Clinical outcomes of placenta previa with and without coverage of a uterine scar: A retrospective cohort study in a tertiary hospital

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Research article

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Abstract

Background To compare the maternal and neonatal outcomes of placenta previa (PP) with and without coverage of a uterine scar in China. **Methods** A retrospective cohort study comparing all singleton pregnancies with PP was conducted at a tertiary, university-affiliated medical center between January 2012 and April 2017. Maternal and neonatal outcomes of PP with and without coverage of a uterine scar were compared. **Results** There were 58,062 deliveries during the study period, of which 738 (1.27%) were complicated PP in singleton pregnancies and were further classified into two groups: the PP with coverage of a uterine scar group (PPCS, n=166) and the PP without coverage of a uterine scar group (Non-PPCS, n=572). Overall, the PPCS group had poorer maternal and neonatal outcomes for premature birth (< 37 weeks, 68.1% vs 54.8%; $P=0.010$), cesarean section (100% vs 97.6%; $P=0.042$), Intraoperative blood loss > 1000 ml (78.3% vs 16.0%; $P<0.001$) or > 3000ml (29.5% vs 3.0%; $P<0.001$), postpartum hemorrhage (48.8% vs 15.7%; $P<0.001$), transfusion (35.2% vs 16.1%; $P<0.001$), hemorrhage shock (8.4% vs 1.9%; $P<0.001$), hysterectomy (3.0% vs 0.5%; $P=0.006$) and fetal distress (36.1% vs 12.0%; $P<0.001$) than the Non-PPCS group. In pregnancies complicated without abnormal invasive placenta (AIP, n=587), the PPCS group had poorer maternal and neonatal outcomes for Intraoperative blood loss > 1000 ml (69.0% vs 12.5%; $P<0.001$) or > 3000ml (9.2% vs 1.0%; $P<0.001$), bleeding within 2-24 hours after delivery (114.7 ± 283.9 vs 47.7 ± 45.1 ml, $P<0.001$), postpartum hemorrhage (70.1% vs 15.2%, $P<0.001$), transfusion (28.7% vs 13.6%, $P<0.001$) and fetal stress (35.6% vs 11.4%, $P<0.001$) than the Non-PPCS group. **Conclusion** The PPCS group had poorer maternal and neonatal outcomes than the Non-PPCS group. Women with PPCS were more likely to have intraoperative and postpartum hemorrhage, transfusion and fetal distress, even without AIP.

Background

Placenta previa (PP) is defined as implantation of the placenta in the lower uterine segment overlying the endocervical os, and it is known as an important cause of serious fetal and maternal morbidity, even mortality [1, 2]. PP is associated with an increased risk of bleeding, blood transfusion, postpartum anemia, hysterectomy, septicemia, thrombophlebitis and maternal death [3-5]. A population-based study [6] noted that 44.4% of patients with PP delivered before 37 weeks of gestation, 16.9% of these delivered before 34 weeks of gestation, and neonatal mortality rates were increased by threefold to fourfold.

The incidence of PP was higher in Asia (1.2%) and lower in Europe (0.36%), North America (0.29%) and sub-Saharan Africa (0.27%) [7]. Our previous research showed that the incidence of PP was between 0.93% and 2.01% in mainland China [8]. The incidence of PP has increased, probably due to the increasing rates of cesarean delivery, maternal age, and assistive reproductive technology. Certainly, there is a dose-response relationship between the number of previous cesarean sections and subsequent placenta previa. Thus, although the etiology of placenta previa remains indeterminate, there appears to be a link between endometrial damage and uterine scarring and subsequent placenta previa.

In general, PP is subdivided into three categories according to the position of the placenta and the cervix: complete previa, marginal previa, and partial previa. However, PP is particularly dangerous when covering a uterine scar (PPCS). PPCS, also called pernicious placenta previa (PPP), one of the most dangerous types of PP, was proposed by Chattopadhyay et al [9] and defined as when the placenta overlies a uterine scar that may or may not with accreta. The incidence of PPCS has increased correspondingly with the increase of cesarean section in China and often leads to unexpected bleeding during delivery and increased risk for peripartum hysterectomy [10-12].

