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(Citation)
Placenta,112:180-184

(Issue Date)
2021-09-01

(Resource Type)
journal article

(Version)
Accepted Manuscript

(URL)
https://hdl.handle.net/20.500.14094/90008604

Clinical Factors Associated with a Placenta Accreta Spectrum

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Abbreviations

PAS	Placenta accrete spectrum
CS	Cesarean section
D&C	Dilatation and curettages
UAE	Uterine artery embolization
PPH	Postpartum hemorrhage
ART	Assisted reproduction techniques
GW	Gestational weeks

Abstract

Introduction: Placenta accrete spectrum (PAS) is a life-threating obstetric complication, and prenatal prediction of PAS can decrease maternal morbidity and mortality. The aim of this prospective cohort study was to determine the clinical factors associated with PAS.

Methods: Pregnant women who delivered at a university hospital were enrolled. Clinical data were collected from medical records, and logistic regression analyses were performed to determine which clinical factors were associated with PAS.

Results: Eighty-seven (2.1%) of the 4,146 pregnant women experienced PAS. Multivariable analyses revealed that a prior history of cesarean section (CS) (OR 3.3; 95% CI 1.9–5.7; $p < 0.01$), dilation and curettage (D&C) (OR 2.8; 95% CI 1.7–4.6; $p < 0.01$), hysteroscopic surgery (OR 5.7; 95% CI 2.3–14.4; $p < 0.01$), uterine artery embolization (UAE) (OR 44.1; 95% CI 13.8–141.0; $p < 0.01$), current pregnancy via assisted reproduction techniques (ART) (OR 4.1; 95% CI 2.4–7.1; $p < 0.01$), and the presence of placenta previa in the current pregnancy (OR 13.1; 95% CI 7.9–21.8; $p < 0.01$) were independently associated with the occurrence of PAS.

Conclusion: Pregnant women who have a prior history of CS, D&C, hysteroscopic surgery, UAE, current pregnancy via ART, and the presence of placenta previa in the current pregnancy are high risk for PAS.

Key words: placenta accrete spectrum, prediction, prospective cohort study, risk factor, uterine artery embolization

Introduction

A placenta accreta spectrum (PAS) describes clinical or histological adherence of the placenta to uterine wall. In the International Federation of Gynecology and Obstetrics (FIGO) classification, PAS includes abnormally adherent placenta and abnormally invasive placenta (AIP); abnormally adherent placenta can be clinically diagnosed based on the incidence of a heavy bleeding after manual removal of placenta, and AIP includes increta and percreta [1]. Whereas, a morbidly adherent placenta (MAP) in the International Classification of Diseases 11th Revision (ICD-11) includes placenta accreta, increta, and percreta. Moreover, in the ICD-11, a retained placenta, which is diagnosed when a placenta is not delivered within a designated time periods, is distinguished from MAP, but it can be caused by MAP.

PAS, including clinically diagnosed conditions, is a significant obstetrical complication with a high risk of severe and life-threatening postpartum hemorrhage (PPH). It is widely recognized that a prior history of cesarean section (CS) and the presence of placenta previa are risk factors for PAS [2-6]. With the recent increase in cesarean deliveries, the incidence of PAS appears to be increasing as well [7]. In cases of PAS with placenta previa, accurate prediction of PAS before delivery and multidisciplinary management strategies can reduce the associated morbidity [8]. Conversely, an unexpected PAS without a current placenta previa or a prior history of CS may cause life-threatening PPH [9].

In addition to a prior history of CS [5] and a current placenta previa [5, 6], advanced maternal age [5, 6], multiparity [5], prior histories of gynecologic procedures including surgical abortion and hysteroscopic surgery [10], and pregnancies by assisted reproductive technology (ART) [6] have been reported to be risk factors for PAS in prospective studies. On the other hand, some retrospective studies have reported a higher frequency of PAS in pregnancies following uterine artery embolization (UAE) [11-13]. However, there are no

prospective cohort studies to assess whether a prior history of UAE is a risk factor for PAS. Therefore, this prospective cohort study evaluated clinical factors associated with PAS, including a prior history of UAE.

