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# Analysis of clinical features of 231 cases with pernicious placenta previa
## A retrospective cohort study

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**Abstract**

Pernicious placenta previa (PEPP) is a severe complication of late pregnancy, which might result in adverse maternal-fetal outcome. To explore the application value of placenta accreta score (PAS) for PEPP and its association with maternal-fetal outcome.

In this retrospective cohort study, the clinical data of PEPP patients were analyzed. According to the ultrasonic PAS, patients were grouped into 3 groups: scores ≤5, a scores between 6 and 9, and scores ≥10. The clinical data, intraoperative and postoperative outcomes were collected. Receiver operating characteristic (ROC) curves were used to evaluate the performance of PAS in disease severity evaluation. Multivariate logistic and linear regression analysis were performed to assess associations of PAS with intraoperative and postoperative outcomes.

A total of 231 patients were enrolled. There were significant differences in intraoperative, postoperative and neonatal outcomes, such as operation time, bladder repair, ICU admission, postoperative hospitalization days, operation complications, Apgar score of newborns in 1 minute and premature delivery among the 3 groups (all $P < .05$), while the worst outcomes were found in those with a score ≥ 10 (all $P < .05$). According to ROC curves, scores <5.5, between 5.5 and 7.5, and >7.5 indicated placenta accreta, placenta increta and placenta percreta, respectively. PAS was independently associated with longer time of operation, surgical complications, intraoperative bleeding volume, and postoperative hospitalization days (all $P < .05$).

Placenta accreta score might help with PEPP subtype diagnosis and predict the maternal-fetal outcome of PEPP patients.

**Abbreviations:** PAS = placenta accreta score, PEPP = pernicious placenta previa.

**Keywords:** low abdominal aortic extravascular occlusion, pernicious placenta previa, placenta accreta score

## 1. Introduction

Pernicious placenta previa (PEPP) is a severe complication of late pregnancy characterized by postpartum hemorrhage. Placenta

implantation (depth of placenta invasion into myometrium) is classified into 3 types, including placenta accreta, placenta increta, and placenta percreta.[1–3] Placenta increta is defined as the complete separation of placenta characterized by massive hemorrhage, which can be life-threatening.[4,5] Currently, due to the increase in the cesarean section rate, the incidence of PEPP has significantly increased.[6,7] Besides, with the implementation of China's two-child policy, such a phenomenon is particularly prominent.

Acute massive hemorrhage, massive blood transfusion, hysterectomy, and even maternal death during cesarean section are frequently encountered in patients with PEPP.[8–11] Therefore, it is necessary to evaluate the position of the placenta increta and operation difficulty before surgery, in order to reduce postpartum hemorrhage during delivery and severe complications. In this study, placenta accreta score[12] was used to judge the depth and area of placenta increta. However, only by accurately evaluating the PEPP and the risk of placenta increta can we determine whether preoperative ureteral stent presetting, deep vein catheterization, arterial catheterization, placenta positioning, incision selection, a large amount of blood preparation, and low abdominal aortic extravascular occlusion are necessary during surgery.

The blood supply of uterus mainly comes from internal iliac artery.[13] In theory, ligation or embolization of bilateral internal iliac arteries can effectively block uterine blood flow and reduce uterine bleeding. However, collateral circulation in the uterus, such as ovarian artery and/or inferior epigastric artery of external iliac artery branch participating in the establishment of collateral blood supply, can affect the internal iliac artery or uterine artery

embolization on blocking uterine blood flow. In case of abnormal hyperplasia of blood vessels in the placental attachment site, the bleeding of arteries can hardly be controlled, and the issue of the newly generated thick and dense venous plexuses should also be addressed. In this case, it is difficult to achieve hemostasis by simply blocking or embolizing the internal iliac artery or uterine artery.[14,15] Preventive vascular embolization or ligation cannot be performed before operation, and there are no conditions for temporary balloon blocking and uterine artery embolization during the perioperative period of the internal iliac artery in many hospitals. However, once the fetus is delivered, the exposure of the placenta increta may result in an uncontrollable massive hemorrhage, which in turn affects the surgical field of vision and aggravates the difficulty of bilateral iliac vascular ligation.[16,17] This may be the leading cause of the PEPP formation, which is usually very difficult to treat. Therefore, timely and effective control of bleeding and reducing hysterectomy rates are of great significance.

