Accuracy of blood loss estimation at caesarean delivery

Jagun OE.[1], Akadri AA.[1], Shorunmu TO.[1], Sotunsa JO.[2], Popoola M.[1]

Abstract

Objective: Inaccurate estimation of blood loss during caesarean delivery may be associated with inappropriate decisions in transfusing patients and this may lead to increased maternal morbidity. The study aimed at comparing the accuracy of blood loss estimation by obstetricians and anaesthetists at caesarean delivery.

Methods: This was a cross-sectional retrospective study of 153 women who had caesarean delivery. The anaesthetists and obstetricians involved in the deliveries independently estimated blood loss. The preoperative and 48-hour postoperative haemoglobin concentration values were used to calculate the actual blood loss. The difference in mean blood loss estimates between anaesthetist and obstetricians, and the calculated blood loss was assessed using paired sample t-test. P-value less than 0.05 was deemed statistically significant.

Results: Blood loss estimates by anaesthetists and obstetricians were inaccurate in 78.4% and 80.4% of cases respectively. There was statistically significant difference between blood loss estimates by obstetricians when compared to calculated blood loss (t-test = -2.578; p = 0.011). However, there was no statistically significant difference between blood loss estimates by anaesthetists when compared to calculated blood loss (t-test = -1.665; p = 0.098).

Conclusion: Visual estimation of blood loss at time of caesarean delivery is commonly inaccurate especially at extremes of blood loss. Intra-operative blood loss estimates by anaesthetists correlated better with actual blood loss than estimates by obstetricians.

Keywords: Blood loss, estimation, caesarean delivery, haemoglobin concentration.

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Précision de la perte de sang estimation lors de l'accouchement par césarienne

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Résumé

Objectif: estimation inexacte de la perte de sang pendant l'accouchement par césarienne peut être associée à des décisions inapprpriate chez les patients transfuser et cela peut entraîner une augmentation de la morbidité maternelles. Pour comparer la précision de sang estimation des pertes par obstétriciens et anesthésistes à l'accouchement par césarienne.

Méthodes: Ce fut une étude transversale rétrospective de 153 femmes qui ont eu un accouchement par césarienne. Les anesthésistes et obstétriciens impliqués dans les livraisons estimées indépendamment perte de sang. Le pré-opératoire et de 48 heures hémoglobine postopératoire valeurs de concentration ont été utilisés pour calculer la perte de sang réelle. La différence dans les estimations moyennes de perte de sang entre l'anesthésiste et obstétriciens, et la perte de sang calculée a été évaluée en utilisant un test t de l'échantillon appariés. P-valeur inférieure à 0,05 a été considérée comme statistiquement significative.

Résultats: estimations de perte de sang par les anesthésistes et obstétriciens étaient inexactes dans 78,4% et 80,4% des cas, respectivement. Il y avait une différence statistiquement significative entre le sang des estimations de pertes par Obstétriciens par rapport à la perte de sang calculée (test t = -2,578; p = 0,011). Cependant, il n'y avait pas de différence statistiquement significative entre les estimations de perte de sang par les anesthésistes par rapport à la perte de sang calculée (test t = -1,665; p = 0,098).

Conclusion: L'estimation visuelle de la perte de sang au moment de l'accouchement par césarienne est souvent inexact en particulier à des extrêmes de perte de sang. Peropératoires estimations de perte de sang par les anesthésistes corrélés mieux avec la perte de sang réelle que les estimations par obstétriciens.

Mots-clés: perte de sang, estimation, accouchement par césarienne, la concentration d'hémoglobine.

