, Ghana were recruited via consecutive sampling. KATH is the major referral centre of the Ashanti Region of Ghana and serves as a source of primary health care to most inhabitants, both within and outside the metropolis.

Vaginal delivery as per observation by midwives and Obstetricians/Gynaecologists were subject to favourable clinical conditions for vaginal delivery. Otherwise, patients went through a

planned or emergency caesarean section. The sample size was calculated using the formula; $n = \frac{t^2 \times p(1-p)}{m^2}$ Where n = required sample size, t = confidence level at 95% (standard value of 1.96), p = estimated prevalence of PPH (8.6%) [10], m = margin of error at 5% (standard value of 0.05).

2.2 Eligibility

Participants reporting to the labour ward of the KATH Obstetrics and Gynaecology department were eligible for the study. To qualify for recruitment, participant must have undergone vaginal delivery, with singleton pregnancy and willing to consent. As the assessment of blood loss was the main subject matter and not the obstetric procedure, nulliparous, primiparous and multiparous women were all included.

Women not willing to consent, undergoing planned or emergency caesarean section, with antepartum haemorrhage, pregnancy induced hypertension or pre-eclampsia, episiotomy, instrumental deliveries and haemoglobin < 7 g/dl (severe anaemia) [11] were excluded. Patients who bled after initial blood volumes had been estimated were excluded from the analysis and final presentation of data.

2.3 Ethical Consent

The study was approved by the Committee on Human Research, Publication and Ethics (CHRPE) of the Kwame Nkrumah University of Science and Technology (KNUST)/ School of Medical Sciences (SMS) and the Research and Development unit of the KATH; CHRPE/AP/066/12.

2.4 Data Collection

Deliveries were done on a “linen saver”. The amniotic fluid was allowed to drain away and blood was allowed to collect into a graduated receptacle (Fig. 1). Blood loss is usually estimated in the facility by both visual estimation and graduated measurement although visual estimation is practiced more often. To avoid inter-observer bias, visual estimation was done by one skilled midwife. The midwife made a visual estimation of the blood loss from the onset of the third stage of labour to the end of stoppage of active bleed or up to 1 hour post-delivery, whichever was earlier. The blood drained into the graduated receptacle and blood loss was measured at the end of 1 hour, blinded to the midwife.

Blood volume estimations included blood clots and minor spillages were estimated approximately. As a standard practice at the labour ward of the KATH, patients who require oxytocin had it administered when appropriate.

2.5 Criteria

Diagnosis of primary PPH was based on vaginal delivery with a measured blood loss of 500 ml or more up to one hour post-delivery. Vaginal delivery with a measured blood loss of less than 500 ml but enough to cause signs of haemodynamic compromise (e.g. chest discomfort, dyspnoea, weakness, syncope, decreased level of consciousness, dizziness, hypotension diaphoresis and pulmonary congestion) also constituted primary PPH [4,5].

2.6 Data Handling and Statistical Analysis

Data was entered into a Microsoft Excel worksheet and analysed using the Graph Pad Prism software (GraphPad software, San Diego California USA).

Data is presented as mean ± SD for normally distributed data and as median (IQR) for skewed data**.** Summary statistics was performed and the paired t-test was used to compare means of blood losses. A Bland-Altman plot was used to compare the two methods as measures of blood loss after vaginal delivery and in the diagnosis of primary PPH. A value of $p < 0.05$ was considered statistically significant.

3. RESULTS

Mean age of study participants was 27.7±5.7 and most were nulliparous (38.7%). Baseline characteristics of study participants at recruitment are shown in Table 1.

In Table 2, mean blood loss of study participants stratified by different groups is shown. As per visual estimation, most participants were reported to have lost <200 ml of blood (45.0%) as opposed to that of measured losses where most had lost between 200-500 ml of blood (48.7%). Prevalence of primary PPH as estimated with measured blood losses was 20.3% (55/271). Visual estimation, however gave a prevalence of 15.9% (43/271), an underestimation by 4.4%.

The mean measured blood loss was 306.09±218.39 ml against a 250±188.78 ml visually estimated blood loss (*P* < .0001) (Table 3).

A Bland-Altman plot to further compare the two methods as measures of blood loss showed a clinical bias, large enough to cause significant differences in diagnosis. As the average of both methods and of the measured blood loss increased, the scatter and difference between the two methods decreased. This indicates an underestimation by visual estimation (Fig. 2).

Fig. 1. Delivery setup used for blood loss estimation

Left: Before measurement the amniotic fluid drains away into waste. Right: after amniotic fluid drains away; graduated receptacle is placed in position for blood collection and measurement

Table 1. Baseline characteristics of study participants

Parameters	All women (n=271)
Mean Age±SD	27.7±5.7
Medianparity *(IQR)*	1 (0,2)
Nulliparous *n (%)*	105 (38.7)
Primiparous *n (%)*	63 (23.2)
Multiparous *n (%)*	103 (38)
Induced abortions *n (%)*	109 (40.2)
History of PPH *n (%)*	18 (6.6)
Weight (kg)*median (IQR)*	70 (61,79)
Height (cm) *median (IQR)*	160 (156.2,165)
BMI *median (IQR)*	25 (24,28)
Temperature (ºC) *median (IQC)*	36.2 (35.6,36.5)
Pulse (bpm) *median (IQR)*	90 (81,96)

SD= Standard deviation. IQR= Interquartile range. BMI= Body Mass Index. n= number