In this study, low abdominal aortic extravascular occlusion was performed in 231 pregnant women with PEPP and with a high placenta score who were admitted to the Obstetrics Department of the Hospital from 2018 to 2019. This study aimed to explore the application value of placenta accreta score for PEPP and its impact on maternal-fetal outcome.

## 2. Methods

### 2.1. Study design and patients

This retrospective cohort study included patients of Hunan Provincial Maternal and Child Health Care Hospital, Hunan, China from 2018 to 2019. Inclusion criteria were:

1. 20 to 45 years of age;
2. a history of C-section;
3. 28 to 40 weeks of pregnancy;
4. diagnosis of placenta previa by ultrasound[18];
5. placenta attached to the uterine scar.

   Exclusion criteria were:

1. placenta previa ruled out by pathological or surgical evidence;
2. multiple pregnancy;
3. concurrent fetal malformation;
4. combination with primary coagulation dysfunction, thrombocytopenia, aplastic anemia, and other hematological diseases;
5. other serious pregnancy complications;
6. incomplete clinical data.

It was approved by the ethics committee of Hunan Provincial Maternal and Child Health Care Hospital, Hunan, China. The requirement for informed consent was waived due to its retrospective nature.

### 2.2. Placenta accreta scale

Ultrasound was performed by the transvaginal method with a full bladder, at gestational weeks 7–8, 12, 24, and 32, respectively. Then, the placenta accreta ultrasound rating scale[12] (Supplemental Digital Content 1, http://links.lww.com/MD/F840) was applied for the assessment of patients with PEPP by an experienced radiologist. Interruption or disappearance of postplacental hypoechoic cords indicated the possibility of placenta increta; interruption or disappearance of the bladder line indicated the possibility of invasion of "cross-border" blood vessels into the bladder. Placental lacuna referred to the formation of blood sinuses after placenta increta into myometrium. Arterial blood flow occurs when blood sinuses fuse into pieces, and "boiling water sign" occurs when blood flow is swift. According to the corresponding scores, the type of placenta increta was predicted as follows: score ≤5, a non-increta or placenta accreta; a score between 6 and 9, a placenta increta; score ≥10, a placenta percreta.[8]

### 2.3. Low abdominal aorta extravascular occlusion

For PEPP with a high score, preparation for low abdominal aorta extravascular occlusion was made. Implementation steps of extravascular occlusion of the low abdominal aorta were as follows: after the delivery of the fetus during cesarean section, the lower segment of the uterus was bundled with a pulse pressure belt. Saline gauze pads were then used to reveal the intestinal canal. About 3 cm above the bifurcation of the abdominal aorta and below the renal artery level of the branch of the abdominal aorta, the abdominal aorta segment was freed about 1 cm. The prepared scalp needle plastic tube was used as the blocking tube to bypass the lower segment of the abdominal aorta twice. The plastic tube was pushed to cling to the abdominal aorta with right-angle forceps, and the blocking band was clamped with right-angle forceps for the fixture. When the hand touched the common iliac artery, and the pulsation disappeared, the operation was completed. After blocking, 20 mg heparin was intravenously injected to prevent thrombosis, and 20 mg protamine was intravenously injected to resist heparin effect after releasing blocking.

### 2.4. Diagnosis, data collection, and outcomes

The gold standard method for placenta accreta spectrum diagnosis was pathological analysis. Postoperative complications were assessed, including intestinal obstruction, poor wound healing, infection, and intra-abdominal bleeding.

The patient's age, gestational age, pregnancy times, parity times, induced abortion times, cesarean section times, placenta accreta score, neonatal weight and score, intraoperative blood loss, autologous blood transfusion, uterus removal, operation duration, and postoperative hospitalization days were collected.

