

Prevalence and Factors Associated with Severe Anaemia Post-Caesarean Section at a Tertiary Hospital in Southwestern Uganda

Sylvie Atosa Sivahikyako

Mbarara University of Science and Technology

Asiphas Owaraganise (✉ asiphas@gmail.com)

Mbarara University of Science and Technology

Leevan Tibaijuka

Mbarara University of Science and Technology

David Collins Agaba

Mbarara University of Science and Technology

Musa Kayondo

Mbarara University of Science and Technology

Joseph Ngonzi

Mbarara University of Science and Technology

Julius Mugisha

Mbarara University of Science and Technology

Hamson Kanyesigye

Mbarara University of Science and Technology

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Abstract

Background: Severe anaemia post-caesarean section adversely affects the woman and the new-born. While prenatal anaemia is extensively studied, the literature on post-caesarean section anaemia is limited and characteristics of women more likely to develop severe anaemia after caesarean section are unknown. This study aimed to determine the prevalence and factors associated with severe anaemia on day three post caesarean section.

Methods: Women at day three post-caesarean section were consecutively enrolled in a cross-sectional study at Mbarara Regional Referral Hospital. We measured their haemoglobin (Hb) concentration and defined severe anaemia as Hb<7.0 g/dL. We excluded women diagnosed with severe pre-caesarean section anaemia and those who got blood transfusion without pre-transfusion Hb record. We interviewed the women and collected data on sociodemographic, obstetric, and medical characteristics. The primary outcome was severe anaemia post-caesarean section. We used logistic regression analysis to determine independent factors associated with severe anaemia after caesarean section. P-value <0.05 was considered statistically significant.

Results: From December 2019 to March 2020, 427 of 431 screened women were enrolled in the study. Their mean age was 26.05 (SD ± 5.84) years. Three hundred thirteen (73.3%) had attended at least four antenatal care visits. The prevalence of severe post-caesarean section anaemia was 6.79 per cent. Fetal macrosomia (aOR 7.9 95%CI: 2.18-28.85, p<0.01) and having mild or moderate anaemia pre-caesarean section (aOR:9.6, 95%CI: 3.91- 23.77, p<0.01) were the factors associated with severe anaemia post-caesarean section.

Conclusion: Severe anaemia post-caesarean section commonly occurs and is associated with anaemia preoperatively and delivering a foetus with macrosomia. Preoperative haemoglobin optimization and intraoperative blood conserving measures are imperative among such women to prevent postoperative anaemia—as well as post-caesarean section haemoglobin estimation before discharge from the hospital to detect anaemia early and optimise remedies.

Background

Anaemia refers to the decrease in the total count of the red blood cells (RBCs) or the packed cell volume of RBCs or the haemoglobin concentration below the referent threshold for the individual's age, gender, geographical location, and physiological status [1, 2] resulting into the impaired ability of the blood to carry oxygen to the tissues. Although postpartum anaemia—haemoglobin concentration below 10g/dL is commoner among low-income settings [3, 4], developed countries are also affected [5, 6]. An estimated 12.8 per cent and 3.7 per cent of maternal deaths in Asia and Africa respectively were attributed to postpartum anaemia [7].

The major causes of postpartum anaemia are pre-delivery anaemia combined with blood losses at delivery [6]. Evidence shows that caesarean section increases postpartum haemorrhage largely through

increased risk of uterine atony and minimally through severed vessels while opening the abdominal cavity [8–10]. Anaemia in pregnancy especially occurring in the third trimester, excessive intrapartum blood loss, younger women, and those not taking iron supplementation during the postpartum period are likely to suffer postpartum anaemia [5]. Up to half of the women who miss prenatal iron supplements develop anaemia 48-hours after delivery [11].

Several studies have been conducted on anaemia during pregnancy[12–16] however, these studies have provided limited information about postpartum anaemia occurrence especially among women undergoing caesarean section—even when the global trends show increasing caesarean section rate. Prompt diagnosis of anaemia postpartum helps to avert its complications including blood transfusion, impaired wound healing, re-admission and/or prolonged hospitalization, altered mother’s emotional functioning, postpartum depression, reduced mother’s ability to care for her new-born as well as the increased cost of care for families [17]. However, with limited resources, most of the post-caesarean section women are discharged with unknown haemoglobin concentration. The clinical care-providers thus need to identify women who are prone to severe anaemia post-caesarean section in order to intervene appropriately before discharge. This study aimed to determine the prevalence and factors associated with severe anaemia post-caesarean section.