Table 2. Mean blood losses of study participants stratified by different groups

	Visual estimation	Measured losses
<200 *(ml)*	122 (45.0%)	90 (33.2%)
200-500 *(ml)*	115 (42.4%)	132 (48.7%)
>500 *(ml)*	34 (12.5%)	49 (18.1%)
Primary PPH	43 (15.9%)	55 (20.3%)

Table 3. Comparison of direct calibrated measurement and visual estimation

Parameters	Measured losses	Visual estimation	P value
Observations *(n)*	271	271	
Minimum volume *(ml)*	50.00	100.00	
Maximum *volume (ml)*	1050.00	900.00	
Mean *(ml)*	306.09	250.40	
SD	218.39	188.78	
Bias *(ml) mean*±SD	55.68266±47.3384		< 0.0001

SD= Standard deviation. n= Number

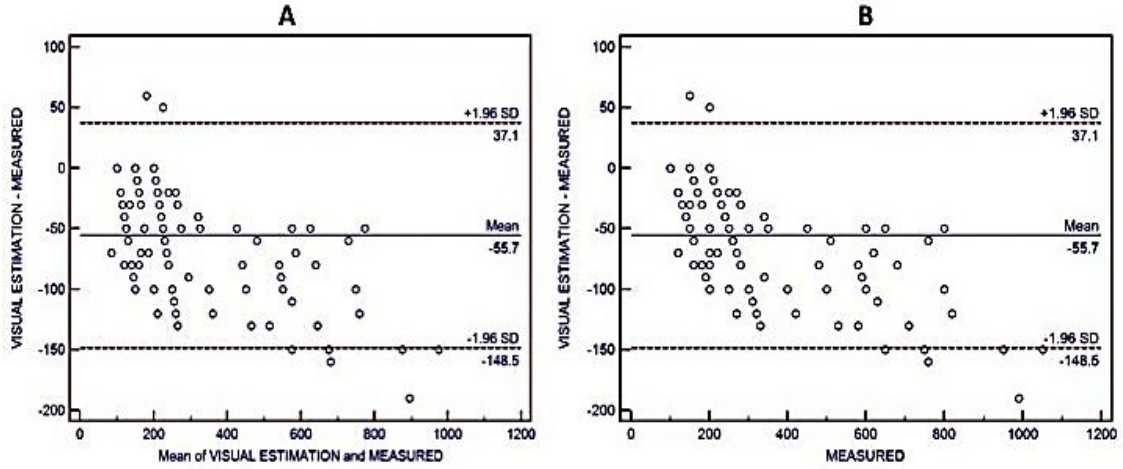

Fig. 2. Bland-Altman plot of visual estimation against measured blood loss. A: plot against mean of the methods. B: plot against the measured blood loss (standard)

4. DISCUSSION

Traditionally, blood loss in the third stage of labour when visually estimated, comes with variations in accuracy, mainly due to subjective observation. In this study, the mean measured blood loss was 306.09±218.39 ml against a 250 ± 188.78 ml mean visually estimated blood loss and this was statistically significant. Prevalence of primary PPH as estimated with measured blood losses was 20.3% against a 15.9% by visual estimation, an underestimation by 4.4%. Our findings indicate that visual estimation is unreliable for the diagnosis of primary PPH, and underestimates blood losses.

In similar studies, [12,13] it was found that actual blood loss was higher than visually estimated blood loss during vaginal births. This underestimation by visual estimation increased as the quantity of blood loss increased. This reflects in a variation in the prevalence of primary PPH as observed in the present study. In a similar study, the prevalence of PPH was found to be 8.9% and 16.2% by visual estimation and with changes in haematocrit respectively [14]. Carroli and colleagues confirmed this with a systematic review, where in about 19 studies that accurately measured the blood loss, prevalence was found to be 10.5% compared to 7.23% in 22 others, which estimated blood loss by visual examination [10].

The observed rate of underestimation of primary PPH in the present study, is however lower than that reported in a study conducted by Prasertcharoensuk et al. [15] who compared visual estimation with direct measurement of blood loss during vaginal births. The incidence of PPH was underestimated in the visual estimation by 89%. The smaller difference in prevalence of primary PPH between the two methods, as observed in the present study, could be due to the fact that midwives are relatively accurate in estimating blood loss as reported by Kavle et al. [16]. According to this study, nurse-midwives' ability to estimate blood loss during birth was as accurate as within 5 ml of a laboratory determination.

Notwithstanding, there have been opposing views to the observed findings in the present study. Razvi et al. [17] found that the estimated blood loss was 20% greater than the measured blood loss in 57% of vaginal births. The tendency to underestimate visually however, was persistent, especially when the loss was > 300 ml. This is consistent with the findings in the present study and that of Prasertcharoensuk et al. [15].

This study adds to evidence that the visual estimation of blood loss in clinical settings is not reliable and can lead to misdiagnosis of primary PPH. The skill of the midwives cannot be discounted, as the difference in prevalence was not as high as reported in other areas. As such in remote areas where transportation to a medical facility is often difficult, estimation of blood loss can be encouraged, to determine when transport is necessary. Traditional birth attendants (TBA) can therefore be educated to begin treatment for haemorrhage and to transport at certain thresholds, as has been encouraged in Tanzania through the use of the “Kanga” [7].

The present study is limited to the consecutive sampling and exclusion of laboratory methods in blood loss estimation. Further studies on whether proper measurement of blood loss can help prevent further delays in the diagnosis and management of primary PPH will be of great importance.

5. CONCLUSION

Visual estimation of blood loss in clinical settings is not reliable and can lead to misdiagnosis of primary PPH and thus an underestimation of the condition. The use of graduated measurement methods is encouraged.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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