### 2.5. Statistical analysis

SPSS19.0 statistical software (IBM Corp., Armonk, NY) was used for processing. Mean (standard deviation) or median (interquartile range [Q1, Q3]) was used as measurement data, and frequency (%) was used as enumeration data. One-way analysis of variance was used for inter-group comparison of data satisfying normality and variance homogeneity. The LSD method was used for multiple comparisons. The non-parametric rank-sum test was adopted for those data that did not meet these criteria. The enumeration data were mainly analyzed by the $x^2$ test or Fisher accurate probability method. Receiver operating characteristic (ROC) curves and area under the ROC curves (AUCs) were used to evaluate the performance of PAS in disease severity evaluation. Multivariate logistic and linear regression analysis were performed to assess associations of PAS with intraoperative and postoperative outcomes. A $P$ value <.05 was considered statistically significant.

**Table 1**

**Characteristics of patients.**

| Characteristics | ≤5 points (n=101) | 6–9 points (n=100) | ≥10 points (n=30) | *P* value |
|---|---|---|---|---|
| Age, years | 32.95±3.89 | 33.36±4.13 | 33.73±4.18 | .590 |
| Gestational weeks, weeks | 36.04±1.71 | 35.96±1.27 | 35.34±1.89 | .091 |
| Pregnancy times | 3.87±1.55 | 3.99±1.45 | 4.53±1.59 | .111 |
| Parity, times | 1.10±0.33 | 1.17±0.43 | 1.43±0.57[*,†] | .001 |
| Induced abortion, times | 1.75±1.47 | 1.81±1.28 | 2.07±1.36 | .545 |
| Cesarean section, times | 1.05±0.22 | 1.10±0.33 | 1.33±0.55[*,†] | <.001 |
| Preoperative Hemoglobin, g | 113.08±11.84 | 112.35±10.95 | 111.57±14.08 | .802 |
| Body mass index, kg/m² | 26.48±2.91 | 26.50±2.85 | 26.26±2.31 | .915 |

When comparing

[*] with the group with a score ≤5, *P* < .05, and when comparing.

[†] with the group with a score between 6 and 9, *P* < .05.

Data displayed as mean (SD).

## 3. Results

### 3.1. General clinical data

Among 231 pregnant women, a total of 53 people (22.9%) were from the city. The 231 cases had an average age of 33.23±4.02 years (23–45-year-old), a gestational age (35.91±1.57), 2–10 pregnancies, 1–3 parity times, 0–6 induced abortions, 1–3 cesarean sections. The general patient features are shown in Table 1. The parity times and cesarean section times were greater in patients with score ≥10 than in those with a score ≤5 and a score between 6 and 9 (all *P* < .05); while there was no significant difference between patients with a score ≤5 and those with a score 6–9 (all *P* > .05). In addition, there was no significant difference in age, gestational weeks, pregnancy times, induced abortion times, preoperative Hb, and body mass index BMI among the 3 groups.

### 3.2. Comparison of intraoperative outcomes among 3 groups

The difference in intraoperative blood loss among the 3 groups was statistically significant (*P* < .001). The comparison showed that largest amount of intraoperative blood loss was found in patients with a score ≥10. There were also significant differences among the 3 groups in autologous blood transfusion, hysterectomy, operation time, bladder repair, and ICU admission (all *P* < .001). The comparison showed that the percentage of autologous blood transfusion, hysterectomy, operation time > 3 hours, bladder repair, and ICU admission were higher in patients with a score ≥10,

than that in those with a score ≤5 and score between 6 and 9 (all *P* < .05). Besides, the percentage of autologous blood transfusion and ICU admission in the group with a score between 6 and 9 was higher than that in the group with a score ≤5 (both *P* < .05). There was no significant difference in emergency surgery among the 3 groups (*P* = .190) (Table 2).

### 3.3. Comparison of postoperative and neonatal conditions among 3 groups

There were no multiple pregnancies in this study. The difference in Apgar score in 1 minute among the 3 groups was statistically significant (*P* = .009). Apgar score in 1 minute among the newborns in the group with a score ≥10 was lower than that in the group with a score between 6 and 9 and the group with a score ≤5 (both *P* < .05). In addition, there was no significant difference in neonatal weight and gender among the 3 groups (*P* = .088, *P* = .810).

