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Prevalence and associated factors of postpartum haemorrhage following caesarean delivery at a tertiary care hospital

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Abstract
Background: Postpartum haemorrhage is an obstetric emergency that requires immediate recognition and intervention, to prevent serious morbidity and death. Its magnitude and associated factors after caesarean delivery have not been studied in our Centre.
Objective: This study aimed to evaluate the prevalence and associated factors of postpartum haemorrhage following caesarean section in a tertiary care hospital.
Methods: A retrospective case-control study of a cohort of women who gave birth by caesarean section after 28 weeks, from 1st June 2021 to 31st May 2023, who had blood loss ≥ 1000 ml, was carried out. Data from medical records, including baseline characteristics, obstetric, and perioperative findings were retrieved. All independent variables were analyzed using bivariate analysis, and the variables with an association were fitted into a multivariate logistic regression analysis. The results were displayed as frequency tables with odds ratio (OR) and 95% confidence interval (CI), and a p-value < 0.05 was considered significant.
Results: There were 2072 caesarean deliveries during the study period, of which 78 women had postpartum haemorrhage, giving a prevalence of 3.8%. The mean maternal age was 33.90±4.80 years, their mean gestational age at delivery was 36.69±2.49weeks, and their median parity was 1. Significant factors on bivariate analysis were placenta previa (P=0.027), abruptio placenta (P=0.012), stillbirth (P=0.008), additional procedure [repair of uterine incision extension and hysterectomy], (P=0.0001), duration of surgery (P=0.0001), and blood transfusion (P=0.0001).The surgery duration was two times more likely to last > 60 minutes and need for blood transfusion was four times more likely, in women with postpartum haemorrhage than their counterparts.
Conclusion: Postpartum haemorrhage after caesarean delivery was prevalent in our setting. Intraoperative factors such as duration of surgery, need for blood transfusion, and additional procedures (repair of uterine incision extension and hysterectomy) were significantly associated with postpartum haemorrhage.

Keywords: Postpartum haemorrhage, caesarean delivery, associated factors

Introduction
Postpartum haemorrhage (PPH) is defined as the loss of blood that is ≥500 ml following vaginal delivery or blood loss of ≥1000 ml following caesarean delivery [1]. It is said to be primary PPH when it occurs in the first 24 hours following delivery of the baby [2]. Postpartum haemorrhage is a leading cause of severe maternal morbidities and death, responsible for 27.1% of maternal deaths worldwide, varying from 8-13.4% in developed countries to 34% in African countries [3, 4]. The incidence of PPH is estimated to occur in 3 to 8% of all deliveries, varying between geographic regions and delivery settings, with an increasing rate that is of public health concern [5-8]. There are many causes of PPH, including uterine atony, retained placenta, coagulation abnormalities, and placental abnormalities such as placenta previa, abruptio placenta or placenta accreta [9, 10]. Failure of the uterus to contract is the major cause of PPH, responsible for about 80% of cases, and often occurs in the absence of recognized risk factors [11, 12]. Only about one-third of PPH cases have identifiable risk factors [13], and there are no known factors to help predict women who will fail to respond to treatment with conventional utero-tonics [14].
Caesarean delivery (CD) increases blood loss at delivery and thus is a risk factor for PPH [10]. Compared to normal births, CD, especially following labour, has been shown to be a common risk factor for PPH [7, 15-17].

The need for peripartum blood transfusion in women undergoing CD is also higher [18]. Among studies that have evaluated predictors for PPH after CD, previous scar [19, 20], antepartum haemorrhage (APH) [17, 20], multiple pregnancies [16, 21], preeclampsia [5], general anaesthesia [16, 17, 21], antepartum anaemia [20, 21], and maternal age ≥ 35 years [5] have been reported as risk factors.

