

# Emergent versus planned delivery in patients with placenta accreta spectrum disorders

## A retrospective study

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### Abstract

The aim of this study is to compare the clinical outcomes and to identify risk factors for emergent cesarean delivery and planned cesarean delivery in patients with placenta accreta spectrum (PAS) disorders in Vietnam.

The medical records of patients admitted to our hospital with a diagnosis of PAS disorders >5 years were retrospectively reviewed.

A total of 255 patients with PAS disorders were identified, including 95 cases in the emergent delivery group and 160 cases in the planned delivery group. The percentage of complete/partial placenta previa in the planned delivery group was significantly higher than that in the emergent delivery group (59.22% vs 32.16%,  $P = .027$ ). Fewer patients in the planned group had vaginal bleeding compared with those in the emergent group (29 vs 36 cases,  $P < .001$ ). The percentage of blood transfusion was similar between the 2 groups; however, the transfused units of pack red blood cells were greater in the emergent delivery group ( $5.3 \pm 0.33$  vs  $4.5 \pm 0.25$  U,  $P = .036$ ). When considering the neonatal outcomes, the data demonstrated that the planned delivery group had a significantly higher birth weight and a lower rate of preterm delivery than the emergent group ( $P < .001$ ). The mean gestational age at delivery for the emergent group was  $35.1 \pm 0.27$  weeks compared with  $38.0 \pm 0.10$  weeks for the planned group ( $P < .001$ ). The increased risk factors for emergent delivery were vaginal bleeding (odds ratio 2.86, 95% confidence interval 1.59–5.26) and preterm delivery (odds ratio 5.26, 95% confidence interval 2.13–14.29).

Planned delivery is strongly associated with a lower need for blood transfusion and better neonatal outcomes compared with emergent delivery. Antenatal vaginal bleeding and preterm labor are risk factors for emergent delivery among patients with PAS disorders. Based on the results of this study, we recommend that the management strategies for patients with PAS disorders should be individualized to determine the optimal timing of delivery and to decrease the rate of emergent cesarean delivery.

**Abbreviations:** CI = confidence interval, OR = odds ratio, PAS = placenta accreta spectrum.

**Keywords:** emergent delivery, placenta accreta spectrum, planned delivery, risk factors

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*Ethics approval and consent to participate:* Ethical approval for the study was granted by the Medical Ethics Committee of the National Hospital of Obstetrics & Gynecology. Patients' informed consent was not obtained due to the retrospective nature of the study.

The authors report no conflicts of interests.

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

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## 1. Introduction

Placenta accreta spectrum (PAS) is an abnormal condition in which the placenta invades the myometrium, other pelvic tissue and sometimes the organs.<sup>[1,2]</sup> PAS includes placenta accreta, placenta increta, and placenta percreta.<sup>[3,4]</sup> The incidence of PAS disorders has increased significantly in the last few decades and seems to correlate with the increasing rate of cesarean delivery.<sup>[5]</sup> One recent estimate for the incidence of PAS is 9 in 1000 patients (0.91%),<sup>[6]</sup> which has increased from 0.12% to 0.31% over the last 30 years.<sup>[7]</sup> PAS disorders have become a life-threatening obstetric problem with a mortality rate of approximately 7%.<sup>[3,8]</sup>

Several risk factors have been identified for PAS, including previous cesarean section, placenta previa,<sup>[9,10]</sup> uterine surgeries, multiparity, and maternal age.<sup>[3,11]</sup> The study of Eshkoli et al<sup>[10]</sup> proved that women with placenta previa and prior cesareans were more likely to have PAS disorders. Likewise, a national case-control study in the UK showed that the increased odds of having PAS were associated with older maternal age.<sup>[11]</sup> Zhang et al<sup>[12]</sup> retrospectively reviewed 153 cases and added parity as another risk factor for PAS disorders. Among patients with PAS disorder, antenatal vaginal bleeding and preterm premature rupture of membranes were more likely to require emergent delivery.<sup>[13]</sup> Wang et al<sup>[14]</sup> also demonstrated that the risk of emergent delivery increased 2.4-fold for patients with antepartum hemorrhage.