The difference in postoperative hospitalization days, preterm delivery, and surgical complications among the 3 groups was statistically significant (all *P* < .05). Additional results of comparison between groups were shown in Table 3.

### 3.4. Multivariate analysis of the association between placenta accreta score and clinical outcomes

Multivariable logistic regression analysis showed that PAS was independently associated with longer operation time (OR=6.837, 95%CI: 3.639–12.845, *P* < .001) and surgical complications

**Table 2**

**Comparison of intraoperative outcomes.**

| Intraoperative conditions | ≤5 points (n=101) | 6–9 points (n=100) | ≥10 points (n=30) | *P* value |
|---|---|---|---|---|
| Intraoperative bleeding volume, ml, median (Q1, Q3) | 400 (300, 500) | 600 (400, 1075)[*] | 2000 (1075, 3550)[*,†] | <.001 |
| Autologous blood transfusion, n (%) | 6 (5.9) | 27 (26.7)[*] | 22 (73.3)[*,†] | <.001 |
| Hysterectomy, n (%) | 1 (1.0) | 4 (4.0) | 10 (33.3)[*,†] | <.001 |
| Emergency operation, n (%) | 10 (9.9) | 6 (6.0) | 5 (16.7) | .190 |
| Time of operation, n (%) | | | | <.001 |
|   < 3h | 97 (96.0) | 83 (83.0) | 11 (36.7) | |
|   > 3h | 4 (4.0) | 17 (17.0) | 19 (63.3)[*,†] | |
| Bladder repair, n (%) | 1 (1.0) | 1 (1.0) | 5 (16.7)[*,†] | <.001 |
| ICU admission, n (%) | 3 (3.0) | 13 (13.0)[*] | 17 (56.7)[*,†] | <.001 |

When comparing:

[*] with the group with a score ≤ 5, *P* < .05, and when comparing.

[†] with the group with a score between 6 and 9, *P* < .05.

**Table 3**

**Comparison of Postoperative and Neonatal Conditions.**

| Postoperative and neonatal conditions | ≤5 points (n=101) | 6–9 points (n=100) | ≥10 points (n=30) | P value |
|---|---|---|---|---|
| Neonatal weight, g, mean (SD) | 2805.94±480.85 | 2702.50±447.52 | 2598.33±630.47 | .088 |
| 1-minute Apgar score of newborns, mean (SD) | 9.99±0.10 | 10.00±0.00 | 9.90±0.40[*,†] | .009 |
| Newborn male gender, n (%) | 58 (57.4) | 53 (53.0) | 17 (56.7) | .810 |
| Premature delivery, n (%) | 68 (67.3) | 85 (85.0)[*] | 26 (86.7)[*] | .005 |
| Postoperative hospitalization days, days, median (range) | 4 (4, 5.5) | 6 (4, 7)[*] | 8 (6, 10)[*,†] | <.001 |
| Surgical complications, n (%) | 5 (5.0) | 17 (17.0)[*] | 7 (23.3)[*] | .006 |

When comparing:

[*] with the group with a score ≤ 5, P<.05, and when comparing.

[†] with the group with a score between 6 and 9, P<.05.

SD = standard deviation.

(OR=2.397, 95%CI: 1.365–4.210, P=.002). Multiple linear regression analysis also showed that PAS was an independent risk factor for intraoperative bleeding volume (beta=834.1, 95%CI: 634.7–1033.5, P<.001) and postoperative hospitalization days (beta=1.75, 95%CI: 1.22–2.29, P<.001).