Materials And Methods

Study design and site

A cross-sectional study was conducted on the postnatal ward at Mbarara Regional Referral Hospital (MRRH) in South-western Uganda from December 2019 to March 2020. MRRH is a government-funded public tertiary hospital. According to the 2019 hospital records, the hospital conducts approximately 9,000 deliveries per year—40% caesarean; its maternal mortality ratio is 261 per 100,000 live births [18]. Routinely, women who undergo caesarean section are discharged on the day three post-operative without estimating the haemoglobin concentration.

Study population and eligibility

We studied adult women and emancipated minors on their day three post-caesarean section. We excluded women who had severe anaemia pre-operative and those who received blood transfusion without pre-transfusion haemoglobin measured post-operative.

Sample size estimation

A conservative sample size of 427 participants including 10% non-response was estimated using the Kish Leslie formula for a single population proportion[19].

Study enrolment and data collection

Research staff consecutively approached women on their day three post-caesarean section, explained the study and invited them to participate. Of women who accepted to be screened, those who passed the

study eligibility criteria were enrolled in the study. To estimate haemoglobin concentration, we drew about 5ml of the venous blood sample into EDTA vacutainer bottle and measured haemoglobin concentration using Sysmex XN-1000i ® 5-part haematology analyser manufactured by *Sysmex America, Inc. Lincolnshire, Illinois, USA*. Severe anaemia was defined as haemoglobin concentration < 7.0g/dL. Fetal macrosomia was defined as neonatal birthweight \geq 4000 grams. We interviewed women using a structured questionnaire to collect the research-specific variables. These variables included: the woman's demographic characteristics—age, marital status, occupation, residence, and level of education; medical characteristics—pre-delivery haemoglobin concentration, HIV serostatus, and history of malaria in the current pregnancy, diabetes; and obstetric characteristics—parity, gestational age, prenatal care attendance, iron supplement and duration, history of previous caesarean section, inter-delivery interval, history of pre-eclampsia, multifetal gestation. Other variables abstracted from the patient's chart were: the type of caesarean section (emergency versus elective), indication for the caesarean section, birth weight, and surgeon's estimated blood loss.

Data entry and analysis

Completed questionnaires were entered into an EPI-Info software version 7.2.1 database and imported into STATA software version 15.0 for analysis. We described maternal baseline characteristics using means and standard deviation for continuous variables and proportions for categorical variables.

To determine the prevalence of severe anaemia post-caesarean section, we calculated the proportion and percentage of participants with severe anaemia post-caesarean section. To determine factors associated with severe anaemia, variables with p-value < 0.2 at bivariate logistic regression were entered into a multiple logistic regression model to determine factors independently associated with severe anaemia with p-value < 0.05.

Ethical consideration:

Ethical approval was obtained from the Mbarara University Research Ethics Committee (MUST REC); Protocol reference number: 21/10–19. Written informed consent was obtained from all study participants using prior-approved consent forms in English and local language translated versions. Adults aged 18 years and over consented to study participation independently while parent and legal guardian consented for study participants below 18 years of age. The health workers in the postnatal ward were immediately informed about any woman who needed further evaluation and management of anaemia.

Results

A total of 431 women were screened on day three post-caesarean section. We enrolled 427 participants and excluded 4 who received blood transfusion pre-operative (2) and lacked haemoglobin estimation pre-transfusion (2). The mean age of the enrolled participants was 26.1 (\pm 5.84) years). Ninety four percent (n = 401) were married, 73.3% (n = 313) attended at least four prenatal visits, and 43.6 % (n = 186)

attained at least secondary level education. Other baseline characteristics of the women enrolled into the study are shown in Table 1.