A large number of previous studies have reported the clinical outcomes and associated risk factors of PP [5, 9-11, 13-15], and only a few reports have focused on comparing PPCS and Non-PPCS [12, 16]. This information on these conditions is important to know so that women with a specific type of PP can be appropriately counseled regarding their outcomes, and physicians can be appropriately prepared for their deliveries. Thus, the specific objective of this study was to investigate the maternal and neonatal outcomes of women with PPCS and Non-PPCS in a Chinese cohort.

Materials And Methods

Study design and population

A retrospective cohort study comparing pregnancies with PP with and without coverage of a uterine scar was conducted over 24 weeks. This hospital was a tertiary university-affiliated medical center with a stable number of approximately 13,000 deliveries per year, which accounted for approximately 10% of the city's deliveries and provided care for the region's obstetrical population, especially those with complicated pregnancies. There were 58,062 pregnancies who delivered a liveborn or a stillborn infant of at least 24 gestational weeks at our hospital during the period of January 2012 to March 2017, and 738 women who had complicated PP with a singleton pregnancy were included for further study (Figure 1). All data were retrospectively analyzed from the electronic medical records, surgical records and anesthetic records. Exclusion criteria included multiple pregnancies, misdiagnosis or fetal malformation; not delivering in the study hospital and no archive in the hospital electronic system; or loss of information regarding placental position. The study was approved by the Human Subjects Committee of the Southern Medical University Affiliated Maternal & Child Health Hospital of Foshan. To ensure patient privacy, our data did not include the patient's name, phone number, home address, or other sensitive information.

PP is defined as implantation of the placenta in the lower uterine segment in advance of the fetus, including complete placenta previa, partial placenta previa and marginal placenta previa. Low-lying placenta previa was excluded in our study because of its different clinical management [17]. In this study, the patients with PP were divided into two groups: the placenta previa with coverage of a uterine scar group (PPCS group, n=166 cases) and the placenta previa without coverage of a uterine group (Non-PPCS group, n=572 cases). PPCS was defined as PP where the placenta covered a uterine scar in the lower uterine segment. Non-PPCS was defined as PP where placenta did not cover a uterine scar in the lower uterine segment. The placental position was divided into 3 groups: anterior, posterior, and ante-posterior or laterally positioned. The placental position was evaluated in a transverse cross-section by ultrasound or MRI, in which the maximum placental area was depicted. Anterior placenta is a placenta dominantly attached to the anterior wall of the uterus, and a posterior placenta is a placenta dominantly attached to the posterior wall of the uterus. The other placentas were defined as ante-posterior or laterally positioned. All types of PP

were diagnosed by experienced obstetricians, based on serial transvaginal or transabdominal ultrasonographic scans or MRI, and confirmed at the time of delivery.

Definitions

The following clinical characteristics were evaluated in all patients: maternal age, BMI, gestational weeks, race/ethnicity, parity, prior CS, mode of delivery, in vitro fertilization and embryo transfer (IVF-ET) or not, diseases associated with pregnancy (diabetes or gestational diabetes mellitus, hypertension disorder complicating pregnancy). To compare maternal and neonatal outcomes, gestational weeks, mode of delivery (vaginal, CS), postpartum hemorrhage, postpartum anemia, hysterectomy, number of days in the hospital, hospitalization expenses, infant weight, intrauterine death, fetal distress, Apgar score at 1 min, and Apgar score at 5 min were compared in the two groups. We calculated gestational age on the basis of the actual delivery date in the medical record. PPH was diagnosed according to blood loss of more than 500 ml for vaginal deliveries and more than 1000 ml for cesarean delivery by the American College of Obstetricians and Gynecologists (ACOG) [18]. Postpartum anemia was defined as a hemoglobin concentration of <110 g/L (6.8 mmol/L) according to WHO [19]. HDCP (systolic blood pressure ≥ 140 mmHg and/or diastolic blood pressure ≥ 90 mmHg, with or without proteinuria) can be classified into five groups: (1) gestational hypertension, (2) preeclampsia, (3) eclampsia, (4) superimposed preeclampsia on chronic hypertension and (5) chronic hypertension in pregnancy preeclampsia [20]. GDM was diagnosed when one of the following conditions was met: (1) fasting plasma glucose ≥ 5.1 mmol/L two or more times; (2) two or more test results equal to or above the following values after a 75 g-load OGTT: fasting, 5.1 mmol/L; 1-hour, 10.0 mmol/L; 2-hour, 8.5 mmol/L.