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INTRODUCTION

Delivery by caesarean section is one of the commonest obstetric operations worldwide (Ramadani, 2004). Nevertheless, it exposes women to the inherent risks of abdominal surgery such as injury to pelvic structures, infections and there may be the need for blood transfusion (Ramadani, 2004). Accurate assessment of blood loss at the time of abdominal delivery is problematic (Dodson *et al.,* 1994). The inevitability of mixture of blood with amniotic fluid during caesarean sections also makes blood loss estimation challenging. Several methods are available for estimation of intra-operative blood loss. These include gravimetric measurement, haemoglobin calorimetry, photometric techniques and volumetric assessment (Wilcox, Hunt and Owen, 1959; Ashrat and Ramadani, 2006). Other modalities of blood loss assessment include alterations in laboratory results (such as haemoglobin or haematocrit levels), mechanical means (drapes, pad counts), radioactive methods and dye dilution techniques (Haswell, 1981; Nelston *et al.,* 1981; Chua *et al.,* 1998). It is clear that the more accurate methods are not readily suitable to the setting of life-threatening situations due to their complexity, unavailability and cost, and so real-time approximations are the most valuable means for early detection of hazardous blood loss (Maslovitz *et al.,* 2008). Visual estimation of blood loss by the operative staff is the prevalent method in spite of being claimed to be notoriously inaccurate by some investigators (Duthie *et al.,* 1991; Young *et al.,* 2010). Preoperative estimation of intra-operative blood loss by both anaesthetist and operating surgeon is a criterion of the WHO's surgical checklist (Solon, Egan and McNamara, 2013). Most authors claim that obstetricians tend to underestimate blood loss by approximately 50% (Duthie *et al.,* 1991).

Inaccuracies in blood loss estimation may eventually lead to inappropriate decisions in transfusing patients and this may lead to low haemoglobin values and hypovolemia with a potential of kidney injury (Beattie *et al*., 2009).

The aim of this study was to compare the accuracy of blood loss estimation by obstetricians and anaesthetists at caesarean delivery.

MATERIALS AND METHODS

This cross-sectional retrospective study involved 153 women who had primary or repeat lower segment caesarean section between 1st January to 31st May, 2014 at Olabisi Onabanjo University Teaching Hospital, Sagamu, Ogun State, Nigeria. Ethical approval for the study was obtained from the Health Research Ethics Committee of Olabisi Onabanjo University Teaching Hospital. The age, parity and educational level of the participants were recorded on a data capture sheet. Information on the category of surgery (elective or emergency), class of surgery (primary or repeat) and the type of anaesthesia used were also recorded. The pre-operative haemoglobin concentration of the participants was assessed and recorded. After each caesarean delivery, blood loss was estimated independently by the obstetrician and the anaesthetist. Amniotic fluid was excluded from the volume assessment by discarding laparotomy pads, sponges and towel soaked mainly with this liquid, and changing suction bottles prior to suctioning blood. The volume of blood in suction apparatus prior to pelvic irrigation was recorded. Blood collected by plastic drapes was suctioned prior to irrigation and also recorded. The amount of blood soaked in laparotomy pads, sponges and gauzes were visually estimated according to the routine of the hospital. The total estimated blood loss was calculated by the summation of the various components. The preoperative and 48-hour postoperative haemoglobin concentration values were used to calculate the actual blood loss. A drop of haemoglobin concentration by 1gm/dl was taken as blood loss of 500mls (Elzik, Dirschl and Dahners, 2006). A blood loss estimate that was within the range of 20% below to 20% above the calculated blood loss was considered a correct estimate (Razvi *et al*., 1996). A blood loss estimate that was greater than 20% above calculated blood loss was regarded as an overestimation while an estimate that was greater than 20% below calculated blood loss was regarded as an underestimation.

Data management and analysis

Data was analyzed using IBM-SPSS windows version 20. Continuous variables were summarized using descriptive statistics such as mean and standard deviation at 95% confidence interval. Categorical variables were summarized by frequencies and percentages. The difference in mean blood loss estimates between anaesthetist and obstetricians, and the calculated blood loss estimate was assessed using paired sample t-test. The association between blood loss estimates by anaesthetists and obstetricians, and calculated blood loss (from haemoglobin concentration)

was assessed using chi-square test. P-value less than 0.05 was deemed statistically significant.