Differences in the quantification of blood loss, varying definitions of PPH, and varied methodologies of studies, have resulted in a lack of consensus and underestimated the global burden of PPH [22, 23]. Also, clinical practices for preventing and managing PPH vary greatly depending on medical resources and the health system [24]. Despite these variations, there is need to distinguish between PPH after CD and that following vaginal birth, because the management of PPH after CD may differ from that of vaginal birth given the large volume of blood loss at CD compared to vaginal delivery. Thus, identifying risk factors for PPH after CD allows for early diagnosis and intervention that may prevent the occurrence of further complications [25].

Many deaths resulting from PPH occur in the first 24 hours after birth and could be avoided by prevention and timely treatment of PPH. The transition from a compensated to decompensated state from haemorrhage is rapid and easily overlooked [26]. Hence, prediction, early recognition and intervention are crucial to reduce the likelihood, or improve the clinical outcomes, of PPH [27]. While the magnitude and predictors for PPH generally have been extensively studied, little is known about the incidence of PPH and its risk factors after CD in sub-Saharan countries, and only a few studies have paid specific attention to perioperative factors. Therefore, this study aimed to determine the incidence of PPH after CD and to identify perioperative and other associated factors at a tertiary care hospital in Port Harcourt, Nigeria.

Materials and Methods

Study Site / Area

This study was carried out at the obstetric theatre and wards of the Rivers State University teaching hospital (RSUTH). The hospital serves as a referral center and provides antenatal care and delivery services for women registered with the hospital. The hospital has qualified teams of Obstetricians and Anaesthetists, and availability of blood bank services. There is an average annual delivery of about 2000 births.

Study design and population

A retrospective, matched, case-control study was conducted over a two-year period from 1st June 2021 to 31st May 2023. The study population were women who had CD after 28 weeks of gestation at the RSUTH. The case-group included all consecutive women diagnosed as PPH (estimated blood loss ≥ 1000 ml) and the control-group was made up of women without PPH (estimated blood loss < 1000 ml), selected with matched factors within 48 hours of the cases. Maternal age (categorized as ≤ 25 years, 26-34 years and ≥ 35 years) and gestational weeks (categorized as <37 weeks and ≥ 37 weeks) were considered as the matching factors because advanced maternal age (> 35 years) [5, 28] and preterm births [13] are known risk factors for PPH. The sample size was not calculated as we included all eligible women who underwent CD during the study period, those with incomplete data were excluded.

Data collection

Information was extracted from the theatre and wards records, as well as patient case notes. For each parturient, based on plausibility and previous studies, information on demographic characteristics (age, parity), obstetric characteristics (GA, ANC booking status, current singleton or twin pregnancy, previous uterine scar), comorbidities (pregnancy induced hypertension [PIH}, gestational/diabetes mellitus [GDM], uterine fibroid), pregnancy and labour complications (abruptio placenta, placenta previa, placental accreta syndrome, cephalopelvic disproportion [CPD], transverse lie, breech presentation), fetal characteristics (birth weight, sex, outcome [live/stillborn]) and perioperative events (type of CS [emergency/elective], duration of surgery, cadre of surgeon [consultant/senior resident/junior resident], and blood transfusion), was collected using a proforma.

Clinical practice and operational definitions

Most caesarean sections in our center were performed through a transverse lower uterine segment incision and under regional (spinal) anaesthesia. The primary outcome was PPH defined as estimated blood loss (EBL) 1000 ml or more after CD within 24 hours [29]. In our hospital, the EBL was measured based on amount of fluid in the suction apparatus and visual estimation of how many gauze-packs/dressing that were soaked (subjective EBL). PPH was managed using pharmacological agents, applying figure of eight stitches, or inflated intrauterine Foley's catheter, and when these fail, surgical intervention with subtotal or total abdominal hysterectomy. Management of PPH includes bolus intravenous Oxytocin or infusion of Oxytocin in saline solution, Misoprostol, Carbetocin, Tranexamic acid and blood transfusion as necessary.