Statistical analysis

Categorical data were reported as numbers and percentages (%), and descriptive data were expressed as the means $\pm$ standard deviations (SD). Boxplots describe the amount of bleeding between groups by using the median, the upper quartile, and the lower quartile. The 95% confidence intervals or interquartile range were calculated and presented. Statistical significance was calculated using a Chi-square test or Fisher's exact test for differences in qualitative variables and a t test for differences in continuous variables. Statistical analyses were performed with the Statistical Package for Social Science Version 22.0 (SPSS Inc, Chicago, IL, USA) and R (3.4.1). Two-tailed P values <0.05 were considered statistically significant.

Results

There were 58,062 pregnant women who delivered a liveborn or a stillborn infant of at least 24 gestational weeks at our hospital during the period of January 2012 to March 2017, and 738 women had complicated PP with a singleton pregnancy and were identified for further data review (Figure 1). Of these 738 women, 166 (22.5%) had PPCS and 572 (77.5%) had Non-PPCS.

The clinical characteristics of the groups are shown in Table 1. The mean age of individuals with pregnancies complicated with PP was 31.71 ± 5.25 years old, the mean BMI was 26.06 ± 3.11 , and the mean number of gestational weeks was 35.70 ± 2.46 weeks. Most of the women were Han Chinese (98.4%), 31.3% were primipara and 8.3% had a pregnancy with IVF-ET. PPCS was significantly associated with advanced maternal age, higher than average BMI, greater parity and prior CS compared with Non-PPCS. There were no significant differences in gestational weeks, IVF-ET, HDCP and diabetes or GDM between the two groups.

PPCS was significantly associated with a higher proportion of AIPs (47.6% vs 12.6%, $P < 0.001$) and placenta increta or percreta (37.3% vs 5.6%, $P < 0.001$) compared to Non-PPCS (Table 2). There was no significant difference between the two groups in the number of women with placenta accreta (10.2% vs 7.0%, $P = 0.168$). The PPCS group was dominated by anterior placentas (46.4%), followed by ante-posterior or laterally positioned (34.3%) and posterior placentas (19.3%), while the Non-PPCS group was dominated by posterior placentas (56.1%), followed by ante-posterior or laterally positioned (21.9%) and anterior placentas (21.9%).

In pregnancies complicated with AIP ($n=151$, Table 3), the PPCS group was associated with poor maternal outcomes for intraoperative blood loss (3000 [1500,4500] ml vs 700 [400,1500] ml, $P < 0.001$, Figure 2) and bleeding within 2-24 hours after delivery (209.9 ± 415.2 ml vs 65.5 ± 114.2 ml, $P = 0.008$) and with greater hospitalization expenses (29756 ± 9849 vs 18359 ± 8712 , CNY, $P = 0.008$) than the Non-PPCS group. The Non-PPCS group was associated with a higher incidence of postpartum anemia (41.7% vs 24.1%, $P = 0.021$) and higher APGAR scores at 5 min (9.7 ± 1.3 vs 9.1 ± 1.6 , $P = 0.035$) than the PPCS group. There was no significant association between the PPCS group and the Non-PPCS group in the rates of CS, postpartum hemorrhage, transfusion, hemorrhagic shock, hysterectomy and number of days in the hospital.

In pregnancies not complicated with AIP ($n=587$, Table 3), the PPCS group was associated with poor maternal outcomes for intraoperative blood loss (1100 [800,1750] ml vs 400 [300,600] ml, $P < 0.001$, Figure 2), bleeding within 2-24 hours after delivery (114.7 ± 283.9 vs 47.7 ± 45.1 ml, $P < 0.001$), postpartum hemorrhage (70.1% vs 15.2%, $P < 0.001$), transfusion (28.7% vs 13.6%, $P < 0.001$), and fetal stress (35.6% vs 11.4%, $P < 0.001$) and with greater hospitalization expenses (20920 ± 7197 vs 13220 ± 8242 , CNY, $P < 0.001$) than the Non-PPCS group. There was no significant association between the PPCS group and Non-PPCS group in the rates of CS, hemorrhagic shock, postpartum anemia, hysterectomy, number of days in the hospital, mean infant weight, intrauterine death and Apgar score at 1 and 5 min.