RESULTS

A total of 153 women were recruited for the study. Their ages ranged from 22 – 44years with a mean of 31.4 ± 4.4 years. The mean parity was 1.6 ±1.2 with a range of 0 – 4. With regard to the educational level of subjects, majority (52.9%) attained secondary level education, 25.5% attained primary level education while 21.6% attained tertiary level. Majority (85%) of the subjects had emergency caesarean sections. One hundred and ten (71.9%) of the caesarean sections were primary caesarean sections while 43(28.1%) were repeat caesarean sections. One hundred and fifty (98%) of the caesarean sections were performed under subarachnoid block while the remaining 3(2%) were performed under general anaesthesia.

Table 1 shows the mean blood loss estimate by anaesthetists, obstetricians and calculated estimate from pre- and post-operative haemoglobin concentration. The mean estimated blood loss by anaesthetists and obstetricians were 668.2 ± 459.8mls and 624.1 ± 462.8mls respectively. There was statistically significant difference between blood loss estimates by anaesthetists when compared to estimates by obstetricians (t-test = 4.403; p = 0.000). The mean calculated blood loss was 751.2 ± 801.1mls. There was statistically significant difference between blood loss estimates by obstetricians when compared to calculated blood loss (t-test = -2.578; p = 0.011). However, there was no statistically significant difference between blood loss estimates by anaesthetists when compared to calculated blood loss (t-test = -1.665; p = 0.098).

Table 2 shows the distribution of blood loss estimates by anaesthetists and obstetricians. In higher percentage of cases anaesthetists estimated blood loss to within 20% of calculated blood loss (21.6% vs 19.6%). Similarly, in higher percentage of anaesthetist overestimated blood loss when compared to obstetricians (43.1% Vs 41.2%). However, more obstetricians than anaesthetist underestimated blood loss (39.2% Vs 35.3%).

Table 3 shows the distribution of blood loss estimates by anaesthetist stratified according to calculated blood loss. When the calculated blood loss was less than 500mls, 13% of estimates by anaesthetists were accurate (i.e within 20%); 87% of estimates were overestimation while there were no cases of underestimation. When the calculated blood loss was within 500- 999mls range, (50%) of anaesthetist estimates were accurate. However, when the calculated blood loss was above 1000mls, majority (77.8%) of anaesthetist estimates were underestimations. The pattern of association between blood loss estimates by anaesthstist and calculated blood loss was statistically significant (X^2= 122.356; p = 0.000).

Table 4 shows the distribution of blood loss estimates by obstetricians stratified according to calculated blood loss. When the calculated blood loss was less than 500mls, 17.4% of estimates by obstetricians were accurate (i.e within 20%); 82.6% of estimates were overestimation while there were no cases of underestimation. When the calculated blood loss was within 500- 999mls range, 40% of estimates were accurate while 50% were underestimations. Similarly, when the calculated blood loss was above 1000mls, majority (83.3%) of obstetrician estimates were underestimations. The pattern of association between blood loss estimates by obstetricians and calculated blood loss was statistically significant (X^2= 115.761; p = 0.000).

DISCUSSION

The importance of accurate estimation of blood loss at caesarean delivery cannot be overemphasized. Inadequate circulating blood volume may impair the delivery of oxygen to tissues, cause orthostatic changes and may result in further bleeding due to inadequate haemostatic factors (Dodson *et al*., 1994). Accurate blood loss estimation however facilitates timely resuscitation, minimizes risk of disseminated intravascular coagulation and reduces severity of hemorrhagic shock (Bose, Regan and Paterson-Brown, 2006).

In this study, 78.4% and 80.4% of blood loss estimates by anaesthetists and obstetricians respectively were inaccurate within 20% margin of error. This confirms the widely held assertion that visual estimation of blood loss was inaccurate (Dodson *et al*., 1994, Larsson *et al*., 2006, Young *et al*., 2010). The combination of a failure to closely examine laparotomy pads, suction apparatus and drapes; along with natural tendency to underestimate blood loss are considered to be contributory factors. There were more cases of overestimation of blood loss by anaesthetist whereas underestimation of blood loss was commoner in estimates by obstetricians. The diametrically opposite views may be a trade off between caution on the part of the anaesthetics

and meticulousness on the part of the obstetrician

The mean estimated blood loss by obstetricians was significantly lower than the mean estimation by anaesthetists (624.1ml vs 668.2 ml). Similar finding was reported in a previous study with blood loss estimates of 539 ml and 560 ml by obstetricians and anaesthetists respectively (Ashrat and Ramadani, 2006).