Material and methods

This prospective cohort study followed the principles of the Declaration of Helsinki and was approved by the research ethics committee of Kobe University Graduate School of Medicine (reference number B200187), and written informed consent was obtained from all participants. Women who received maternal checkup and delivered at ≥22 gestational weeks (GW) between January 2010 and December 2019 at Kobe University Hospital were enrolled in the study.

All pregnant women were queried about conception by ART, and prior history of CS, dilation and curettage (D&C), hysteroscopic surgery, myomectomy, and UAE at the first visit. ART included in vitro fertilization or intracytoplasmic sperm injection followed by embryo or blastocyst transfer. Pregnant women who were suspected of having PAS, for example, because of the presence of current placenta previa or multiple risk factors for PAS, etc., received detailed ultrasound (US) and/or magnetic resonance imaging (MRI) examinations. The patients' characteristics and clinical findings, including age at delivery, gravidity, parity, multiple pregnancy, placenta previa, gestational age at delivery, delivery mode, the amount of blood loss at delivery, and the presence of PAS, were collected from the medical records. A PAS was diagnosed by histopathological or clinical findings. Histopathological diagnoses of PAS included placenta accreta, increta, and percreta. PAS was clinically diagnosed by the experienced senior obstetricians when one of two criteria was met: 1) when manual removal of the placenta was required, because there was no sign of placental separation 30 minutes after vaginal delivery, despite active management in third-stage labor, including intravenous infusion of synthetic oxytocin, uterine massage, and gentle controlled cord traction [14], or because there was partial or no placental separation during cesarean delivery [15]; 2) an operator had to use a vessel sealing system to remove the

placenta during CS [16]. Cases with retained placenta caused by uterine atony or a trapped placenta were completely excluded from those with PAS.

Clinical characteristics and findings were compared between pregnant women with and without PAS. Differences between the two groups were analyzed using the Student's *t*-test, Fisher's exact test, and chi-square test. Statistical significance was considered present at *P* values <0.05.

Clinical factors associated with PAS were determined by a stepwise approach. Variables with a *P* value <0.05 on univariate logistic regression analysis were subjected to multivariable logistic regression analyses, and variables with *P* values <0.05 on multivariable logistic regression were significantly associated with the occurrence of PAS. All statistical analyses were performed using EZR (Saitama Medical Center, Jichi Medical University, Saitama, Japan), a graphical user interface for R (The R Foundation for Statistical Computing, Vienna, Austria).

Results

During the study period, 4,870 pregnant women visited Kobe University Hospital. Three hundred seventy-five pregnancies ended in spontaneous or induced abortion, and 349 women delivered at other hospitals. A total of 4,146 women delivered at the university hospital, and 87 (2.1%) had PAS **(Figure 1).** Total of 32 women with PAS required hysterectomy, 10 required UAE, and 2 received intrauterine balloon tamponade to control PPH. Of the 87 women with PAS, 3 were diagnosed with placenta percreta, 8 with placenta increta, 20 with placenta accreta, and the remaining 56 were clinically diagnosed with PAS.

Table 1 shows the clinical characteristics of the 4,146 pregnant women. Pregnant women with PAS were significantly older than those without PAS ($p < 0.01$). Women with PAS had more gravidity ($p < 0.01$) and parity ($p < 0.05$). The frequencies of a prior history of CS ($p < 0.01$), D&C ($p < 0.01$), hysteroscopic surgery ($p < 0.01$), UAE ($p < 0.01$), ART pregnancy ($p < 0.01$), placenta previa ($p < 0.01$), and cesarean delivery ($p < 0.01$) in the current pregnancy were significantly higher in women with PAS than in those without PAS. GW at delivery in women with PAS was significantly earlier than in women without PAS ($p < 0.01$), and the birth weight in women with PAS was significantly lighter than in women without PAS ($p < 0.05$). The amount of blood loss at delivery was significantly larger in women with PAS than in those without PAS ($p < 0.01$).