Discussion

Principal findings of this study

Prior studies have shown that PP was significantly associated with a range of adverse outcomes for both mothers and neonates; however, comparisons of PP with and without coverage of a uterine scar were rarely reported. Thus, the aim of our study was to investigate the maternal and neonatal outcomes of PPCS

and Non-PPCS in a Chinese cohort. This large retrospective cohort study of 738 women with PP between January 2012 and March 2017 found that the PPCS group had poorer maternal and neonatal outcome for intraoperative blood loss, bleeding within 2 – 24 hours after delivery, postpartum hemorrhage, transfusion and fetal distress than the Non-PPCS group, even after being grouped according to whether they were complicated with AIP. Overall, infant weight, intrauterine death, postpartum anemia, oligohydramnios and number of days in the hospital were not associated with the incidence of PPCS.

China's family planning policy has been in place for more than three decades, and most couples have been restricted to only one child since 1980. Many pregnant women have had a primary cesarean section on account of only one child being allowed. Rising primary cesarean delivery rates strongly affect maternal mortality rates due to the increase of placenta previa and accreta after multiple cesareans. With the rapid growth of the aging population, China relaxed its more than three-decade-old family planning policy and allowed a couple to have two children. A survey of maternal and child health in Asia by the WHO showed that the rate of cesarean section in China was 46.2% in 2010, which is the three times (15%) the WHO's recommended upper limit [21]. Another study [22] recently found that the cesarean section rate rose from 28.8% in 2008 to 34.9% in 2014. However, this proportion varies widely in the 31 provinces of China from 4% to 62.5% in 2014. The high cesarean delivery rate is associated with an increased risk of placenta previa in subsequent pregnancies. This risk of PP rises as the number of prior cesarean sections increases. With the implementation of the universal two-children policy in China, there will be more multipara with a scarred uterus and PPCS in the future.

PP is suspected and diagnosed in approximately 5% of pregnancies between 15 and 16 weeks [23], and almost 90% of PP resolves to a normal position by term [24], which may be explained by the elongating of the uterus and the gradually rising position of the placenta away from the cervix with increasing gestational age. However, such a mechanism will be interfered with if the placenta is covered in uterine scarring from a previous CS such that the placenta cannot move normally. Moreover, our data showed that nearly half (47.2%) of PPCS pregnancies combined with AIP, suggesting that we should do detailed prenatal check-ups, including ultrasound and MRI when we find this condition in clinical practice, to determine the likelihood of placenta implantation, location and depth of placenta accreta.

The correlation between gestational age and different types of placenta previa remains controversial. Some studies reported no differences in gestational age at delivery of infants born to mothers with different types of placenta previa [10, 25]. However, more studies agreed that premature delivery was more frequent in women with complete placenta previa [17, 26], but the comparison of preterm birth rates between infants with mothers with PPCS and Non-PPCS is rarely reported. Our results found that premature birth remains a major problem, with 54.8% of infants born prematurely to women in the Non-PPCS group and 68.1% of infants born to women in the PPCS group.

Some studies have addressed whether types of placenta previa are associated with the severity of symptoms in mothers and neonates, but data aimed at understanding PPCS were insufficient. Our results show that women with PPCS had a higher rate of CS, postpartum hemorrhage, transfusion, and hysterectomy and that the infants born to women with PPCS had lower Apgar scores at 1 and 5 min. Specifically, women in the PPCS group are at an approximately 3-fold (48.8% vs 15.7%) increased risk of postpartum hemorrhage, and 6-fold (3.0% vs 0.5%) increased risk of hysterectomy than women in the Non-PPCS group. Additionally, the presence of accreta is often the factor that determines a change in clinical management and outcome. We divided the subjects into an AIP group and non-AIP group and found that obstetric hysterectomy was performed in 6.3% and 2.8% of the women with PPCS and Non-PPCS, respectively, in the AIP group, while it was performed in 0% and 0.2% of the women with PPCS and Non-PPCS, respectively in the non-AIP group. Prior studies simply compared the hysterectomy rates between the two AIP groups but did not perform subgroup analysis based on the type of placenta implantation. Nevertheless, our results showed that the proportion of women with hysterectomy was lower than that reported in most other studies. Ling Li [16] reported that the hysterectomy rate was 8.47% in women with PPCS and 0% in women with Non-PPCS. Another study [27] in China reported hysterectomy rates were 11.9% (12/101) and 0.8% (3/369) in women with PPCS and Non-PPCS, respectively. However, there is also a report of a very low hysterectomy rate from Israel, which stated that only 1.2% of mothers with PP underwent a hysterectomy [28]. One possible and important reason for the low hysterectomy rate in our study is that obstetricians in our hospital use a random placenta margin incision [29] (also called an Ar's incision), and we have found it may be a potentially valuable surgical procedure to control intraoperative and postoperative bleeding in pregnancies with complete placenta previa. We believe that retaining the uterus is of great significance to young women who desire to preserve fertility, so it is acceptable to have an increased risk of postpartum hemorrhage and postpartum transfusion in women with PPCS if we can preserve the uterus.