Blood loss was significantly underestimated by obstetrician when compared to calculated blood loss. However for anaesthetists, there was no statistically significant difference between the estimated blood loss and the calculated blood loss indicating that anaesthetists' estimates were better correlated with actual blood loss. Similar finding was also reported in a previous study (Ashrat and Ramadani, 2006). It is also noteworthy that 21.6% of the blood loss estimates by anaethetists were within 20% of calculated blood loss compared to 19.6% of obstetrician estimates. This also indicates that anaesthetists were better in estimating blood loss than obstetricians. It has been postulated that being daily exposed to surgical fields for repeated times with different procedures made anaesthetists more able to give a precise estimated figure for blood loss (Ashrat and Ramadani, 2006).

Blood loss estimates by both anaesthetists and obstetricians were more likely to be accurate when the calculated blood loss was between the range of 500mls – 999mls. It is important to note that the mean blood loss at caesarean delivery is usually within this range (Villeneuve, Khalife and Marcoux, 1990; Ashrat and Ramadani, 2006). When the calculated blood loss was less than 500mls, both anaesthetists and obstetrician tended to overestimate blood loss; however when the calculated blood loss was above 1000mls, blood loss was usually underestimated by both professionals. This pattern of association between blood loss estimates by obstetricians and anaesthetist, and the calculated blood loss was statistically significant. This suggests that visual estimation of blood loss is particularly inaccurate especially at extremes of actual blood loss. This pattern has also been reported in a previous similar study (Razvi et al., 1996). It is believed that visual estimation of blood loss tends to be clouded by the conventional wisdom which suggests that blood loss at caesarean delivery should be between 500 – 999 mls (Razvi et al., 1996).

CONCLUSION

This study has shown that visual estimation of blood loss at time of caesarean delivery is commonly inaccurate especially at extremes of blood loss. Intra-operative blood loss estimates by anaesthetists correlated better with actual blood loss than estimates by obstetricians. The drawbacks of visual estimation should always be kept in mind in clinical situations, vigilance in monitoring women's vital sign is essential to avoid unnecessary morbidities.

The study is limited by the sample size and the result may therefore not be generalizeable. Also the experience of the Anaesthetist and Obstetricians estimating varies which may affect the accuracy of the estimation

Conflicts of Interest: The authors wish to state that there were no conflicts of interest.

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REFERENCES

1. Ashrat AH, Ramadani HM. Assessment of blood loss during caesarean section under general anaesthesia and epidural analgesia using different methods. Alexandria Journal of anaethesia and Intensive Care 2006; 9(1): 25-34.
2. Beattie WS, Karbouti K, Wijeysundera DN, Tait G. Risk associated with pre-operative anaemia in noncardiac surgery: a single centre cohort study. Anaesthesiology 2009; 110: 574-581.
3. Bose P, Regan F, Paterson-brown S. Improving the accuracy of estimated blood loss at obstetric haemorrhage using clinical reconstructions. British Journal of Obstetrics and Gynaecology 2006; 113(8): 919-24.
4. Chua S, Ho LM, Vanaja K, Nordstrom L, Roy AC, Arulkumaran S. Validation of a laboratory method of measuring postpartum blood loss. Gynecologic and Obstetric Investigation 1998; 46:31-3.
5. Dodson MK, Magann EF, Chauhan SP, Harris RL, Martin JN, Morrison JC. Accuracy of