The optimal management method for PAS disorders is still controversial.<sup>[15]</sup> A planned, scheduled delivery with a multidisciplinary team<sup>[16,17]</sup> is associated with shorter operative time,

decreased maternal hemorrhagic morbidity, and fewer intensive care unit admissions when compared with an unscheduled, emergent delivery.<sup>[18,19]</sup> The ideal timing of delivery in patients with PAS disorders has not been decided. The American College of Obstetricians and Gynecologists recommends a scheduled delivery at 34 weeks of gestational age,<sup>[5]</sup> whereas others advise delaying delivery to 36 weeks as a balance between maternal risks and fetal immaturity.<sup>[20]</sup> Thus, the purpose of this study was to compare the clinical outcomes and to identify possible risk factors for urgent cesarean delivery and scheduled cesarean delivery in Vietnam.

## 2. Methods

### 2.1. Study context

The medical records of 255 patients had at least 1 previous cesarean section and admitted to the National Hospital of Obstetrics and Gynecology, Vietnam, with the diagnosis of PAS disorders from January 2014 to December 2018 were collected and analyzed.

### 2.2. Selection criteria

Patients in the third trimester (from 28 weeks of gestation) diagnosed with PAS disorders by either antenatal imaging (ultrasound, Doppler and magnetic resonance imaging), at operation or by pathology specimen were selected for this study. We made the final diagnosis according to postpartum clinical manifestations and/or pathological characteristics. The clinical manifestations included the following criteria:<sup>[21,22]</sup> difficult manual or piecemeal removal of the placenta and heavy bleeding from the placentation site after removal of the placenta during cesarean delivery and placental tissue invading through the surface of the uterus with or without hypervascularity. Absent decidua between villous tissue and myometrium with placental villi attached directly to the superficial myometrium were the histologic criteria of PAS disorders.<sup>[23]</sup>

### 2.3. Data collection

Data were collected using a self-developed tool that captured general and obstetric characteristics, treatment modality, clinical outcomes, and other information. Demographic and obstetric characteristics included maternal age, socioeconomic status, time at hospital before surgery, parity, previous cesarean section, history of miscarriages, history of preterm labor, placental location (anterior, posterior or anterior/posterior), placenta previa (defined as complete or marginal <2 cm from the cervical os), severity of invasion (accreta, increta, percreta), and vaginal bleeding. Treatment modality included delivery type (planned or emergent), skin incisions (low transverse, midline), uterine incisions (transverse uterine fundus, low transverse, vertical uterine), and surgical methods (total/partial hysterectomy, uterine preservation). Clinical outcomes included pre- and postoperative hemoglobin, blood transfusion, surgical complications, time at hospital after surgery, gestational age at delivery, birth weight, preterm delivery, Apgar scores at 1 and 5 minutes, and neonatal mortality.

### 2.4. Ethical considerations

The study was approved by the Medical Ethics Committee of the National Hospital of Obstetrics & Gynecology. Patients'

informed consent was not obtained due to the retrospective nature of the study.

### 2.5. Statistical analysis

STATA 15 Software (StataCorp, 2017, Stata Statistical Software: Release 15, College Station, TX: StataCorp LLC) was used for statistical analysis. Numerical data are expressed as the means  $\pm$  standard deviations (SDs) and ranges, whereas categorical data are expressed as numbers and percentages. Continuous variables were compared using a 2-sample Student *t* test. Categorical variables were compared using a  $\chi^2$  test. Kaplan-Meier statistics were used to analyze the timing of delivery in the planned and emergent delivery groups, and their significance was determined by the log-rank test. A multivariable logistic regression model was constructed to identify independent risk factors associated with delivery type of placenta accreta disorders with the odds ratios (ORs) and their 95% confidence intervals (CIs) computed.  $P < .05$  was considered statistically significant.