In the 87 pregnant women with PAS, 41 women received both detailed US examinations and MRI examinations, 2 women received only detailed US examinations, and 7 women received only MRI examinations, because they were suspected to have PAS during pregnancy (Additional file 1: Tab. S1). In 43 pregnant women with PAS received US examinations, 28 (65.1%) had the presence of placental lacunae, 24 (55.8%) had loss of the retroplacental hypoechoic clear zone, 12 (27.9%) had turbulent blood flow detected by color Doppler, and 16 (37.2%) had the presence of irregularity of the border between the placenta

and myometrium around internal uterine os using transvaginal ultrasonography [16], and 33 (76.7%) had any of these findings. In addition, 48 pregnant women with PAS received MRI examinations, 14 (29.2%) had uterine bulging, 13 (27.1%) had intraplacental abnormal vascularity, 13 (27.1%) had myometrial thinning, 9 (18.8%) had placental protrusion into internal os [17], 6 (12.5%) had heterogeneous placenta, 5 (10.4%) had intraplacental dark band, and 26 (54.2%) had any of these findings.

Table 2 shows results of univariate and multivariable logistic regression analyses of clinical factors associated with PAS. Multivariable logistic regression analysis was performed for the seven clinical factors selected by univariate logistic regression. A prior history of CS (OR 3.3, 95% CI 1.9–5.7; $p < 0.01$), D&C (OR 2.8, 95% CI 1.7–4.6; $p < 0.01$), hysteroscopic surgery (OR 5.7, 95% CI 2.3–14.4; $p < 0.01$), UAE (OR 44.1, 95% CI 13.8–141.0; $p < 0.01$), ART pregnancy (OR 4.1, 95% CI 2.4–7.1; $p < 0.01$) and the presence of placenta previa (OR 13.1, 95% CI 7.9–21.8; $p < 0.01$) in the current pregnancy were found to be independent clinical factors associated with the occurrence of PAS. The diagnostic accuracy of those six clinical factors for the prediction of PAS is shown in Table 3.

The optimal predictive factors were estimated by using the maximum value of the Youden index, which is defined as "sensitivity + specificity–1." The combination of a prior history of hysteroscopic surgery or UAE, or a current ART pregnancy or the presence of placenta previa in the current pregnancy were determined as optimal predictive factors for PAS, yielding 78.2% sensitivity, 82.3% specificity, 8.6% positive predictive value (PPV), 99.4% negative predictive value (NPV), 82.2% accuracy, and a maximum Youden index of 0.60 (Additional file 2: Tab. S2).

Two patients with PAS did not have any of the six predictive factors selected in this study. One patient was a 39-year-old primigravida with uterine leiomyoma. She underwent amniocentesis for chromosome analysis at 17 GW. Eight days after the amniocentesis, she

had abdominal pain and fever caused by uterine infection or degeneration of uterine leiomyoma, and was treated with antibiotics. She underwent manual removal of the placenta followed by cesarean hysterectomy at 37 GW. The other one was a 30-year-old primigravida who had an uneventful and normal pregnancy course, but she underwent manual removal of the placenta at vaginal delivery.

Discussion

This is the first prospective cohort study evaluating clinical factors associated with PAS, including a prior history of UAE. Some investigators reported a higher frequency of PAS in pregnancies following UAE in retrospective studies (16.6%–37.5%) [11-13]. Our prospective study, for the first time, demonstrated that a prior history of UAE is an independent risk factor for PAS. Furthermore, almost half (44.4%) of pregnant women with prior UAE had PAS in their subsequent pregnancies. We reported that the recurrence rate of severe PPH in women with prior UAE were significantly higher than that in women without UAE (35.7% vs 9.4%, $p < 0.05$), and that seven (50%) of the 14 women with prior histories of both PPH and UAE had PAS in subsequent pregnancies [18]. UAE may induce uterine endometrial and myometrial damages and lead to the occurrence of PAS [11, 19]. A prior history of UAE should be considered as one of the most important risk factors for PAS and severe PPH.

In the present study, univariate and multivariable logistic regression analysis revealed that prior histories of CS, D&C, hysteroscopic surgery, ART pregnancy, and the presence of placenta previa in the current pregnancy were also independent clinical factors associated with the occurrence of PAS. In addition, we also found that the combination of a prior history of hysteroscopic surgery or UAE, or a current ART pregnancy or placenta previa were optimal predictive factors for PAS yielding 78.2% sensitivity, 82.3% specificity, 8.6% PPV, 99.4% NPV, and 82.2% accuracy (Youden index 0.60).

Previous prospective cohort studies have showed that a history of CS was a risk factor for PAS, similar to our present study [5, 6]. However, in our present study, no women with prior CS alone had PAS. Therefore, a prior history of CS was selected as a significant risk factor for PAS by multivariable analysis, but it was not selected as a factor included in the combination of optimal predictive factors for PAS.

