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Factors associated with hemorrhage during cesarean section

Abstract

Objective: To identify determinants of hemorrhage during cesarean section (HCS).

Material and methods: This case-control study was carried out between 1st February and 31st May 2026. Women with or without HCS were recruited. The main variables recorded included maternal age and parity, cesarean section (CS) indication, hemoglobin concentration, platelet count and prothrombin time prior to CS, and birth weight. Fisher exact test, t-test and logistic regression were used for comparison. P<0.05 was considered statistically significant.

Results: Of 458 CSs, 105 had HCS (22.9%). Two women with HCS were excluded. Amongst the 309 women of the population under study (103 with HCS and 206 without HCS), emergency CS was carried out in 253 of them (81.9%). Significant independent factors associated with HCS were placenta abruption (aOR 96.42, 95%CI 1.75-502.70), placenta praevia (aOR 19.95, 95%CI 3.28-121.60), parity ≥4 (aOR 3.19, 95%CI 1.52-6.71) and prothrombin time <70% (aOR 8.33, 95%CI 0.96-86.2).

Conclusion: Women with placenta abruption, placenta praevia, prothrombin time <70% and women of parity ≥4 should be informed they are at risk of HCS. Therefore, their CSs should be performed in well-equipped settings and they should have enough blood cross matched before CS.

Keywords: cesarean section, hemorrhage, multiparity, placenta abruption, placenta praevia

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Introduction

Cesarean section (CS) is defined as the delivery of the fetus after laparotomy and hysterotomy. CS is carried out when there is an increased risk of maternal, fetal or neonatal morbidities or mortalities if the delivery has to be done vaginally.

CS rate is on the rise worldwide and varies from one country to another. The national prevalence of CS worldwide varies between 0·6% in South Sudan and 58·1% in the Dominican Republic. Mean CS rates of 44.3% are found in Latin America and the Caribbean and 4.1% in West and Central Africa.[1]

CS is associated with immediate surgical complications such as hemorrhage, extension from the uterine incision, bladder or intestine injuries.[2,3] Short term complications include surgical site infections, wound hematoma or dehiscence, thromboembolic diseases and post-operative pain.[3] Long term complications are uterine scar ectopic pregnancies, isthmocele, uterine rupture, placenta praevia (PP) or abnormal placentation during subsequent pregnancies.[4,5] On the other hand anesthesiological complications such as difficult intubation (with hypoxia as a consequence), pulmonary aspiration and maternal hypotension should not be neglected given that they can lead to maternal death.[6,7]

Hemorrhage remains the leading cause of maternal mortality worldwide.[8,9] The most common lethal complications during CS is also hemorrhage which occurs in about 31% of women having cesarean birth.[10] HCS can be reduced using carbetocin rather than oxytocin[11] and by using tranexamic acid.[12]

HCS is a stressful condition for the obstetrician given that it can occur even when not awaited. Moreover, blood products are not always available in quality and quantity, especially in sub-Saharan African countries.[13] Therefore, knowing the women who might present HCS and who might need blood transfusion during CS is mandatory.

Known risk factors for HCS are PP, placenta abruption, grand parity, previous and emergency CSs.[14–17] Predisposing factors for HCS or their magnitude might be different in our environment. Knowing these conditions might help the physician in preventing HCS, if not in performing CS only in setting where secure blood transfusion can be offered. To the best of our knowledge no study aiming at identifying factors associated with HCS has been carried out in our setting. Therefore, this survey aimed at looking at the factors associated with HCS in our environment.

Methods

This case-control study was carried out between 1st February and 31st May 2026 in three University Teaching Hospitals. Women with HCS were taken as cases. For each case, the two women without HCS who were operated just after the one with HCS were taken as controls. The diagnosis of HCS was made by a blood lost ≥500 ml measured just after skin closure. Blood loss was obtained by adding blood volume obtained from the suction canister to that absorbed by gauzes. Before surgery, all gauzes to be used were weighed. After surgery gauzes soaked with blood were again weighed, the weight difference in gram was taken as the blood loss absorbed by gauzes. When amniotic fluid was present it was aspirated with a different suction canister and not taken into account when calculating blood loss. Women with incomplete files were excluded. A written informed consent was obtained from each woman or from their relatives. This study was approved by the ethics committee of the Faculty of Medicine and Biomedical Sciences under the number 26/023/UY1/FMBS.

The variables recorded on a pre-established questionnaire included maternal age at delivery, parity, marital status, gestational age at delivery (confirmed by an ultrasound scan performed before 20 weeks of gestation), presence or not of hypertensive diseases of pregnancy (defined by a blood pressure ≥140/90 mmHg at ≥20 weeks gestation), the number of fetuses, placenta praevia (diagnosed ultrasonographically after 34 complete weeks and confirmed during CS), placenta abruption (diagnosed during CS by the presence of blood clots between the placenta and the uterine wall), CS indication, the operator (obstetrician or resident), the type of anesthesia (general, spinal or epidural), hemoglobin concentration, platelet count and prothrombin time prior to CS, and birth weight.