Statistical analysis

Data were checked, coded, and analyzed with SPSS (Statistical Package for Social Sciences) for Windows version 23 (SPSS Inc., Chicago, Illinois, USA). Non-continuous measurements were given as numbers and percentages, and continuous measurements as mean and standard deviation. Association between independent and dependent variables was checked using the Pearson chi-square test or Fisher's exact test as appropriate. All independent variables were analyzed using bivariate analysis, and the variables with an association were fitted into a multivariate logistic regression analysis. The results were displayed as a frequency table with odds ratio (OR) and 95% confidence interval (CI), and a p-value < 0.05 considered as a significant factor for PPH.

Results

There were a total of 2072 CD during the two-year study period, of which 78 women had PPH, giving a prevalence of 3.8%. Only 76 cases had complete data (retrieval rate of 97.4%) and were included for further analysis. The mean maternal age of the women with PPH ± SD was 33.90±4.80 years, the median age was 35 years and the range was 20-45 years. Their mean gestational age at delivery ± SD was 36.69±2.49 weeks, with median of 37 weeks and range of 28 – 41weeks. Their median parity was Para 1, with a range of Para 0-6. Table 1 shows a comparison of the mean maternal age, gestational age at delivery, and median parity among the cases and control, with no statistically significant difference.

The distribution of the maternal characteristics among the groups is shown in Table 2. Majority of the women who had PPH were of maternal age ≥ 35 years (51.3%), were in the parity group of 2-4 (55.3%), had gestational age at delivery of ≥ 37 weeks (61.8%), and were booked for antenatal care in our hospital (63.2%). The differences in distribution of maternal characteristics among the cases and control were not statistically significant.

Table 1: Comparison of mean maternal age, gestational age at delivery, and median parity among Cases and Control who underwent CD

Variables	Cases Mean ± SD	Controls Mean ± SD	T	P-Value
Maternal age	33.99 ± 5.17	33.82 ± 4.44	-0.219	0.827
Gestational age at delivery (weeks)	36.71 ± 2.47	36.67 ± 2.52	-0.097	0.922
	Median (Range)	Median (Range)	Mann-Whitney U	P-Value
Parity	2 (0-6)	1 (0-6)	2413.500	0.072

SD: Standard deviation

Table 2: Maternal characteristics of the women who underwent CD

Variables	Cases N = 76, N (%)	Control N = 76, N (%)	Total N = 152, N (%)
Maternal age			
≤ 25 years	4 (5.3)	2 (2.6)	6 (3.9)
26-34 years	33 (43.4)	33 (43.4)	66 (43.4)
≥ 35 years	39 (51.3)	41 (53.9)	80 (52.6)
Chi Square = 0.717; p-value = 0.699			
Parity			
Para 0	17 (22.4)	26 (34.2)	43 (28.3)
Para 1	16 (21.1)	20 (26.3)	36 (23.7)
Para 2-4	42 (55.3)	28 (36.8)	70 (46.1)
Para ≥ 5	1 (1.3)	2 (2.6)	3 (2.0)
Fisher's exact test = 5.506; p-value = 0.120			
Gestational age at delivery			
< 37 weeks	29 (38.2)	32 (42.1)	61 (40.1)
≥ 37 weeks	47 (61.8)	44 (57.9)	91 (59.9)
Chi Square = 0.246; p-value = 0.620			
Booking status			
Booked	48 (63.2)	57 (75.0)	105 (69.1)
Un-booked/ Booked elsewhere	28 (36.8)	19 (25.0)	47 (30.9)
Chi Square = 2.495; p-value = 0.114			

*Statistically significant ($p<0.05$)

The distribution of the obstetric characteristics of the women who had PPH, and comparison with those without PPH, are as shown in Table 3. Majority of the women with PPH, 72 (94.7%), had singleton pregnancy compared to 4(5.3%) with multiple pregnancies, and the difference when compared to those without PPH was not statistically significant (P = 1.000). The occurrence of PPH followed emergency surgery in 52(68.4%) of cases, as against 24 (31.6%) that followed elective surgery, and the difference when compared to those without PPH was likewise not statistically significant (P = 0.494). Post-partum haemorrhage occurred in 36 (47.4%) in those with previous uterine scar, as against 40 (52.6%) in those without previous uterine surgery, and a comparison with those without PPH did not reveal any statistical significance ($P = 0.625$).