Table 1
Demographics and others baseline characteristics of study participants (N = 427)

Characteristics		Frequency	Percent
Age in years (<i>M</i> = 26.05, <i>SD</i> = 5.84)	15–24	194	45.4
	25–34	188	44.0
	35+	45	10.5
Residence	Rural	250	58.5
	Urban	177	41.5
Marital status	Single	26	6.1
	Married	401	93.9
Occupation	Employed	104	24.4
	Unemployed	323	75.6
Education	No formal	43	10.1
	Primary	198	46.4
	≥Secondary	186	43.6
ANC visits	< 4	114	26.7
	≥ 4	313	73.3
Parity	Primiparous	201	47.1
	Multiparous	226	52.9
Pre-caesarean Hb (g/dL)	≥ 11	365	85.5
	7.0-10.9	62	14.5
Number of caesarean sections	None	228	53.4
	Once	91	21.3
	≥ 2	108	25.3
HIV status	Negative	397	93.0
	Positive	30	7.0
Caesarean section type	Emergency	380	89.0
	Elective	47	11.0
Delivery of macrosomia foetus	No	401	93.9
<i>M</i> = Mean, <i>SD</i> = Standard deviation			

Characteristics			Frequency	Percent
		Yes	26	6.1
Indication for the current	Prior scar	No	284	66.5
		Yes	143	33.5
Caesarean section	Prolonged labour	No	324	75.9
		Yes	103	24.1
	Multiple pregnancy	No	421	98.6
		Yes	6	1.4
	Malpresentation	No	382	89.5
		Yes	45	10.5
	Severe preeclampsia	No	424	99.3
		Yes	3	0.7
<i>M</i> = Mean, <i>SD</i> = Standard deviation				

The prevalence of severe anemia was 6.79 (95%CI: 4.78–9.61) per cent as shown in Fig. 1.

The factors independently associated with severe anaemia post caesarean section as presented in Table 2 were: having mild or moderate anaemia pre-caesarean section (aOR 9.6, 95%CI: 3.91–23.77, $p < 0.01$), and delivering a macrosomia foetus $> 400g$ (aOR: 7.9, 95% CI:2.18–28.85, $p < 0.01$).

Table 2
Crude and adjusted odds ratios of factors associated with severe anaemia post- caesarean section at Mbarara Regional Referral Hospital

Factor	Severe Anaemia		OR(95%CI)	P	aOR(95%CI)	p
	Yes	No				
Age (years)						
15-24	16(55.2)	178(44.7)	Reference			
25-34	6(20.7)	182(45.7)	0.4(0.14-0.96)	0.041	0.6(0.19-1.70)	0.312
35+	7(24.1)	38(9.6)	2.0(0.79-5.32)	0.141	1.9(0.95-9.50)	0.149
Pre-caesarean section haemoglobin (g/dL)						
≥11.0	13(44.8)	352(88.4)	Reference			
7.0-10.9	16(55.1)	46(11.6)	9.4(4.26-20.83)	< 0.01	9.6(3.91-23.76)	<0.01
Delivery of macrosomia foetus						
No	22(75.9)	379(95.2)	Reference			
Yes	7(24.1)	19(4.8)	6.3(2.41-17.70)	0.001	7.9(2.18-28.85)	0.002
Number of prior caesarean section						
None	24(82.8)	204(51.3)	Reference			
One	2(6.9)	89(22.3)	0.2(0.04-0.82)	0.026	0.3(0.06-1.67)	0.174
≥2	3(10.3)	105(26.4)	0.2(0.07-0.82)	0.023	0.7(0.14-3.57)	0.666
Indication for the current caesarean section						
Prior scar						
No	26(89.7)	258(64.8)	Reference			
Yes	3(10.3)	140(35.2)	0.2(0.06-0.72)	0.012	0.7(0.10-5.85)	0.174
Prolonged labour						
No	16(55.2)	308(77.4)	Reference			
Yes	13(44.8)	90(22.6)	2.8(1.29-6.00)	0.009	5.0(0.93-27.27)	0.060
OR=Odds ratio. aOR = adjusted odds ratio, CI=Confidence interval. p=significance level						