Another prospective study reported that a previous history of hysteroscopic surgery and endometrial curettage, including suction curettage and surgical abortion, were associated with PAS in primiparous women [10]. Our present study showed that prior history of hysteroscopic surgery and D&C were associated with PAS in the population including both primiparous and multiparous women. The hypothesis of pathogenetic mechanism for PAS is that a secondary defect of the endometrium–myometrial interface, which is caused by CS, hysteroscopic surgery, and surgical abortion, leads to failure of normal decidualization allowing abnormally deep placental anchoring villi and trophoblast infiltration in the previous uterine scar area [20].

Conversely, prior myomectomy was not selected as a factor for PAS by univariate logistic regression analysis in our present study. This result is consistent with the results of a previous retrospective study [21]. This may be caused by the fact that myomectomies do not always cause endometrial damages.

The previous prospective studies demonstrated that advanced maternal age and multiparity were associated with PAS [5, 6]. However, in the present study, advanced maternal age and parity were associated with PAS in univariate analysis, but not in multivariable analysis. The physical endometrial damages caused by uterine surgeries may be more closely associated with the occurrence of PAS than advanced maternal age and parity [20].

In addition, our present study also found that ART pregnancy was an independent risk factor for PAS by univariate and multivariable analysis, and is consistent with the results of a recent prospective birth cohort study in Japan [6]. Thinner endometrial linings and lower peak serum E_2 levels in women with infertility treated by ART are thought to be associated with the occurrence of PAS [22]. Furthermore, it was reported that women who conceived by frozen embryo transfer had a higher risk for PAS than those by fresh embryo transfer [23].

More detailed data, including the specific ART procedures, may be required to better understand the influence of ART on PAS.

Many previous studies have reported that the presence of placenta previa in women with previous CS have a high risk for PAS [4-6], and a higher number of previous CS is associated with an increased risk for PAS [4, 6]. In the present study, among the 34 women with both previa and PAS in their current pregnancies, 29.4% (10/34) had no previous CS, 70.6% (26/34) had one previous CS, and 35.3% (12/34) had two or more previous CS. Moreover, among the 10 women with previa and PAS without previous CS, 3 had prior D&C, 2 had prior D&C and ART pregnancy, 2 had ART pregnancy, 1 had prior UAE, 1 had prior myomectomy with endometrial damage, and 1 had no prior history of uterine surgeries, UAE, or ART pregnancy in current pregnancies. In addition to prior history of CS, prior histories of D&C, UAE, uterine surgeries, and ART pregnancy in the current pregnancies may be associated with an increased risk for PAS in pregnancies complicated by placenta previa.

Ultrasonography and MRI are reported to be useful tools for predicting PAS during pregnancy [24], [25]. Pregnant women with prior history of CS, D&C, hysteroscopic surgery, UAE, ART, and the presence of placenta previa in the current pregnancy should receive careful workups for PAS by imaging examinations. Indeed, in the present study, 76.7% (33/43) of the patients with PAS received US examinations and 54.2% (26/48) of those received MRI examinations had any of the imaging findings suggestive of PAS. When PAS is suspected before delivery, they should be managed and delivered in a tertiary care hospital [26].

Two women with PAS had no prior history of CS, D&C, hysteroscopic surgery, UAE, ART, or the presence of placenta previa in the current pregnancy. PAS in one woman might have been caused by uterine infection after amniocentesis. The cause of PAS in the other women, who had clinically diagnosed PAS, was unclear.

There are some potential limitations associated with this study. In the present study, both pathologically diagnosed cases (n=31) and clinically diagnosed cases (n=56) were enrolled as cases with PAS. The different diagnostic criteria for PAS were used in previous studies [27]. Recently, on clinical criteria for PAS in the FIGO classification, patients who have heavy bleeding after manual removal of placenta can be also diagnosed of having PAS [1]. On the other hand, on a clinical grading system of the International Society for AIP, patients who were thought to have abnormally adherent placenta by a senior, experienced clinician after manual removal of placenta can be diagnosed of having PAS [15]. The clinical criteria in the present study corresponded with that in the latter. The incidence of PAS (2.1%) in the present study was higher than that in the previous reports (0.01%–0.27%) [4-7]. Because Kobe University Hospital has a maternofetal center, where pregnant women at high risk for PAS were often referred from other hospitals and clinics, the rate of ART pregnancy (13.8%) and the prevalence of placenta previa (5.5%) in the present study were higher than those in previous reports (2.9%–4.5% [6, 28] and 0.4%–0.6% [3, 5, 6], respectively). These facts might have partially influenced the results of the present study. Therefore, further studies are required to confirm the conclusions of this study.