## 3. Results

A total of 255 patients were admitted to our hospital with a diagnosis of PAS disorders between January 2014 and December 2018. All diagnoses of PAS were ultimately confirmed by clinical manifestations and/or pathological examination. Table 1 describes the demographic and obstetric characteristics of the 255 patients. The average maternal age was 32.4 (range 19–45). Nearly three-fourths (74.51%) of the patients stayed in the hospital >7 days before surgery, whereas 87.84% stayed  $\leq$ 7 days after surgery. All patients experienced previous cesarean section and mostly had 1 or 2 previous cesarean deliveries (91.37%). Over 40% of patients had a history of miscarriages, and 9.8% had a history of preterm labor. The placenta locations were anterior in 81.96%, posterior in 17.65%, and anterior/posterior in 0.39%. The most common type of placenta previa was the complete/partial group, accounting for 98.04%. There were 8 (0.03%) cases with placenta accreta, 233 (0.92%) cases with placenta increta, and 14 (0.05%) cases with placenta percreta. Twenty-five percent of pregnancies among the cases experienced vaginal bleeding.

Table 2 shows comparisons between the planned and emergent delivery groups regarding demographic and obstetric characteristics. Among 255 patients identified in our study, 95 cases were emergent deliveries, and 160 cases were planned deliveries. Overall, patients in the 2 groups were similar with respect to maternal age at delivery, socioeconomic status, time in the hospital before/after surgery, parity, previous cesarean section, history of miscarriage, and placental location. Eighteen cases (7.06%) in the emergent delivery group had previous preterm labor, compared with 7 cases (2.75%) in the planned delivery group ( $P < .001$ ). The percentage of complete/partial placenta previa in the planned delivery group was significantly higher than that in the emergent delivery group (59.22% vs 32.16%,  $P = .027$ ). There was a significant difference in the severity of invasion between the two groups ( $P = .043$ ). Compared with those in the emergent delivery group, those in the planned delivery group demonstrated a higher rate of placenta increta (59.22% vs 32.16%) and a lower rate of placenta accreta (0.78% vs 2.35%). Fewer patients in the planned group had vaginal bleeding compared with those in the emergent group (29 vs 36 cases,  $P < .001$ ).

**Table 1**  
Demographic and obstetric characteristics.

Characteristics	Mean or No.	Range or percentage
Age, y <sup>*</sup>	32.4 ± 4.64	19–45
Socioeconomic status		
High	114	44.71%
Low	141	55.29%
Time in the hospital before surgery, days		
≤7	65	25.49%
>7	190	74.51%
Time in the hospital after surgery, days		
≤7	224	87.84%
>7	31	12.16%
Parity		
1	96	37.65%
2	117	45.88%
≥3	42	16.47%
Previous cesarean section		
1	134	52.55%
2	99	38.82%
≥3	22	8.63%
History of miscarriages		
Yes	103	40.39%
No	152	59.61%
History of preterm labor		
Yes	25	9.8%
No	230	90.2%
Placental location		
Anterior	209	81.96%
Posterior	45	17.65%
Anterior/posterior	1	0.39%
Placenta previa		
Low-lying placenta	2	0.78%
Marginal placenta previa	3	1.18%
Complete/partial placenta previa	250	98.04%
Severity of invasion		
Accreta	8	0.03%
Increta	233	0.92%
Percreta	14	0.05%
Vaginal bleeding		
Yes	65	25.49%
No	190	74.51%

\* Data presented as the mean ± standard deviation.