Discussion

Our study showed that the prevalence of severe anaemia on the third-day post caesarean section at Mbarara Regional Referral Hospital was 6.79%. Given that most of the studies on anaemia are conducted

during pregnancy, our study provides insights about the burden of severe anaemia post-operatively in the low-income countries settings where caesarean section rates are raising. In this study, the prevalence of anaemia post caesarean section is lower compared with 12% postpartum anaemia prevalence reported by Rakesh and collages reported a study conducted in Tamil Nadu India—also a developing country setting [4]. The possible explanation could be due to the fact that the study was done in a tertiary hospital located in a peri-urban surrounded by agrarian communities with good nutrition and better antenatal care services. Our findings were similar to the findings reported by Butwick et al., from a cohort study done in the developed country setting—California where the overall incidence of severe anaemia after the caesarean delivery was found to be seven per cent [6]. Although, it is notable that our prevalence might be higher given that our lowest threshold was less than 7.0g/dl haemoglobin concentration and Butwick et al., used less than 8 g/dl instead.

In this study, mild or moderate anaemia pre-caesarean section and delivery of a macrosomia foetus > 4000 grams remained independently associated with severe anaemia post caesarean section at Mbarara Regional Referral Hospital. Women with mild or moderate anemia pre-caesarean section had up to ten times higher odds of suffering severe anaemia post-caesarean section—in agreement with other studies conducted at tertiary hospitals in sub-Saharan Africa [6, 20–22]. Similar findings were reported by a study conducted in Southwest Nigeria that showed up to twelve times higher odds of receiving blood transfusion among women with pre-caesarean anaemia [20]; and another observational study that found four times higher odds of suffering post-operative anemia [21]. Also, women with preoperative haemoglobin concentration ranging between 10.0g/dL to 10.9 g/dL were five times likely to develop severe anaemia post caesarean section in California [6]. In North Carolina USA, Women with postpartum anaemia were more likely to have anaemia at each time point during pregnancy compared with women who did not have it postpartum [5]. Also a case-control study in Egypt found Hemoglobin below 11.0 g/dL to be a risk factor for primary postpartum haemorrhage up to seven times and subsequent severe anaemia postpartum regardless of the mode of delivery [22]. Predelivery haemoglobin level below 10.0 g/dL results into impaired transport of oxygen to the uterus, causes cellular dysfunction, a mechanism that can be used to explain impaired myometrial contractility, uterine atony and postpartum haemorrhage that aggravates pre-existing anaemia.

Furthermore, this study established that pregnant women who had a macrosomia foetus had eight times higher likelihood of developing severe anaemia post-caesarean section. This was consistent with previous studies that report an increased risk of postpartum haemorrhage and subsequently postpartum anaemia among women carrying macrosomia fetuses [23–25] including a study done in Uganda. The Uganda study found the risk for postpartum haemorrhage to double following delivery of large babies above 4000g regardless of the mode of delivery [26] while in Egypt the odds of postpartum anaemia was ten times higher in a woman with macrosomia foetus [25]. The finding from our study was also comparable to a previous study where the association between macrosomia and caesarean delivery were reported as independent risk factors for postpartum severe anaemia (aOR = 5.3) [22]. Macrosomia foetus leads to prolonged labour and to other maternal complications, including operative delivery and postpartum hemorrhage hence subsequent severe anaemia. The increased physiological vascularity of

the pregnant uterus plus severed vessels during surgical entry to the abdominal cavity confers a higher risk of postpartum haemorrhage and subsequently severe anaemia to women who undergo caesarean section

Our study was not without limitations. We did not assess the association of estimated blood loss because the surgeon-estimated blood loss was recorded in less than half of all participants. However, the trend severe of anemia in these women was consistent with previous literature citing a higher incidence of postpartum anaemia among women with excessive recorded or perceived intrapartum blood loss. Likewise, our findings from the study conducted at one regional referral hospital in southwestern Uganda implying may not be generalizable to other Ugandan regional referral-level hospitals. Nevertheless, we show how severe anaemia is prevalent and provide insights of women at most risk in a setting of increasing caesarean section rates.

Conclusion

In conclusion, we found that severe anaemia post-caesarean section is prevalent among women undergoing cesarean section at our institution—more so when they had moderate anaemia before surgery and/or delivered a macrosomic foetus. For women undergoing caesarean section, we recommend haemoglobin estimation prior to discharge from hospital to promptly diagnose and treat anaemia to improve postpartum clinical outcomes of women and their babies.