Acknowledgments

We are grateful for the participation of the subjects and the care provided by the staff of Kobe University Hospital. We thank the clinical personnel who supported this study.

Funding

This research did not receive any specific grand from funding agencies in the public, commercial, or not-for-profit sectors.

Declarations of interest

None

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Figure legends

Figure 1. A flow diagram of the study population.

During the study period, 4,870 pregnant women visited the Kobe University Hospital. Three hundred seventy-five pregnancies ended in spontaneous or induced abortion, and 349 pregnant women delivered at other hospitals. A total of 4,146 women delivered and 87 (2.1%) had PAS. Thirty-one of the 87 had histologically diagnosed PAS, and the remaining 56 had clinically diagnosed PAS.

Figure 1

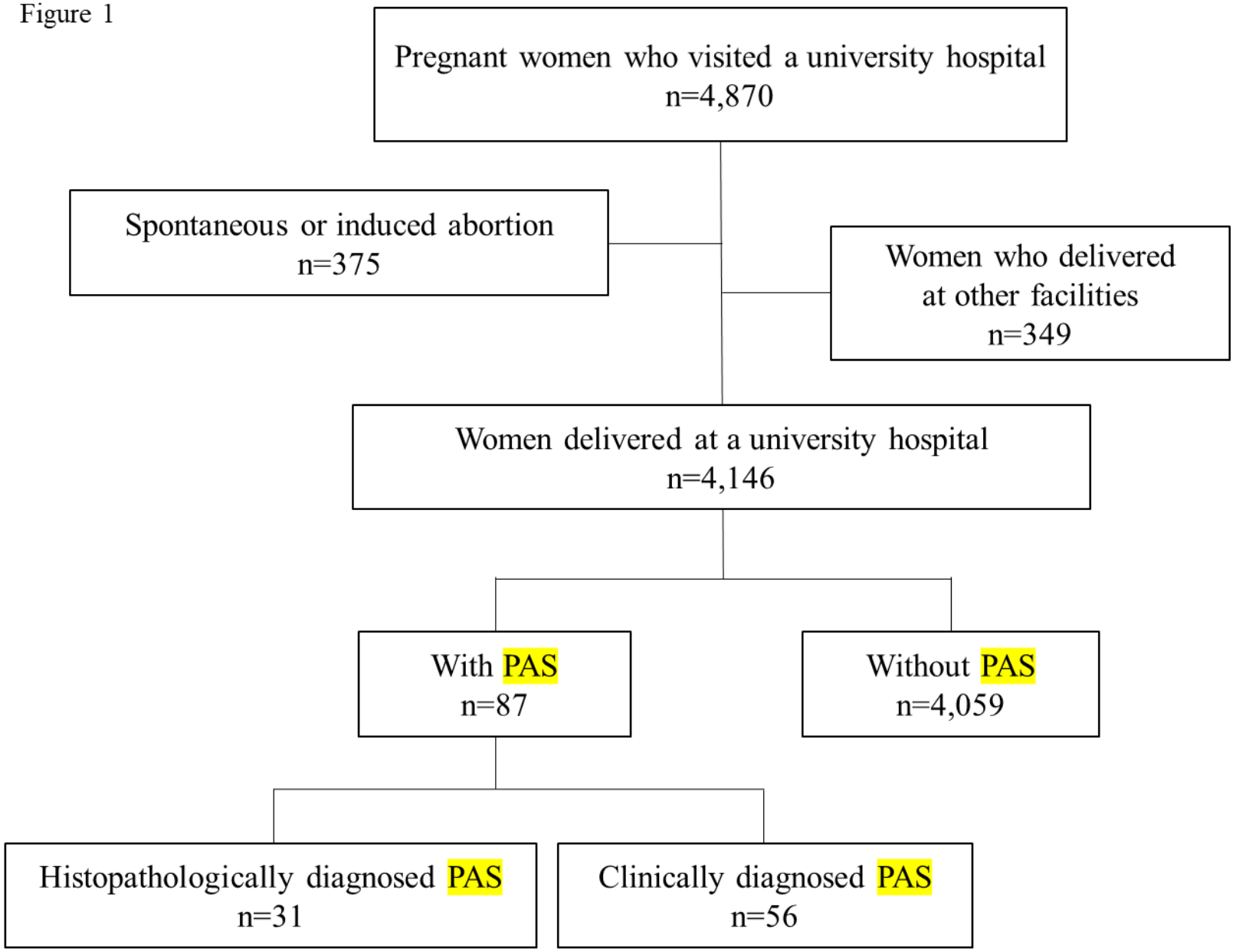
Pregnant women who visited a university hospital
n=4,870
Spontaneous or induced abortion
n=375
Women who delivered
at other facilities
n=349
Women delivered at a university hospital
n=4,146
With PAS
n=87
Without PAS
n=4,059
Histopathologically diagnosed PAS
n=31
Clinically diagnosed PAS
n=56