Studies have shown that women who conceived with assisted reproductive technology (ART) procedures had an increased incidence of placenta previa regardless of the type of ART procedure [30, 31]. The mechanism for the development of the relationship between IVF-ET and PP is uncertain. One explanation is that ART procedures, maternal factors associated with sterility or a combination of both may increase the risk of PP in ART pregnancies. Varying theories have been developed around the effects of hormones on the endometrium, the effects of embryo transfer and the effects of changes in uterine contraction wave patterns [32]. There was no significant difference in IVF-ET between the PPCS and Non-PPCS groups because IVF-ET is a potential confounding factor, both HDCP and diabetes or GMD.

Strengths and limitations of the study

This is one of the largest studies investigating risk factors and clinical outcomes for PPCS and Non-PPCS placenta previa from a single medical center. The largest strength of this study is that the large sample size allowed us to study the association of PPCS and Non-PPCS and maternal and neonatal outcomes. However, there are several potential limitations to this study. First, despite this hospital being the largest maternity and child health care hospital in Foshan, selection bias is likely because this is a single-center study and because this is a retrospective review that relied on medical documentation and a database. Second, although we used ultrasound or MRI to distinguish between the front and back walls of the placenta, the division is not very precise since we did not measure the area of the anterior or posterior placenta walls. Larger studies are needed to determine the safety and efficacy of interventional radiology before this technique can be recommended for routine management of placenta implantation [33]. Therefore, this study does not use the following procedures: intraoperative internal iliac artery and/or postoperative uterine artery embolization and internal iliac artery or abdominal balloon occlusion. It would be prudent

to compare hospitals at different levels or in different regions due to the presence of different surgical instruments, surgical procedures, hemostasis procedures, surgical physician levels, and anesthetics. All of these potential limitations should be considered when interpreting the results of this study.

Conclusions

In conclusion, we investigated risk factors and maternal and neonatal outcomes in women with PPCS and Non-PPCS in a Chinese cohort. As the rate of CS increases with China's universal two children policy, the rate of PP, especially PPCS, will most likely increase as well. Women with PPCS were more likely to have a premature birth, postpartum hemorrhage, hemorrhagic shock, an infant with worse Apgar scores, a longer hospital stay, and greater hospital expenses, and they were more likely to require a hysterectomy at the time of cesarean delivery than women with Non-PPCS. Health care providers should be aware of possible complications of PPCS to provide proper counseling to their patients.

Abbreviations

PP: Placenta previa; PPCS: PP with coverage of a uterine scar; Non-PPCS: PP without coverage of a uterine scar; MRI: Magnetic resonance imaging; CS: Cesarean section; IVF-ET: In vitro fertilization and embryo transfer; ACOG: American College of Obstetricians and Gynecologists; GDM: Gestational diabetes mellitus; HDCP: hypertensive disorder complicating pregnancy; OGTT: Oral Glucose Tolerance Test; SD: standard deviations; BMI: Body mass index; AIP: Abnormal invasive placenta

Declarations

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Author Contributions

JR and FD designed and implemented the study, conducted data analysis and write the manuscript; ZZ, CG, MH and LD designed the statistical analysis and help with data analysis; WS helped with analysis plan and result interpretation; GX and LZ designed the study and developed the manuscript. All the authors have accepted responsibility for the entire content of this submitted manuscript and approved submission.

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Ethics approval and consent to participate

The study was approved by the Human Subjects Committee of the Foshan Women and Children's Hospital Affiliated with Southern Medical University. To ensure patient privacy, our data did not include the patient's name, phone number, home address, or other sensitive information.

Consent for publication

Not applicable.

Competing interests

The authors have no conflicts of interest relevant to this article.