Table 3 summarizes peripartum events and clinical outcomes in the planned and emergent delivery groups. The mean preoperative hemoglobin level was greater in the planned group than in the emergent group (114.9 g/dL ± 0.96 vs 112 ± 1.19 g/dL) but showed no significant difference ( $p=0.063$ ). Meanwhile, the mean postoperative hemoglobin level of patients with planned delivery was significantly higher than that in the emergent group (110.1 ± 1.25 g/dL vs 103.1 ± 1.49 g/dL,  $P=.001$ ). The percentage of blood transfusion was similar between the two groups; however, the transfused units of pack red blood cells were greater in the emergent delivery group (5.3 ± 0.33 vs 4.5 ± 0.25 units,  $P=.036$ ). Overall, there were no significant differences in uterine incision, surgical method, or surgical complications. Compared with a low transverse skin incision, a midline incision was used more often in both the emergent and planned groups (25.49% and 34.12%, respectively). The most common operative complications of patients in this study were bladder or ureteral injuries (54 cases) and hematoma after surgery (3 cases). When considering the neonatal outcomes, the data showed that the

**Table 2**  
Comparisons between planned and emergent delivery groups regarding general characteristics.

Characteristics	Emergent (n=95)	Planned (n=160)	P
Age, y <sup>†</sup>	32.3 ± 0.48	32.5 ± 0.37	.824
Socioeconomic status			
High	37 (14.51%)	77 (30.20%)	.154
Low	58 (22.75%)	83 (32.55%)	
Time in the hospital before surgery, days			
≤7	29 (11.37%)	36 (14.12%)	.155
>7	66 (25.88%)	124 (48.63%)	
Time in the hospital after surgery, days			
≤7	83 (32.55%)	141 (55.29%)	.858
>7	12 (4.71%)	19 (7.45%)	
Parity			
1	32 (12.55%)	64 (25.10%)	.083
2	41 (16.08%)	76 (29.80%)	
≥3	22 (8.63%)	20 (7.84%)	
Previous cesarean section			
1	46 (18.04%)	88 (34.51%)	.517
2	39 (15.29%)	60 (23.53%)	
≥3	10 (3.92%)	12 (4.71%)	
History of miscarriages			
Yes	37 (14.51%)	66 (25.88%)	.717
No	58 (22.75%)	94 (36.86%)	
History of preterm labor <sup>*</sup>			
Yes	18 (7.06%)	7 (2.75%)	<.001
No	77 (30.20%)	153 (60.00%)	
Placental location			
Anterior	80 (31.37%)	129 (50.59%)	.286
Posterior	14 (5.49%)	31 (12.16%)	
Anterior/posterior	1 (0.39%)	0 (0%)	
Placenta previa <sup>*</sup>			
Low-lying/marginal placenta	13 (5.10%)	9 (3.53%)	.027
Complete/partial placenta previa	82 (32.16%)	151 (59.22%)	
Severity of invasion <sup>*</sup>			
Accreta	6 (2.35%)	2 (0.78%)	.043
Increta	82 (32.16%)	151 (59.22%)	
Percreta	7 (2.75%)	7 (2.75%)	
Vaginal bleeding <sup>*</sup>			
Yes	36 (14.12%)	29 (11.37%)	<.001
No	59 (23.14%)	131 (51.37%)	

\* Statistically significant.

† Data presented as the mean ± standard deviation.

planned delivery group had a significantly higher birth weight than the emergent group (2306.5 ± 62.24 g vs 2946.5 ± 29.14 g,  $P<.001$ ). The mean gestational age at delivery for the emergent group was 35.1 ± 0.27 weeks compared with 38.0 ± 0.10 weeks for the planned group ( $P<.001$ ). A total of 189 patients underwent preterm delivery, including 61 cases (23.92%) in the emergent group and 5 cases (1.96%) in the planned group, which was statistically significant ( $P<.001$ ). No differences were found in the Apgar scores at 1 and 5 minutes.

Kaplan–Meier curves were performed to demonstrate the proportions of delivered patients in the emergent and planned groups weekly (Fig. 1). Kaplan–Meier survival analysis showed that emergent patients delivered earlier than those with planned delivery. The log-rank test indicated that preterm delivery was associated with the type of delivery and gestational age at delivery.