Table 3: Distribution and comparison of the obstetric characteristics of the women who underwent CD

Variables	Cases, N = 76, N (%)	Control, N = 76, N (%)	Total, N = 152, N (%)
Type of pregnancy			
Single	72 (94.7)	73 (96.1)	145 (95.4)
Multiple	4 (5.3)	3 (3.9)	7 (4.6)
	Fisher's exact p-value = 1.000		
Class of CD done			
Emergency CD	52 (68.4)	48 (63.2)	100 (65.8)
Elective CD	24 (31.6)	28 (36.8)	52 (34.2)
Chi Square = 0.468; p-value = 0.494			
Previous scar			
Yes	36 (47.4)	33 (43.4)	69 (45.4)
No	40 (52.6)	43 (56.6)	83 (54.6)
Chi Square = 0.239; p-value = 0.625			

The distribution of pregnancy/labour complications in the women who had PPH, and a comparison with those without PPH, are as shown in Table 4. Placenta previa was seen in 14 (18.4%) women who had PPH, compared to 5 (6.6%) in those without PPH, and this difference was statistically significant (P = 0.027) on bivariate analysis. Likewise, abruptio placenta occurred in 6 (7.9%) of those who had PPH, compared to none in the women without PPH, a difference that was also statistically significant (P = 0.012). However, there was no significant difference in both groups with regards to the occurrence of CPD (P = 0.356), breech presentation (P = 0.303), transverse lie (P = 0.731) and others (P = 0.786) which included fetal distress, obstructed labour, heart failure and uterine scar dehiscence.

Table 4: Distribution and comparison of pregnancy/labour complications in the women who underwent CD

Variables	Cases, N = 76, N (%)	Control, N = 76, N (%)	Total, N = 152, N (%)
CPD			
Yes	9 (11.8)	13 (17.1)	22 (14.5)

No	67 (88.2)	63 (82.0)	130 (85.5)
Chi Square = 0.850; p-value = 0.356			
Placenta previa			
Yes	14 (18.4)	5 (6.6)	19 (12.5)
No	62 (81.6)	71 (93.4)	133 (87.5)
Chi Square = 4.872; p-value = 0.027*			
Abruptio placenta			
Yes	6 (7.9)	0 (0.0)	6 (3.9)
No	70 (92.1)	76 (100.0)	146 (96.1)
Fisher's exact test = 6.247; p-value = 0.012*			
Breech presentation			
Yes	6 (7.9)	3 (3.9)	9 (5.9)
No	20 (92.1)	73 (96.1)	143 (94.1)
Fisher's exact test = 1.063; p-value = 0.303			
Transverse lie			
Yes	5 (6.6)	4 (5.3)	9 (5.9)
No	71 (93.4)	72 (94.7)	143 (94.1)
Fisher's exact test = 0.118; p-value = 0.731			
Others			
Yes	7 (9.2)	8 (10.9)	15 (9.9)
No	69 (90.8)	68 (89.5)	137 (90.1)
Chi Square = 0.074; p-value = 0.786S			

*Statistically significant (p<0.05)

The distribution of maternal comorbidities in the women who had PPH, and a comparison with those without PPH, are as shown in Table 5. Pregnancy induced hypertension (PIH) was seen more in women who did not have PPH 13 (17.1%), compared to 4 (5.3%) in those with PPH, and this difference was statistically significant (P = 0.021) on bivariate analysis. There was no significant difference in both groups with regards to the occurrence of fibroid in pregnancy (P = 0.494), maternal HIV infection (P = 1.000), GDM (P = 1.000) and others (P = 0.620) which included bronchial asthma (2) and cardiomyopathy (1) among the cases.