### 3.5. Performance of placenta accreta score in PEPP subtype diagnosis

When the ROC curves were drawn to distinguish placenta increta and placenta accreta subtype, the AUC was 0.702 (95%CI: 0.628–0.775, P<.001) with a sensitivity of 64.2% and a specificity of 67.4%. The cut-off value was 5.5, as those <5.5 were judged as placenta accreta (Fig. 1). When distinguishing Placenta increta from placenta percreta, the AUC was 0.702 (95%CI: 0.628–0.775, P<.001). The best cut-off value was 7.5, and the sensitivity and specificity were 78.8% and 70.6%, respectively (Fig. 2). The AUC was 0.898 (95%CI: 0.834–0.962, P<.001) with a cut-off value of 7.5 when distinguish placenta accreta from placenta percreta. The sensitivity and specificity were 78.8% and 87.6%, respectively (Fig. 3).
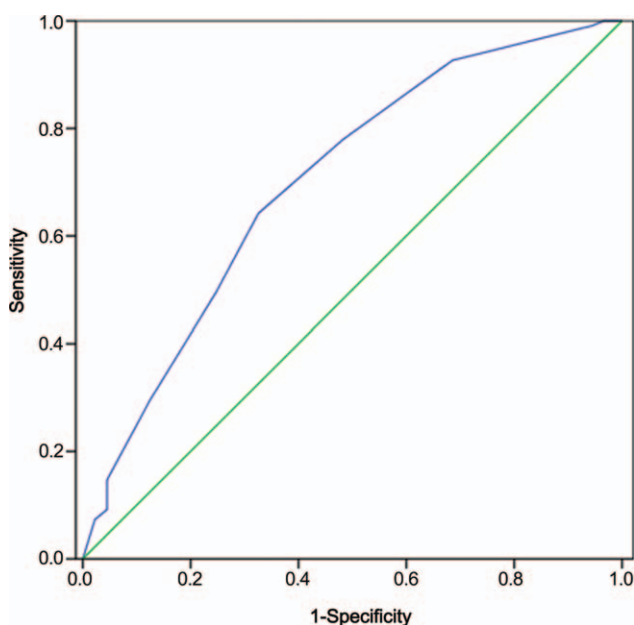
### 4. Discussion

This study demonstrated that placenta accreta score might help PEPP subtype diagnosis and predict maternal-fetal outcome in PEPP patients.

As shown above, the difference of 1-minute Apgar score among the 3 groups was statistically significant. There were fewer patients with the 1-minute Apgar score ≥10 in the group with a score between 6 and 9 and the group with a score ≤5. Although the scope and degree of placenta increta in the 4 groups of patients were different, they were handled with the right operation method at the right time, leading to favorable neonatal outcomes. This conclusion is consistent with the research conclusion of Wang et al.[19] Clinicians can decide the timing of termination of pregnancy according to the placenta accreta score. On the one hand, the gestational weeks can be prolonged as much as possible to reduce the short-term and long-term complications caused to the fetus by premature delivery. In addition, acute intra-abdominal malignant hemorrhage caused by placenta increta penetrating the serosa of the uterus is avoided.

Placenta accreta score is based on ultrasound imaging characteristics, with different scores as boundaries, which
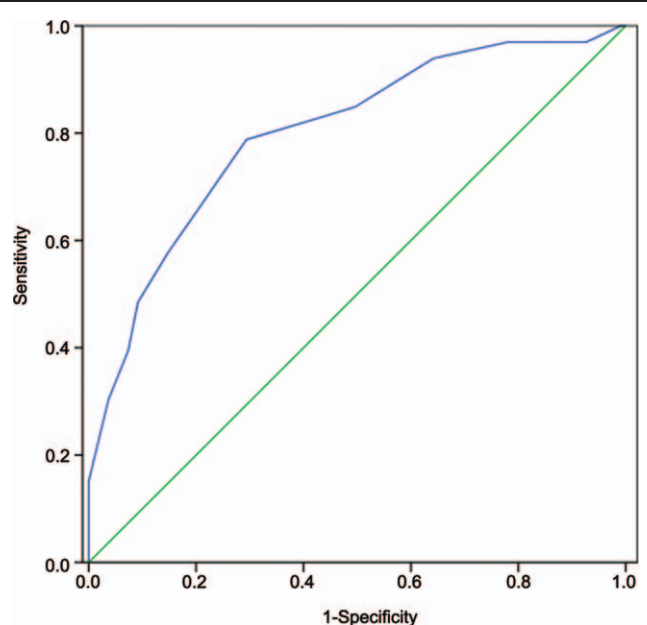


Figure 1. ROC curves for placenta increta and placenta accrete.