Abbreviations

EDTA Ethylenediamine tetra acetic acid

Hb Hemoglobin

MRRH Mbarara Regional Referral Hospital

MUST Mbarara University of Science and Technology

REC Research Ethics Committee

RBC Red blood cells

Declarations

Ethics approval and consent to participate

We obtained ethical approval for this study from the Institutional Review Board: Mbarara University of Science and Technology Research Ethics Committee (MUST REC); Protocol reference number: 21/10-19. All adults aged 18 years and over consented to study participation. Informed consent was also obtained

from parents or legal guardian of study participants below 18 years of age. All study methods were performed in accordance with the Declaration of Helsinki guidelines and regulations.

Consent for publication

Written informed consent for publication was obtained from the participants. Copies of the written consent are available for review by the Editor of this journal.

Availability of data and materials

De-identified data sufficient to produce primary study findings will be made available on reasonable request to the Department of Obstetrics and Gynecology, Mbarara University of Science and Technology. Data requests can be submitted through the corresponding author.

Competing interests

We declare no competing interests

Funding

Not applicable

Authors' contributions

SSA conceived the original study design. SSA and OA wrote the first draft of the manuscript. MK, LT, JN, and AC conducted the analysis. JM and HM oversaw study conduct and data collection. All authors were involved in data interpretation, reviewed the manuscript, and provided critical edits.

All authors read and approved the final version of the article to be submitted for publication, and agree to be accountable for the article and to ensure that all questions regarding the accuracy or integrity of the article are investigated and resolved.

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Authors' information (optional)

Not applicable

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Figures

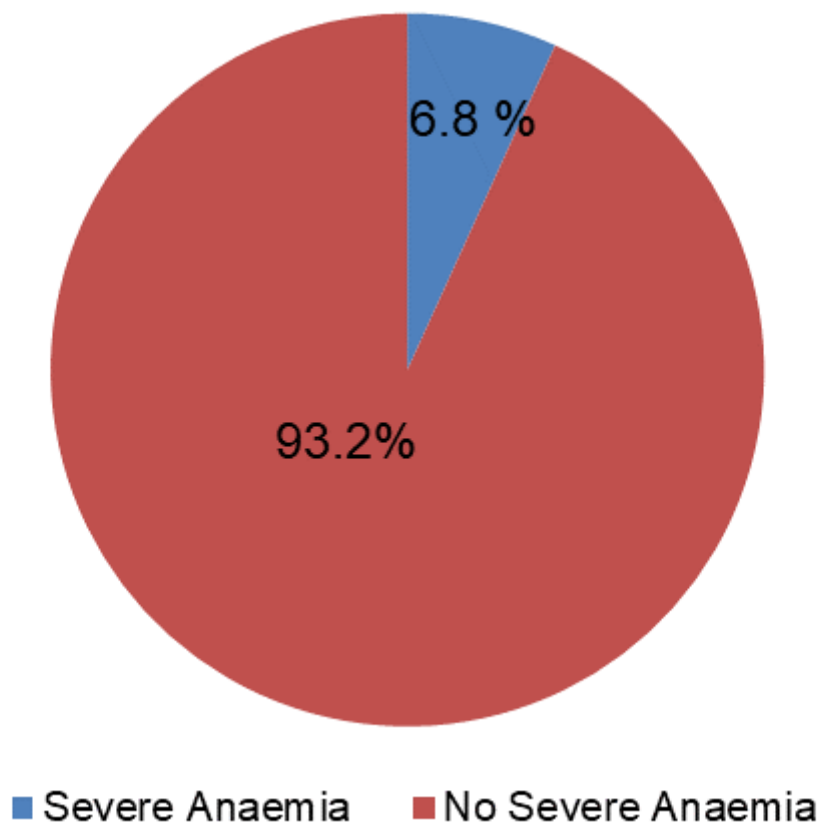


Figure 1

Prevalence of severe anaemia on day three post caesarean section at Mbarara Regional Referral Hospital