Regarding the intraoperative findings, the mean duration of surgery ± SD among the women who had PPH was 79.74±29.45 minutes, while it was 50.18±11.49 minutes in those without PPH, a difference that was statistically significant (P = 0.0001). The distribution of intraoperative factors in the women who had PPH, and a comparison with those without PPH, are as shown in Table 6. Most of the surgery was performed by a senior resident in 39 (51.3%) of cases and 48 (63.2%) of control, with no significant difference (P = 0.080) among the cadre of surgeons. Majority of the cases, 51(67.1%), had a duration of surgery lasting >60 minutes, while it lasted ≤60 minutes in 63(82.9%) of the controls, a difference that was statistically significant (P = 0.0001). There was extension of the uterine incision, requiring repair, occurring in 11(14.5%) of the women with PPH and 4 (5.3%) of the women with PPH had a hysterectomy for uncontrollable bleeding. None of these additional procedures occurred in the women without PPH, a difference that was significant (P = 0.0001) on bivariate analysis. Intraoperative blood transfusion was needed in 43 (56.6%) of the women who had PPH in contrast to only 1 (1.3%) woman in the control group, who was transfused for existing antepartum anaemia, and the need for intraoperative blood transfusion was statistically significant (P = 0.0001) between both groups.

Table 5: Distribution and comparison of maternal comorbidities among the women who underwent CD

Variables	Cases, N = 76, N (%)	Control, N = 76, N (%)	Total, N = 152, N (%)
PIH			
Yes	4 (5.3)	13 (17.1)	17 (11.2)
No	72 (94.7)	63 (82.9)	135 (88.8)
Chi Square = 5.365; p-value = 0.021*			
Fibroid			
Yes	6 (7.9)	3 (3.9)	9 (5.9)
No	70 (92.1)	73 (96.1)	143 (94.1)
Fisher's exact p-value = 0.494			
GDM			
Yes	1 (1.3)	2 (2.6)	3 (2.0)
No	75 (98.7)	74 (97.4)	149 (98.0)
Fisher's exact p-value= 1.000			
HIV			
Yes	1 (1.3)	2 (2.6)	3 (2.0)
No	75 (98.7)	74 (97.4)	149 (98.0)
Fisher's exact p-value= 1.000			
Others			
Yes	3 (3.9)	1 (1.3)	4 (2.6)
No	73 (96.1)	75 (98.7)	148 (97.4)
Fisher's exact p-value = 0.620			

*Statistically significant (p<0.05)

Table 6: Distribution and comparison of intraoperative factors at surgery among the women who underwent CD

Variables	Cases, N = 76, N (%)	Control, N = 76, N (%)	Total, N = 152, N (%)
Cadre of attending surgeon			
Registrar	12 (15.8)	15 (19.7)	27 (17.8)
Senior registrar	39 (51.3)	48 (63.2)	87 (57.2)
Consultant	25 (32.9)	13 (17.1)	38 (25.0)
Chi Square = 5.054; p-value = 0.080			
Duration of surgery			
≤60 minutes	25 (32.9)	63 (82.9)	88 (57.9)
>60 minutes	51 67.1)	13 (17.1)	64 (42.1)
Chi Square = 38.972; p-value = 0.0001*			
Additional procedure			
None	61 (80.3)	76 (100.0)	137 (90.1)
Extension	11 (14.5)	0 (0.0)	11 (7.2)
Hysterectomy	4 (5.3)	0 (0.0)	4 (2.6)
Fisher's exact test = 17.741; p-value = 0.0001*			
Blood transfusion			
Yes	43 (56.6	1 (1.3)	44 (28.9)
No	33 (43.4	75 (98.7)	108 (71.1
Chi Square = 56.424; p-value = 0.0001*			

*Statistically significant (p<0.05)

Regarding the maternal and fetal outcomes, the mean birth weight among the women who had PPH was 2990.79±697.08 grams, compared to 3025.00±720.76 grams among those without PPH, a difference that was not significant (P = 0.767). There was also no significant difference (P = 0.561) between the groups upon categorization of the birth weights, and the sex of the neonate (P = 0.514). There was 1(1.3%) maternal death among the women who had PPH and none in the control. The stillborn rate was 13 (17.1%) among the cases and 3(3.9%) among the control, and this difference was statistically significant (P = 0.008) on bivariate analysis.