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Tables

Table 1: Comparison of characteristics of patients with PPCS and Non-PPCS .

Characteristics	Total (n=738)	PPCS (n=166)	Non-PPCS (n=572)	<i>t/chi-square</i>	<i>P value</i>
Maternal age	31.71±5.25	32.50±4.88	31.48±5.33	-2.221	0.027
mean ± SD, y	[16-48]	[21-43]	[16-48]		
Maternal BMI ^a	26.06±3.11 [17.31-39.96]	26.49±3.35	25.93±3.03	-2.046	0.041
mean ± SD		[19.44-38.05]	[17.31-39.96]		
Gestational weeks	35.70±2.46	35.72±2.25	35.84±2.39	-0.629	0.530
mean ± SD	[28-41]	[28-41]	[28-41]		
Race/ethnicity (%)				0.822	0.365
Han Chinese	726(98.4)	162(97.6)	564(98.6)		
National minority	12(1.6)	4(2.4)	8(1.4)		
BMI (%)				2.409	0.300
<24	185(25.1)	34(20.5)	151(26.4)		
24 to 28	375(50.8)	90(54.2)	285(49.8)		
>28	178(24.1)	42(25.3)	136(23.8)		
Parity ^b (%)				90.928	<0.001
0	231(31.3)	2(1.2)	229(40.0)		
1	411(55.7)	136(81.9)	275(48.1)		
2	85(11.5)	25(15.1)	60(10.5)		
3	11(1.5)	3(1.8)	8(1.4)		
Prior CS (%)				345.017	<0.001
No	494(66.9)	12(7.2)	482(84.3)		
Yes	244(33.1)	154(92.8)	90(15.7)		
IVF-ET (%)				3.355	0.067
No	677(91.7)	158(95.2)	519(90.7)		
Yes	61(8.3)	8(4.8)	53(9.3)		
HDCP				2.845	0.092
No	720(97.6)	159(95.8)	561(98.1)		
Yes	18(2.4)	7(4.2)	11(1.9)		
Pre diabetes or GDM				0.151	0.698
No	612(82.9)	136(81.9)	476(83.2)		
Yes	126(17.1)	30(18.1)	96(16.8)		

Note: n, number of observations; SD, standard deviation; ^a, BMI, body mass index, at delivery; ^b, BMI before this delivery;

Data are mean±SD (independent t test) or n (%) (x² test) unless otherwise specified.

HDCP: hypertensive disorder complicating pregnancy; GDM: gestational diabetes mellitus.

Table 2: Comparison of abnormal invasive placenta in patients in the PPCS and Non-PPCS groups.

Abnormal invasive placenta	Total (n=738)	PPCS (n=166)	Non-PPCS (n=572)	<i>chi-square</i>	<i>P value</i>
Abnormal placenta					
Total AIP	151(20.5)	79(47.6)	72(12.6)	96.862	<0.001
Placenta accreta	57(7.7)	17(10.2)	40(7.0)	1.904	0.168
Placenta increta or percreta	94(12.7)	62(37.3)	32(5.6)	116.727	<0.001
Placenta position				72.547	<0.001
Anterior	202(27.4)	77(46.4)	125(21.9)		
Posterior	352(47.8)	32(19.3)	320(56.1)		
Ante-posterior or laterally positioned	182(24.7)	57(34.3)	125(21.9)		

Table 3: Comparison of pregnancy outcomes with and without abnormal invasive placenta in patients with PPCS and Non-PPCS.