Table 1. Clinical characteristics of 4,146 pregnant women

Clinical findings	Women with placenta accreta spectrum n=87	Women without placenta accreta spectrum n=4,059	*p* -value
Age (years)	36.0 ± 4.8	33.2 ± 5.5	<0.01
Gravidity	3.2 ± 1.9	2.2 ± 1.4	<0.01
Parity	0.8 ± 0.9	0.6 ± 0.8	<0.05
Prior CS	39.1%	14.8%	<0.01
Prior D&C	56.3%	31.2%	<0.01
Prior hysteroscopic surgery	12.6%	1.0%	<0.01
Prior myomectomy	4.6%	2.4%	0.2
Prior UAE	9.2%	0.2%	<0.01
ART pregnancy	41.4%	13.4%	<0.01
Multiple pregnancy	4.6%	5.6%	1.0
Placenta previa	39.1%	4.5%	<0.01
Gestational weeks at delivery	36.0 ± 3.4	37.1 ± 3.2	<0.01
Caesarean delivery	70.1%	49.1%	<0.01
Amount of blood loss at delivery (g)	2,482 ± 3,092	859 ± 601	<0.01
Birth weight (g)	2,568 ± 689	2,713 ± 661	<0.05

Data are expressed as average ± standard deviation or percentage.

Abbreviations: CS, caesarean section; D&C, dilation and curettage; UAE, uterine artery embolization; ART, assisted reproductive technology.

Table 2. Univariate and multivariable logistic regression analyses of clinical factors associated with placenta accreta spectrum

Clinical factors	Univariate analysis		Multivariable analysis	
	OR (95% CI)	*p* -value	OR (95% CI)	*p* -value
Age (years)	1.1 (1.1–1.2)	< 0.01	1.0 (0.98–1.09)	0.2
Parity	1.3 (1.0–1.5)	< 0.05	1.0 (0.7–1.3)	0.8
Prior CS	3.7 (2.4–5.8)	< 0.01	3.3 (1.9–5.7)	< 0.01
Prior D&C	2.9 (1.9–4.4)	< 0.01	2.8 (1.7–4.6)	< 0.01
Prior hysteroscopic surgery	14.2 (7.0–28.7)	< 0.01	5.7 (2.3–14.4)	< 0.01
Prior myomectomy	1.9 (0.7–5.4)	0.2		
Prior UAE	41.0 (15.8–107.0)	< 0.01	44.1 (13.8–141.0)	< 0.01
ART pregnancy	4.7 (3.0–7.2)	< 0.01	4.1 (2.4–7.1)	< 0.01
Placenta previa	13.5 (8.6– 21.3)	< 0.01	13.1 (7.9–21.8)	< 0.01

Abbreviations: OR, odds ratio; CI, confidence; CS, caesarean section; D&C, dilation and curettage; UAE, uterine artery embolization; ART, assisted reproductive technology.