Table 7: Distribution and comparison of maternal and neonatal outcomes among the women who underwent CD

Variables	Cases, N =76, N (%)	Control, N = 76, N (%)	Total, N = 152, N (%)
Maternal outcome			
Alive	75 (98.7)	76 (100.0)	151 (99.3)
Not alive	1 (1.3)	0 (0.0)	1 (0.7)
Fisher's exact p-value = 1.000			
Sex of neonate			
Male	44 (57.9)	40 (52.6)	84 (55.3)
Female	32 (42.1)	36 (47.4)	68 (44.7)
Chi Square = 0.426; p-value = 0.514			
Birth weight			
<2500g)	17 (22.4)	12 (15.8)	29 (19.1)
2500 – 4000g	56 (73.7)	62 (81.6)	118 (77.6)
>2500g	3 (3.9)	2 (2.6)	5 (3.3)
Fisher's exact test = 1.423; p-value = 0.561			
Fetal outcome			
Live birth	63 (82.9)	73 (96.1)	136 (89.5)
Still birth	13 (17.1)	3 (3.9)	16 (10.5)
Chi Square = 6.985; p-value = 0.008*			

*Statistically significant (p<0.05)

The variables with an association on bivariate analysis were fitted into a multivariate logistic regression analysis as shown in Table 8. Note however, that additional procedures (extension repair and hysterectomy) and abruptio placenta, even though significant in the bivariate analysis were not added due to the presence of zero in one of their cells. Following multivariate analysis, placenta previa (P = 0.264) and stillbirth (P = 0.149) were no longer statistically significant, but the duration of surgery (P = 0.0001) and need for blood transfusion (P = 0.0001) remained significantly associated with PPH. The CD surgery duration was two (2) times more likely to last >60 minutes and need for blood transfusion intraoperatively was four (4) times more likely, in women with PPH than those without PPH following CD.

Table 8: Multiple logistic regression showing factors associated with post-partum haemorrhage among the women who underwent CD

Factors (N = 152)	Coefficient (B)	Odds ratio (OR)	95% CI	p value
Placenta previa				
Yes	1.176	3.241	0.41 – 25.53	0.264
No [R]		1		
Duration of surgery				
> 60 minutes	2.299	9.963	3.70 – 26.82	0.0001*

≤ 60 minutes [R]		1		
Blood transfusion				
Yes	4.674	107.158	12.40-926.02	0.0001*
No [R]		1		
Fetal outcome				
Still birth	1.245	3.471	0.64-18.84	0.149
Live birth [R]		1		

*Statistically significant (p<0.05)

Discussion

A comparison of the difference in mean maternal age, gestational age at delivery, and median parity between the cases and control was not statistically significant, which means the groups were comparable and the differences observed is not likely attributable to extraneous variables.

The prevalence of PPH in this study of 3.8% was like the 3.6% reported by Zewdu *et al.* [24] among women who underwent CD. Lower prevalence of 1.13% in Nigeria [30], 1.2% in Uganda [31], 1.56% in China [8], and 2.1% in Japan [32], have all been reported. Possible reason for the variation in these reported lower prevalence rates is that, unlike this study and that by Zewdu *et al.* [24], which included only women who underwent CD, a mode of delivery that increases the likelihood of PPH, the others incorporated vaginal deliveries. However, a study from Cameroon by Halle-Ekane *et al.*, had reported a prevalence as high as 23.63% [33].

Also, differences in estimation of blood loss and management of PPH in different clinical practice settings and between countries could be attributed to the observed differences in prevalence. While the WHO accepts visual estimation of blood loss as standard practice, it is known that visual assessment underestimates blood loss volumes by 33-50% when compared to spectrophotometry [34, 35]. Some studies incorporated in their definition of PPH, the use of haemoglobin differences and units of blood transfused, in a bid for a more accurate estimation of blood loss [22-24].