A logistic regression model was developed to determine risk factors related to the type of delivery. In this model, only vaginal

**Table 3**  
**Comparisons between planned and emergent delivery groups regarding peripartum events and clinical outcomes.**

Characteristics	Emergent (n=95)	Planned (n=160)	P
Preoperative Hb, g/dL <sup>†</sup>	112.0 ± 1.19	114.9 ± 0.96	.063
Postoperative Hb, g/dL <sup>*,†</sup>	103.1 ± 1.49	110.1 ± 1.25	.001
Blood transfusion			
Yes	86 (33.73%)	148 (58.04%)	.579
No	9 (3.53%)	12 (4.71%)	
Transfused units (pack red blood cells; ×10 <sup>12</sup> cells/L) <sup>*,†</sup>	5.3 ± 0.33	4.5 ± 0.25	.036
Complications			
Yes	73 (28.63%)	125 (49.02%)	.812
No	22 (8.63%)	35 (13.73%)	
Skin incision <sup>*</sup>			
Low transverse	30 (11.76%)	73 (28.63%)	.027
Midline	65 (25.49%)	87 (34.12%)	
Uterine incision			
Low transverse	25 (9.80%)	27 (10.59%)	.171
Vertical uterine	47 (18.43%)	94 (36.86%)	
Transverse fundus	23 (9.02%)	39 (15.29%)	
Surgical method			
Total hysterectomy	7 (2.75%)	10 (3.92%)	.937
Partial hysterectomy	79 (30.98%)	134 (52.55%)	
Uterine preservation	9 (3.53%)	16 (6.27%)	
Birth weight, g <sup>*,†</sup>	2306.5 ± 62.24	2946.5 ± 29.14	<.001
Gestational age at delivery, wk <sup>*,†</sup>	35.1 ± 0.27 (Range: 28–39)	38.0 ± 0.10 (Range: 34–41)	<.001
Preterm delivery <sup>*</sup>			
≥37 wk	34 (13.33%)	155 (60.78%)	<.001
< 37 wk	61 (23.92%)	5 (1.96%)	
Apgar score at <sup>†</sup>			
1 min	8.9 ± 0.06	8.9 ± 0.03	.532
5 min	9.9 ± 0.06	9.9 ± 0.02	.238
Neonatal mortality	—	—	—

\* Statistically significant.  
<sup>†</sup> Data presented as the mean ± standard deviation.  
 Hb = Hemoglobin.

bleeding ( $P=.001$ ) and preterm delivery ( $P<.001$ ) were significantly associated with emergent delivery (Table 4). The logistic regression analysis showed that vaginal bleeding and preterm delivery increased the risk of emergent delivery (OR

2.86, 95% CI 1.59–5.26 and OR 5.26, 95% CI 2.13–14.29, respectively).

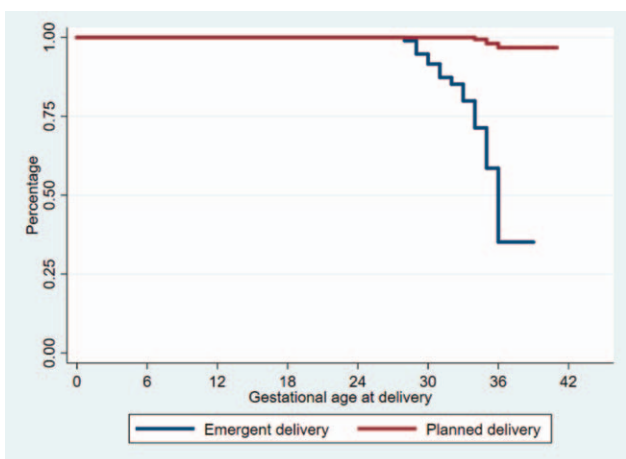
**4. Discussion**

In our hospital, PAS patients were diagnosed prenatally on ultrasound and magnetic resonance image (MRI). We used ultrasound to detect PAS patients. After then, these patients underwent MRI because of suspicion of PAS disorder by ultrasonography. A prospective cohort study showed that placenta accreta can be successfully detected prenatally using ultrasound (sensitivity 95.1% and specificity 95.5%). MRI can provide additional information in doubtful cases (sensitivity 85.7% and specificity 76.9%).<sup>[24]</sup>