Table 3. Diagnostic accuracy of each clinical factor associated with placenta accreta spectrum

Clinical findings	Sensitivity, %	Specificity, %	Positive predictive value, %	Negative predictive value, %	Accuracy, %
Prior CS	39.1	85.2	5.4	98.5	84.3
Prior D&C	56.3	68.8	3.7	98.7	68.6
Prior hysteroscopic surgery	12.6	99.0	21.2	98.1	97.2
Prior UAE	9.2	99.8	44.4	98.1	97.9
ART pregnancy	41.4	86.8	6.3	98.6	85.9
Placenta previa	39.1	95.5	15.6	98.7	94.3

Abbreviations: CS, caesarean section; D&C, dilation and curettage; UAE, uterine artery embolization; ART, assisted reproductive technology

Supplemental table 1. Clinical characteristics of women with placenta accreta spectrum who received imaging examinations.

Clinical findings	US and MRI n=41	only US n=2	only MRI n=7
The presence of current placenta previa	33	0	1
The presence of low-lying placenta	1	0	0
Placenta located on the cesarean scar	1	0	0
Morphological abnormality of placenta	0	0	4
Prior UAE	5	1	0
Prior myometrium resection for adenomyosis	1	0	0
Prior adherent placenta	0	1	0
Prior endometrial curretage 4 times for early-stage endometrial cancer	0	0	1
Prior retained placenta	0	0	1

Abbreviations: US, ultrasound; MRI, magnetic resonance imaging.

Supplemental table 2. Diagnostic accuracy of combination of clinical factors associated with placenta accreta spectrum.