Previous studies have reported that advanced maternal age (≥ 35) was associated with increased risk of PPH [5, 36], However, one study found a significant association of PPH with maternal age ≤ 18 years [8]. This study did not find any such association between maternal age and the risk of PPH, and this agrees with a meta-analysis which reported that no relationship was found between maternal age ≥ 35 years and PPH [37].

This study did not find any significant association between previous caesarean scar and the risk of PPH. Some studies have however, shown an association of previous scar with PPH [8, 19, 20, 24]. Unlike the study by Zewdu *et al.* [24], which reported that women with previous scar ≥ 2 were more likely to develop PPH, our study included all previous scar, irrespective of the number, and with many parturient in our study population with previous scar (47.4% of cases and 43.4% of control), we did not find any significant association.

We however, found a significant association of women with placenta previa and abruptio placenta being more likely to develop PPH on bivariate analysis. Findings from other studies [8, 17, 20, 21, 24], have found the likelihood of developing PPH to be significantly higher in women who had antepartum haemorrhage (APH). Our study separated APH into the two entities above, and when tested with multiple logistic regression, placenta previa was no longer significant, while abruptio placentae could not be fitted into the analysis because of the absence of any case among the control group. Ahmadzia *et al.* [18], in a risk prediction model of women who underwent CD, have shown that women with APH (particularly abruptio on presentation) had a threefold risk for requiring peripartum blood transfusion due to severe PPH. This study found a strong association of intraoperative blood transfusion in women who developed PPH following CD than their counterparts.

In this study, those requiring additional procedures, such as extension of the uterine incision and hysterectomy for uncontrolled haemorrhage, were also significantly associated with PPH as was found in other studies [38, 39]. The duration of surgery was also longer in those who had PPH than their counterparts of course, more time would be required to tackle more difficult surgeries, when there is extension of the uterine incision requiring repair or if hysterectomy would be required as a follow-up procedure.

Some studies have found an association between PPH and types of anaesthesia (especially general anaesthesia) [16, 17, 21, 24], and others have also shown that midline vertical (classical) uterine incisions were associated with much more blood loss compared to transverse lower segment uterine incisions [24, 39]. These were not investigated in our study, as all the CDs were carried out through a transverse lower segment uterine incision and under spinal anaesthesia. It has been suggested that there is increasing likelihood of severe bleeding in the vertical incisions, since more vascular and thicker myometrial tissue are surgically incised [39].

It has also been suggested that inhalational anaesthetic agents have an inhibitory effect on uterine contraction, thereby increasing the chance of uterine atony [40].

Like the study of Liu *et al.* [8], which found a significant association of stillbirth with PPH, this study also found an increase in stillbirth rate in women who had PPH, but though significant on bivariate analysis, was not proved by multiple logistic regression analysis. Contrary to other studies that have shown an association between PPH and severe preeclampsia [5, 24, 32], this study found a protective effect of pregnancy induced hypertension on the occurrence of PPH on bivariate analysis. It is true that preeclampsia results in hypertension and coagulation abnormalities that might cause bleeding that can evolve into PPH, but much will depend on the severity of the disease and the variation of clinical practice in the management.

Limitations

The limitations in our study might arise from estimation of blood loss volume, which can be challenging, and studies have found that clinicians often underestimate the volume lost; however, estimating blood loss during CD is more accurate than other modes of delivery. Also, being a retrospective study, known risk factors such as antepartum anaemia and previous history of PPH were not included, as a sizeable number of patients were referred from peripheral health institutions and their medical records were not known. These may need future prospective study to elucidate.

Conclusion

Postpartum haemorrhage after CD was prevalent in this setting. Intraoperative factors such as duration of surgery, need for blood transfusion, and additional procedures (repair of extension and

hysterectomy) were significantly associated with PPH after CD. We recommend taking appropriate measures to identify those at risk and enabling early intervention to prevent serious morbidity. It is, however, important to prepare for all women giving birth, as some can develop PPH without any known risk factor.

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Conflict of Interest
Not available

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