The necessary minimum sample size was calculated as needing at least 91women with HCS using the following formula:[18] $N=2\times(Z\alpha+Z\beta/P0-P1)^2\times P\times(1-P)$, where $Z\alpha$ =1.65 corresponds to a type I error of 5%, $Z\beta$ =1.96 corresponds to a type II error of 2.5% or a power of 97.5%, P0 the percentage of HCS amongst women with PP in South Africa (18.6%)[15], P1 the percentage of HCS amongst women without PP (7%)[15] and P is (P0+P1)/2. To increase the power of our study, we decided to recruit two controls for each case. Data were analyzed using Statistical Package for the Social Sciences (SPSS) version 26.0 (IBM, Armonk, NY, USA). Data of cases were compared to those of controls. Fisher's exact test was used to compare categorical variables and t-test or Mann Whitney U test to compare continuous variables. We used odds ratios with their 95% confidence intervals (CIs) to present the comparison between the two groups. Logistic regression was used to control for confounders. P<0.05 was considered statistically significant.

Results

During the study period, we had a total of 105 cases of HCS out of 458 CSs performed, giving a frequency of 22.9%. Two files were excluded for incompleteness. The 103 remaining files and 206 files of controls were reviewed. The majority of CSs in our study were emergency CSs (253/309 or 81.9%). Some sociodemographic and obstetrical variables are given in Table 1.

Table 1 Some sociodemographic and obstetrical characteristics of the population under study

Variables	Women (n=103) with HCS	Women (n=206) without HCS	OR	95% CI	P-value
	N (%)	N (%)			
Maternal age ≥35	36 (34.9)	48(23.3)	1.77	1.05-2.97	0.041
Maternal parity ≥4	38 (36.9)	50 (24.3)	1.82	1.09-3.04	0.023
Married women	53 (51.5)	72 (35.0)	1.97	1.22-3.19	0.007
Past-history of cesarean section	36 (34.9)	66 (32.0)	1.14	0.69-1.88	0.700
Hypertensive diseases of pregnancy	14 (13.6)	22 (10.7)	1.32	0.64-2.69	0.573
Gestational age <37 weeks	24 (23.3)	19 (9.2)	2.99	1.55-5.76	0.001
Multiple gestation	8 (7.8)	12 (5.8)	1.36	0.54-3.44	0.624
Pre operatory Hb<10 g/dl	16 (15.5)	17 (8.3)	2.04	0.98-4.24	0.077
Platelet count <100 000/ µl	8 (7.8)	14 (6.8)	1.15	0.47-2.85	0.816
Prothrombin time <70%	4 (3.9)	1 (0.5)	8.28	0.91-75.08	0.044
Emergency cesarean section	83 (80.6)	170 (82.5)	0.88	0.48-1.61	0.754
Resident as operator	66 (64.1)	148 (71.8)	0.70	0.42-1.16	0.191
General anesthesia	22 (21.4)	28 (13.6)	1.73	0.93-3.20	0.101
Birth weight ≥3500g	36 (35)	71 (34.5)	1.02	0.62-1.68	1

HCS, hemorrhage during cesarean section; OR, Odds ratio; CI, Confidence interval; Hb, hemoglobin.

Mean blood loss was 620.9 ± 205.2 ml (500-2000) in women with HCS as against 331.8 ± 70.7 (100-450) in women without HCS (P<0.001). Blood loss in women with HCS varied between 500 and 1000 ml in 98 cases (95.1%), three women (2.9%) had blood loss between 1000 and 1500 m while just two women (2%) had blood loss above 1500 ml.

Concerning maternal age, we found a statistically significance difference between the two groups: 31.8 ± 6.5 (15-52) for women with HCS vs.29.4 ± 6.7 (16-45) for women without HCS, P=0.006). Adolescence was a protective factor against HCS (2 or 1.9% vs 19 or 9.2%,OR 0.19, 95%CI 0.04-0.85, P=0.028).

PP was a risk factor for HCS (Table 2). Women with major types PP (types III and IV) were more at risk of HCS than those with minor types (types I and II): 11/14 cases vs 3/14 cases, P=0.007.

Table 2 Indications for cesarean section among the study population

Variables	Women (n=103) with HCS	Women (n=206) without HCS	OR	95% CI	P-value
	N (%)	N (%)			
Scarred uterus	23 (22.3)	39 (18.9)	1.23	0.69-2.20	0.547
Fetal head malposition	12 (11.7)	25 (12.1)	0.95	0.46-1.99	1
Cephalopelvic disproportion	10 (9.7)	32 (15.5)	0.58	0.27-1.24	0.217
Macrosomic baby	12 (11.7)	18 (8.7)	1.38	0.64-2.98	0.541
Placenta praevia	11 (10.7)	2 (1)	12.20	2.65-56.13	<0.001

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Table 2 Continued...