**Table 4**  
**Independent risk factors for delivery type identified by logistic regression.**

Risk factor	Odds ratio	Emergent vs Planned		P
		95% CI		
		Lower	Upper	
Vaginal bleeding <sup>*</sup>	2.86	1.59	5.26	.001
Preterm delivery <sup>*</sup>	5.26	2.13	14.29	<.001

\* Statistically significant.  
 CI = confidence interval.



**Figure 1.** Time to delivery for patients with placenta accreta spectrum disorders in the emergent and planned groups. Figure legend: Survival time is defined as gestational age at delivery in weeks. Log-rank test:  $P$  value <.001.

Women with PAS disorders were at increased risk for early, emergent delivery if they experienced vaginal bleeding or preterm delivery. This risk of emergent delivery increased 2.9-fold for patients with antenatal vaginal bleeding (95% CI 1.59–5.26,  $P=.001$ ) and 5.2-fold for patients who delivered before 37 weeks (95% CI 2.13–14.29,  $P<.001$ ). These results agreed with the findings of 2 authors. Bowman et al<sup>[13]</sup> studied risk factors for unscheduled delivery in patients with PAS disorders and found that vaginal bleeding and preterm premature rupture of membranes were considered significant risk factors. Wang et al<sup>[14]</sup> also reported that antepartum hemorrhage increased the risk of emergent delivery (OR 2.54, 95% CI 1.19–5.44,  $P=.016$ ).

Previous studies have demonstrated that planned cesarean delivery is a safe procedure and provides an additional benefit by improving resident surgical training.<sup>[25]</sup> Meanwhile, emergent delivery of patients with PAS can lead to profuse, life-threatening hemorrhage and difficulty in surgical procedures.<sup>[26]</sup> In the present study, we found a significantly lower postoperative hemoglobin level and a consequent increase in the units of packed red blood cells transfused in the emergent group. These results were supported by a retrospective study that reported that planned patients with predelivery diagnosis required smaller units of packed red blood cells compared to emergent patients with no predelivery diagnosis ( $4.7\pm 2.2$  vs  $6.9\pm 1.8$  U,  $P=.02$ ).<sup>[18]</sup> In Schwickert et al's study, the likelihood of blood loss  $>3500$  mL was reduced in planned compared to emergent cesarean delivery.<sup>[27]</sup>

The present results revealed that the planned delivery group had a significantly higher gestational age ( $35.1\pm 0.27$  vs  $38.0\pm 0.10$  weeks,  $P<.001$ ) and birth weight ( $2306.5\pm 62.24$  g vs  $2946.5\pm 29.14$  g,  $P<.001$ ) than the emergent group. Our results were also in agreement with the study of Eller et al,<sup>[16]</sup> which reported that scheduled delivery with a multidisciplinary team showed better neonatal outcomes when compared with an emergent delivery. Meller et al<sup>[28]</sup> studied 95 cases of PAS and found that emergent patients were delivered earlier than those in the planned delivery group (mean 30.9 vs 36 weeks). In Bowman et al's study, emergent delivery accounted for 46.75% (36/77), with a mean gestational age of 32.3 weeks, and planned delivery occurred in 53.25% (41/77), with a mean gestational age of 35.7 weeks.<sup>[13]</sup>

In our study, the planned delivery group had more dangerous types of placenta previa (151 patients complete/partial placenta previa) and worse invasion of the placenta (151 patients increta and 7 patients percreta) compared with the emergent group. Despite these differences, the planned patients showed better clinical outcomes, including greater postoperative hemoglobin level, lower units of packed red blood cells transfused, higher gestational age, and birth weight.