Maternal/Neonatal Outcomes	All (n=738)		P-value	With AIP (n=151)		P-value	Without AIP (n=587)		P-value
	PPCS (n=166)	Non-PPCS (n=572)		PPCS (n=79)	Non-PPCS (n=72)		PPCS (n=87)	Non-PPCS (n=500)	
Maternal									
Gestational weeks			0.010			0.542			0.2
<28	0	0		0	0		0	0	
28-36	111(68.1)	312(54.8)		59(75.6)	48(67.6)		52(61.2)	264(53.0)	
37-39	49(30.1)	240(42.2)		17(21.8)	21(21.8)		32(37.6)	219(44.0)	
> 40	3(1.8)	17(3.0)		2(3.6)	2(2.6)		1(1.2)	15(3.0)	
Mode of delivery			0.042			-			0.1
Vaginal	0	14(2.4)		0	0		0	14(2.8)	
Cesarean section	166(100.0)	558(97.6)		79(100.0)	72(100.0)		87(100.0)	486(97.2)	
Intraoperative blood loss> 1000 ml	130(78.3)	91(16.0)	<0.001	70(88.6)	29(40.8)	<0.001	60(69.0)	62(12.5)	<0.0
Intraoperative blood loss> 3000 ml	49(29.5)	17(3.0)	<0.001	41(51.9)	12(16.9)	<0.001	8(9.2)	5(1.0)	<0.0
Bleeding within 2 hours after delivery, ml	32.3±86.6	28.5±58.8	0.553	40.0±107.6	19.9±44.6	0.166	24.7±58.5	29.8±60.5	0.5
Bleeding within 2 - 24 hours after delivery, ml	162.3±357.5	49.9±58.4	<0.001	209.9±415.2	65.5±114.2	0.008	114.7±283.9	47.7±45.1	<0.0
Postpartum hemorrhage	81(48.8)	90(15.7)	<0.001	20(25.3)	14(19.4)	0.388	61(70.1)	76(15.2)	<0.0
Transfusion	58(35.2)	92(16.1)	<0.001	33(42.3)	24(33.3)	0.258	25(28.7)	68(13.6)	<0.0
Hemorrhagic shock	14(8.4)	11(1.9)	<0.001	12(15.2)	4(5.6)	0.055	2(2.3)	7(1.4)	0.5
Postpartum anemia	39(23.5)	172(30.1)	0.099	19(24.1)	30(41.7)	0.021	20(23.0)	142(28.4)	0.2
Hysterectomy	5(3.0)	3(0.5)	0.006	5(6.3)	2(2.8)	0.300	0	1(0.2)	0.6
Oligohydramnios	9(5.4)	24(4.2)	0.501	4(5.1)	5(6.9)	0.626	5(5.7)	19(3.8)	0.3
Hospital day	12.7±9.2	11.4±12.2	0.221	14.5±10.0	13.2±13.3	0.503	11.0±8.0	11.1±12.1	0.8
Hospitalization expenses, ¥	25097±9607	13869±9327	<0.001	29756±9849	18359±8712	<0.001	20920±7197	13220±9242	<0.0
Neonatal									
Infant weight, mean ± SD	2702.8±577.4	2711.8±558.8	0.857	2630.3±533.2	2668.3±507.7	0.657	2767.8±610.2	2718.1±566.0	0.4
Infant weight, g			0.703			0.339			0.7
<1500	8(4.8)	23(4.1)		4(5.1)	1(1.4)		4(4.6)	22(4.4)	
1500-2500	35(21.2)	145(25.6)		17(21.8)	21(29.6)		18(20.7)	124(25.0)	
2500-4000	121(73.3)	396(69.8)		56(71.8)	49(69.0)		65(74.7)	347(70.0)	
>4000	1(0.6)	3(0.5)		1(1.3)	0		0	3(0.6)	
Intrauterine death	1(0.6)	4(0.7)	0.893	1(1.3)	0	0.338	0	4(0.8)	0.4
Fetal distress	60(36.1)	69(12.0)	<0.001	29(36.7)	13(18.1)	0.030	31(35.6)	56(11.4)	<0.0
APGAR at 1 min	8.7±2.1	9.3±1.7	<0.001	8.2±2.5	9.0±2.1	0.657	9.1±1.6	9.4±1.6	0.1
APGAR at 5 min	9.2±1.5	9.6±1.6	0.009	9.1±1.6	9.7±1.3	0.035	9.3±1.3	9.6±1.6	0.1
APGAR <7at 1 min	27(16.6)	40(7.1)	<0.001	21(27.6)	9(12.9)	0.027	6(6.9)	31(6.3)	0.8
APGAR <7at 5 min	5(3.0)	16(2.8)	0.902	2(2.6)	1(1.4)	0.625	3(3.4)	15(3.0)	0.8

Note: n, number of observations; SD, standard deviation; Data are mean±SD (independent t test) or n (%) (x² test or Fisher's Exact Test).

Figures

Fig 1. Flow chart of study population.

Figure 1

Flow chart of the study population.

Figure 2

Box plots of intraoperative blood loss in the PPCS and Non-PPCS groups of women with and without AIP.