blood loss estimation and measurement at caesarean birth. The Journal of Maternal-Fetal & Neonatal Medicine 1994; 3: 171-174.
6. Duthie SJ, Ven D, Yung GL, Guang DZ, Chan SY, Ma HK. Discrepancy between laboratory determination and visual estimation of blood loss during normal delivery. European Journal of Obstetrics Gynecology and Reproductive Biology 1991; 38(2): 119-24.
7. Elzik ME, Dirschl DR, Dahners LE. Correlation of transfusion volume to change in haematocrit. American Journal of Hematology 2006; 81: 145-146.
8. Haswell JN. Measured blood loss at delivery. The Journal of the Indiana State Medical Association 1981; 74:34-6.
9. Larsson C, Saltvedt S, Wiklund I, Pahlen S, Andolf E. Estimation of blood loss after caesarean section and vaginal delivery has low validity with tendency to exaggeration. Acta Obstetricia et Gynecologica 2006; 85: 1448-1452.
10. Maslovitz S, Barkai G, Lessing JB, Ziv A, Many A. Improved accuracy of postpartum blood loss estimation as assessed by stimulation. Acta Obstetricia et Gynecologica 2008; 87: 929-934.
11. Nelston GH, Ashford C, Williamson R, Amburn SD. Method for calculating blood loss at vaginal delivery. Southern Medical Journal 1981; 74:550-2.
12. Ramadani H. Caesarean section: intraoperative blood loss and mode of placenta separation. International Journal of Gynecology and Obstetrics 2004; 87(2): 114-8.
13. Razvi K, Chua S, Arulkumaran S, Ratnam SS. A comparison between visual estimation and laboratory determination of blood loss during the third stage of labour. The Australian and New Zealand Journal of Obstetrics and Gynaecology 1996; 36: 152-4.
14. Solon JG, Egan C, McNamara DA. Safe surgery: how accurate are we at predicting intra-operative blood loss. Journal of Evaluation in Clinical Practice 2013; 19(1): 100-5.
15. Villeneuve MG, Khalife S, Marcoux S. Surgical staples in caesarean section: a randomized controlled trial. American Journal of Obstetrics and Gynecology 1990; 163(5pt1): 1641-6.
16. Wilcox CF, Hunt AB, Owen CA. The measurement of blood lost during caesarean section. American Journal of Obstetrics and Gynecology 1959; 77:772-779.
17. Young W, Karavolos S, Damodaram M, Madgwick K, Milestone N, Al-Habib A et al. Observer accuracy and reproducibility of visual estimation of blood loss in obstetrics: how accurate and consistent are health-care professionals? Archives of Gynecology and Obstetrics 2010; 281(2): 207-13.

Table 1: Mean blood loss estimates by anaesthetists and obstetricians

		Mean estimate ± S.D(mls)	t-test	p-value
Pair 1	Anaesthetist Calculated blood loss	668.2 ± 459.8 751.2 ± 801.1	-1.665	0.098
Pair 2	Obstetrician Calculated blood loss	624.1 ± 462.8 751.2 ± 801.1	-2.578	*0.011
Pair 3	Anaesthetist Obstetrician	668.2 ± 459.8 624.1 ± 462.8	4.403	*0.000

*P < 0.05 Statistically significant

Table 2: Blood loss estimates by anaesthetists and obstetricians

Calculated Blood loss	Anaesthetists estimate n(%)	Obstetricians estimates n(%)
Within 20% of calculated blood loss	33(21.6)	30(19.6)
> 20% above calculated blood loss	66(43.1)	63(41.2)
> 20% below calculated blood loss	54(35.3)	60(39.2)

Table 3: The distribution of blood loss estimates by anaesthetists stratified according to calculated blood loss

Calculated blood loss	Anaesthetist Within 20% of calculated blood loss	> 20% above calculated blood loss	blood loss > 20% below calculated blood loss	Estimate X^2	p-value
0 – 499	9(13.0)	60(87.0)	0(0.0)		
500 – 999	15(50.0)	3(10.0)	12(40.0)	122.356	*0.000
≥1000	9(16.7)	3(5.6)	42(77.8)		

*P < 0.05 Statistically significant

Table 4: The distribution of blood loss estimates by obstetricians stratified according to calculated blood loss

Calculated blood loss	Within 20% of calculated blood loss	Obstetricians > 20% above calculated blood loss	blood loss > 20% below calculated blood loss	estimate X^2	p-value
0 – 499	12(17.4)	57(82.6)	0(0.0)		
500 – 999	12(40.0)	3(10.0)	15(50.0)	115.761	*0.000
≥1000	6(11.1)	3(5.6)	45(83.3)		

*P < 0.05 Statistically significant