The optimal management strategy of PAS disorders has yet to be established because of different data in the present literature.<sup>[29,30]</sup> To obtain planned timing for surgery, the decision should be made individually based on the severity of placental implantation and the patient's condition.<sup>[5,31]</sup> Some authors recommend delivery between 34 and 35 weeks of gestational age,<sup>[18,31]</sup> whereas others advise delaying delivery to 36 weeks as a balance between maternal risks and fetal immaturity.<sup>[20]</sup> Meller et al<sup>[28]</sup> support the rationale of a scheduled delivery at approximately 36 weeks in the absence of risk factors. According to the study by Morlando et al, delivery at  $>36$  weeks' gestation in women who have not bled and have no risk factors for preterm birth could be considered.<sup>[32]</sup> In

another study by Robinson and Grobman, delivery at 37 weeks of gestation was the preferred strategy in limited situations, and delivery at 39 weeks of gestation was considered only in unlikely situations.<sup>[33]</sup> According to the management strategy of PAS disorders in our hospital, the time of planned cesarean section is ranged between 36 and 37 weeks. However, some patients in our study did not get checkups and prenatal testing from an obstetrician through their pregnancy. As a result, they were admitted to our hospital and underwent a planned cesarean section at 41 weeks of gestation. By contrast, 5 patients (1.96%) in our study underwent a planned cesarean section at  $<37$  weeks of gestation. These patients were delivered at  $<37$  weeks' gestation because they had other diseases such as hypertension and preeclampsia.

It is important to set the strategy to minimize the risk of emergent cesarean delivery. First, we need to detect women with PAS early by combining obstetrics history, clinical findings and imaging techniques (ultrasound, MRI). After then, we should refer these women to specialized obstetrics referral centers whenever possible. A multidisciplinary team of obstetricians, gynecologist, vascular surgeons, interventional radiologists, urologists, and hematologists in referral centers increases accuracy of the diagnosis, and subsequent management by experts reduces maternal morbidity and mortality.<sup>[34,35]</sup> In our hospital, the strategy of a planned cesarean section included blood typing, cross-matching of at least 2 units of packed red cells, and invitation of multiple team works. In planned cases of cesarean hysterectomy, we used a midline vertical incision to minimize dissection of tissue planes and provide good visualization of the abdomen and pelvis.<sup>[35]</sup>

We were limited by the retrospective nature of this study. The quality of our data may be affected by the quality of documentation available over the 5-year study period. Furthermore, our sample size was insufficient to identify small differences in rare complications, such as bowel injury or coagulopathy, between the 2 groups (emergent vs planned). Another study limitation was the shortness of data relating to additional procedures before and after operation. We look forward to data in future studies that prospectively follow a cohort of patients with PAS to provide the detailed information what additional procedures were done preoperatively or postoperatively. Despite these limitations, our study also had a number of strengths. First, data were collected by trained physician researchers and double checked for accuracy by 2 investigators. Secondly, we included a relatively large number of typical cases of PAS disorders in a single center; therefore, patients were managed in a similar strategy. In the future, prospective cohort studies and randomized trials are necessary to inform better clinical decision-making about the timing of delivery and mode of birth, which minimizes the risk of maternal and neonatal morbidity.

## 5. Conclusions

Antenatal vaginal bleeding and preterm labor are risk factors for emergent delivery among patients with PAS disorders. Planned delivery is strongly associated with a lower need for blood transfusion and better neonatal outcomes compared with emergent delivery. Based on the results of this study, we recommend that the management strategies for patients with PAS disorders should be individualized to determine the optimal timing of delivery and to decrease the rate of emergent cesarean delivery.

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## Author contributions

TNM, TLP, ANTH: Conceptualization, Methodology

TLP, TPH: Investigation.

TPH, ANTH: Formal analysis.

ANTH, TPH, TNM: Writing – Original Draft, Visualization.

TNM, CTD: Supervision, Writing – Review & Editing.

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