Combination of clinical findings	Sensitivity, %	Specificity, %	Positive predictive value, %	Negative predictive value, %	Accuracy, %	Youden Index
Prior CS or D&C	74.7	59.4	3.8	99.1	59.7	0.34
Prior CS or hysteroscopic surgery	44.8	84.4	5.8	98.6	83.6	0.29
Prior CS or UAE	44.8	85.1	6.1	98.6	84.2	0.30
Prior CS or current ART pregnancy	71.3	74.0	5.6	99.2	74.0	0.45
Prior CS or current placenta previa	50.6	81.3	5.5	98.7	80.6	0.32
Prior D&C or hysteroscopic surgery	64.4	68.2	4.2	98.9	68.1	0.33
Prior D&C or UAE	64.4	68.6	4.2	98.9	68.5	0.33
Prior D&C or current ART pregnancy	75.9	61.0	4.0	99.2	61.3	0.37
Prior D&C or current placenta previa	77.0	65.8	4.6	99.3	66.0	0.43
Prior hysteroscopic surgery or UAE	17.2	98.8	23.4	98.2	97.1	0.16
Prior hysteroscopic surgery or current ART pregnancy	48.3	86.2	7.0	98.7	85.4	0.34
Prior hysteroscopic surgery or current placenta previa	46.0	94.5	15.2	98.8	93.5	0.40
Prior UAE or current ART pregnancy	48.3	86.6	7.2	98.7	85.8	0.35
Prior UAE or current placenta previa	46.0	95.2	17.2	98.8	94.2	0.41
Current ART pregnancy or placenta previa	71.3	83.1	8.3	99.3	82.9	0.54
Prior CS or D&C or hysteroscopic surgery	79.3	58.9	4.0	99.3	59.3	0.38
Prior CS or D&C or UAE	80.5	59.3	4.1	99.3	59.7	0.40
Prior CS or D&C, or current ART pregnancy	90.8	52.7	4.0	99.6	53.5	0.43
Prior CS or D&C, or current placenta previa	80.5	56.6	3.8	99.3	57.1	0.37
Prior CS or hysteroscopic surgery or UAE	47.1	84.3	6.0	98.7	83.5	0.31
Prior CS or hysteroscopic surgery, or current ART pregnancy	74.7	73.4	5.7	99.3	73.5	0.48
Prior CS or hysteroscopic surgery, or current placenta previa	56.3	80.5	5.8	98.8	80.0	0.37
Prior CS or UAE, or current ART pregnancy	75.9	73.9	5.9	99.3	73.9	0.50
Prior CS or UAE, or current placenta previa	55.2	81.2	5.9	98.8	80.6	0.36
Prior CS, or current ART pregnancy or placenta previa	78.2	70.8	2.4	99.3	70.9	0.49
Prior D&C or hysteroscopic surgery or UAE	69.0	68.0	4.4	99.0	68.0	0.37
Prior D&C or hysteroscopic surgery, or current ART pregnancy	80.5	60.5	4.2	99.3	60.9	0.41
Prior D&C or hysteroscopic surgery, or current placenta previa	81.6	65.1	2.5	99.4	65.5	0.47
Prior D&C or UAE, or current ART pregnancy	82.8	60.8	4.3	99.4	61.2	0.44
Prior D&C or UAE, or current placenta previa	83.9	65.6	5.0	99.5	65.9	0.49
Prior D&C, or current ART pregnancy or placenta previa	92.0	58.4	4.5	99.7	59.1	0.50
Prior hysteroscopic surgery or UAE, or current ART pregnancy	51.7	86.0	7.3	98.8	85.3	0.38
Prior hysteroscopic surgery or UAE, or current placenta previa	49.4	94.3	15.7	98.9	93.4	0.44
Prior hysteroscopic surgery, or current ART pregnancy or placenta previa	75.9	82.5	8.5	99.4	82.3	0.58
Prior UAE, or current ART pregnancy or placenta previa	77.0	82.9	8.8	99.4	82.8	0.60
Prior CS or D&C or hysteroscopic surgery or UAE	81.6	58.8	4.1	99.3	59.3	0.40
Prior CS or D&C or hysteroscopic surgery, or current ART pregnancy	94.3	52.3	4.1	99.8	53.2	0.47
Prior CS or D&C or hysteroscopic surgery, or current placenta previa	85.1	56.0	4.0	99.4	56.7	0.41
Prior CS or D&C or UAE, or current ART pregnancy	95.4	52.5	4.1	99.8	53.4	0.48
Prior CS or D&C or UAE, or current placenta previa	85.1	56.5	2.6	99.4	57.1	0.42
Prior CS or D&C, or current ART pregnancy or placenta previa	94.3	50.3	3.9	99.8	51.2	0.45
Prior CS or hysteroscopic surgery or UAE, or current ART pregnancy	75.9	73.4	5.8	99.3	73.4	0.49
Prior CS or hysteroscopic surgery or UAE, or current placenta previa	57.5	80.4	5.9	98.9	79.9	0.38
Prior CS or hysteroscopic surgery, or current ART pregnancy or placenta previa	81.6	70.2	5.6	99.4	70.5	0.52
Prior CS or UAE, or current ART pregnancy or placenta previa	81.6	70.7	5.6	99.4	70.9	0.52
Prior D&C or hysteroscopic surgery or UAE, or current ART pregnancy	83.9	61.4	4.3	99.5	61.8	0.45
Prior D&C or hysteroscopic surgery or UAE, or current placenta previa	85.1	64.9	4.9	99.5	65.4	0.50
Prior D&C or UAE, or current ART pregnancy or placenta previa	95.4	57.9	4.6	99.8	58.7	0.53
Prior D&C or UAE, or current ART pregnancy or placenta previa	97.7	58.2	4.8	99.9	59.0	0.56
Prior hysteroscopic surgery or UAE, or current ART pregnancy or placenta previa	78.2	82.3	8.6	99.4	82.2	0.60
Prior CS or D&C or hysteroscopic surgery or UAE, or current ART pregnancy	95.4	52.2	4.1	99.8	53.1	0.48
Prior CS or D&C or hysteroscopic surgery or UAE, or current placenta previa	86.2	56.0	4.0	99.5	56.6	0.42
Prior CS or D&C or hysteroscopic surgery, or current ART pregnancy or placenta previa	97.7	50.0	4.0	99.9	51.0	0.48
Prior CS or D&C or UAE, or current ART pregnancy or placenta previa	97.7	50.2	4.0	99.9	51.2	0.48
Prior CS or hysteroscopic surgery or UAE, or current ART pregnancy or placenta previa	81.6	70.2	5.5	99.4	70.4	0.52
Prior D&C or hysteroscopic surgery or UAE, or currentART pregnancy or placenta previa	97.7	57.8	4.7	99.9	58.6	0.55
Prior CS or D&C or hysteroscopic surgery or UAE, or current ART pregnancy or placenta previa	97.7	49.9	4.0	99.9	50.9	0.48

Abbreviations: CS, caesarean section; D&C, dilation and curettage; UAE, uterine artery embolization; ART, assisted reproductive technology