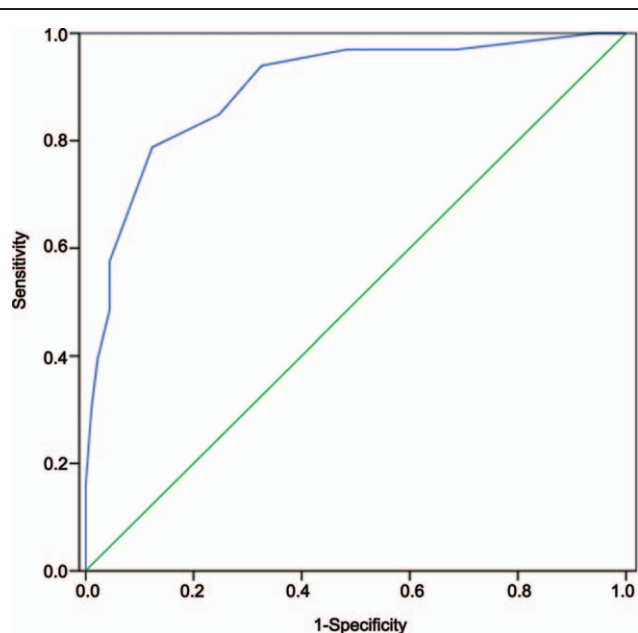Figure 2. ROC curves of placenta increta and placenta percreta.

**Figure 3.** ROC curves for placenta accreta and placenta percreta.

can predict the subtypes of placenta accreta before the operation: scores ≥5 can predict placenta accreta and placenta increta, respectively. Among them, when the score is ≥10, the possibility of placenta percreta is high. The higher the score, the greater the odds of bleeding and hysterectomy treatment. According to the type of placenta increta, the amount of intraoperative blood loss is predicted. The blood source is prepared before the operation, which not only ensures sufficient blood source for rescue and prevents shock or even death caused by excessive blood loss, but also reduces the waste of blood source caused by excessive blood matching under the situation of a tight blood source. When severe placenta increta is predicted, urologists should be asked to perform cystoscopy before the operation to find out whether the placenta has penetrated the bladder. In addition, ureteral stents should be placed at the same time to reduce the risk of ureter injury when uterine artery ligation is used for hemostasis during operation. In case of placenta percreta, preparations should be made for low abdominal aortic extravascular occlusion before operation, and even for perioperative preparations for in-situ hysterectomy, and patients and their families should be fully informed to obtain full understanding and informed consent.

In this study, multivariable logistic regression analysis showed that PAS was independently associated with longer operation time and surgical complications. In addition, PAS independently predicted intraoperative bleeding volume and postoperative hospitalization days. In agreement, previous reports have also demonstrated the associations of placenta accreta with adverse maternal and neonatal outcomes.[20,21] These adverse outcomes could be reduced by performing prenatal assessment and appropriate planning, especially in high-risk individuals. The above findings demonstrate the value of PAS in such evaluation. This could also be of great value in women with a prior delivery by caesarean section that have a high incidence of placenta accreta.[22]

The limitations of the present study should be mentioned. First, this was a retrospective cohort study, with inherent shortcomings such as unavoidable selection bias. In addition, the sample size was relatively small, and all patients were treated in the same hospital. Furthermore, the results of this study might not be applicable when encountering research subjects excluded from this study in clinical practice, and the qualification of ultrasound doctors in different medical institutions is different, which reduces the generalizability of our results. Therefore, further well-designed studies with large samples are warranted to confirm our findings.

In conclusion, PEPP could be harmful to both mother and infant. PAS was independently associated with longer time of operation, surgical complications, intraoperative bleeding volume and postoperative hospitalization days in this study. Preoperative evaluation of placenta increta by using placenta accreta score of PEPP, prediction of postpartum hemorrhage risk, and timely application of low abdominal aortic extravascular occlusion may reduce postpartum hemorrhage and perinatal complications, thus improving maternal-fetal outcomes.

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## Author contributions

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