Acute fetal distress	9 (8.7)	38 (18.4)	0.42	0.20-0.91	0.028
Pre-eclampsia/ eclampsia	8 (7.8)	21 (10.2)	0.74	0.32-1.74	0.542
Placenta abruption	9 (8.7)	0 (0)	-	-	<0.001
PRM and poor Bishop score	6 (5.8)	9 (4.4)	1.35	0.47-3.91	0.780
Abnormal presentation	3 (2.9)	22 (10.7)	0.25	0.07-0.86	0.025

HCS, hemorrhage during cesarean section; OR, Odds ratio; CI, Confidence interval.

Table 3 shows risk factors for HCS after logistic regression.

Table 3 Risk factors for hemorrhage during cesarean section after logistic regression

Variables	OR	95%CI	P-value	aOR	95%CI	P-value
Placenta abruption	-	-	<0.001	96.42	1.75-502.70	0.024
Placenta praevia	12.20	2.65-56.13	<0.001	19.95	3.28-121.6	0.001
Parity ≥4	1.82	1.09-3.04	0.023	3.19	1.52-6.71	0.005
Prothrombin time <70%	8.28	0.91-75.08	0.044	8.33	0.96-86.2	0.046
Pre operatory Hb<10 g/dl	2.04	0.98-4.24	0.077	1.36	0.57-3.22	0.491
Gestational age <37 weeks	2.99	1.55-5.76	0.001	1.64	0.76-3.55	0.210
Women aged ≥35	1.77	1.05-2.97	0.041	1.24	0.66-2.31	0.504
Married women	1.97	1.22-3.19	0.007	1.05	0.54-1.97	0.256

OR, Odds ratio; aOR, adjusted Odds ratio; CI, Confidence interval; Hb, hemoglobin.

Discussion

Significant independent factors associated with HCS found in our survey were placenta abruption, PP, parity ≥4 and prothrombin time <70%.

Our prevalence of HCS (22.9%) is lower than the 31% worldwide mean rate.[10] It might be due to the fact that the majority of physicians in our setting perform CS using the Misgav Ladach technique rather than the Pfannenstiel technique, especially for emergency CS, as Misgav Ladach technique has been shown to be less associated with HCS.[19]

Blood loss exceeding 1500 ml was observed in 2% of our women. This rate is similar to that of 1-2% found in USA.[20] With respect to maternal age, adolescents were less prone to develop HCS, as observed in Ethiopia and in Australia respectively.[16,21] This might be explained by the fact that most obstetrical conditions that could lead to uterine atony such as uterine fibroids, adenomyosis or multiparity appear with advanced maternal age.[16,21–23]

Placenta abruption in our survey was a major contributor to HCS as noticed in China.[24] It is due to the fact that coagulation factors are consumed in the retro placental blood clots leading to consumptive coagulopathy. The second explanation is uterine atony frequently observed due to the infiltration of the myometrium by blood cells and plasma (Couvelaire uterus). Major types PP exposed women to HCS in our study, as observed elsewhere.[14–16,24,25] PP is responsible for HCS by the fact that the lower uterine segment does not contract or retract well, therefore hemostatic mechanisms are not efficient enough.

Multiparity was a RF for HCS. This has already been found in Ethiopia.[16] It can be explained by the fact that in multiparity there is impairment of uterus and uterine blood vessels due to aging and scar.[23]

Past history of CS was not associated with HCS in our study. This is different from the studies in France and Nigeria respectively where past history of CS was a predisposing factor for HCS.[17,26] Emergency CS was not associated with HCS in our series, contrarily to the findings in Nigeria.[17] The fact that this was not observed in our study might be due to the Misgav Ladach largely used in our setting.

Abnormal prothrombin time (<70%) was a risk factor in our survey as found in China.[24] It shows that coagulation defects expose women to HCS. Since the majority of our CSs were emergency CSs, we had little time to correct this anomaly.

We observed no association between women' age ≥35, prematurity (<37 w), multiple gestation, pre-operatory hemoglobin concentration <10 g/dl, hypertensive diseases of pregnancy, general anesthesia, birth weight ≥3500 g and HCS. This might be due to our small sample size. Some researchers in Japan found birth weight >3500 g and advanced maternal age as risk factors for HCS.[27]

Our limitations are our small sample size. Further studies with large sample size should be carried out to look for other factors associated with HCS in our environment.

Conclusion

Pregnant women with placenta abruption, placenta praevia, prothrombin time <70% and women of parity ≥4 should be informed they are at risk of HCS. Therefore, their CSs should be performed in well-equipped settings and they should have enough blood cross matched before the surgery.

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Conflicts of interest

The authors have no conflicts of interest to declare.

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