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Comparison between placenta accreta scoring system, ultrasound staging, and clinical classification

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Abstract

Placenta accreta spectrum (PAS) is a series of disorders, which means that the placental trophoblast invades into the myometrium of the uterine wall. It is a serious obstetric complication which could be detected by ultrasound prenatally. In order to compare our placenta accreta scoring system with prenatal ultrasound staging system and International Federation of Gynecology and Obstetrics (FIGO) clinical classification, we did a retrospective study including 105 patients diagnosed with PAS disorders by operation or pathology at Peking University First Hospital, Beijing, China, between January, 2019 and December, 2020. Placenta accreta scoring system, prenatal ultrasound staging system and FIGO clinical classification were used on each patient. Basic information and clinical outcomes including gestational weeks, intraoperative hemorrhage, hysterectomy rate and blood transfusion were also counted. Both of placenta accreta scoring system, prenatal ultrasound staging system can give a rather clear prediction of placenta percreta, with their area under curve were 0.872 (95% confidential interval [CI]: 0.793–0.951) and 0.864 (95%CI: 0.779–0.949), *P* value were .000 compared with clinical classification. Beside for ultrasound staging system was designed for placenta previa patients, all those 3 criteria showed their relationships with preterm birth, hysterectomy rate and intraoperative bleeding. PAS scoring system also had the ability to predict a gestational week of delivery ≤34 weeks, intraoperative massive bleeding ≥2000 mL and hysterectomy at over 12 points. Our placenta accreta scoring system had good accordance with pre-operational ultrasound staging and FIGO clinical classification, with higher universality for patients without placenta previa.

Abbreviations: CI = confidential interval, FIGO = International Federation of Gynecology and Obstetrics, PAS = placenta accreta spectrum.

Keywords: outcome, placenta accreta spectrum, scoring system, ultrasound

1. Introduction

Placenta accreta spectrum (PAS) is a series of disorders, which means that the placental trophoblast invades into the myometrium of the uterine wall.[1] It is a serious obstetric complication, which might cause massive postpartum bleeding, as the placenta won't separate spontaneously. International Federation of Gynecology and Obstetrics (FIGO) made a classification on PAS disorders and it was used in clinical works worldwide: abnormally adherent placenta (accreta), abnormally invasive placenta (increta) and abnormally invasive placenta (percreta).[2] Placenta accreta is the lightest one as placenta still had the chance to be fully removed, while placenta percreta is the hardest situation that hysterectomy was always performed.[3]

Ultrasound is the most convenient way for screening PAS patients during routine clinical visit. There were many PAS scoring systems based on ultrasound findings from different centers.[4–11] We did a multicenter retrospective study and designed our own PAS scoring system for screening placenta percreta, using previous gestational history and ultrasound manifestations (see Table S1, http://links.lww.com/MD/H859, Supplemental Content, which shows placenta accreta scoring system), without restriction of Cesarean section history or placenta previa. Cali et al developed a prenatal ultrasound staging system for placenta previa patients and separated PAS disorders into 4 types (see Table S2, http://links.lww.com/MD/H860, Supplemental Content, which shows ultrasound staging),[12] which showed a favorable connection with FIGO clinical staging system.[13] FIGO updated their clinical classification in 2019 in order to give a more clearly classification for identifying placenta accreta and increta, for the former grading system depends on the scale and extent of placenta separation, instead of precise description of intraoperative findings about the uterus myometrium appearance (see Table S3, http://links.lww.com/

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All authors approved the final manuscript.

The authors have no conflicts of interest to disclose.

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

This study was approved by the ethics committee of Peking University First Hospital (ID:2019[232]). Written informed consent was obtained from all patients.

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MD/H861, Supplemental Content, which shows FIGO clinical classification).[2]

Though PAS scoring systems have been widely used in each center for prenatal detection and evaluation, some of them only designed for patients with previous Cesarean section history or placenta previa. This would limit the usage of scoring system. Our study is the first one to evaluate PAS scoring system with newly founded prenatal ultrasound staging system and the latest FIGO clinical classification, thus make sure of the utility of our PAS scoring system, and found the potential possibility for popularization and promotion.

2. Materials and methods

A retrospective study including 105 patients diagnosed with PAS disorders by operation or pathology at Peking University First Hospital, Beijing, China, between January, 2019 and June, 2020. Some of those patients was first suspected for PAS at other hospitals and referred to our center for further diagnosis and routine clinical visit. This study was approved by the ethics committee of Peking University First Hospital (ID:2019[232]). Written informed consent was obtained from all patients when they were admitted into hospital.

2.1. Diagnosis of PAS disorders and scoring systems

All the 105 patients went through routine clinical prenatal visit at our outpatient department under a same group of doctors specified in PAS disorders before delivery. Prenatal ultrasound was done by both transvaginal and transabdominal, all the ultrasound reports were written by experienced ultrasound doctors. We used following ultrasonic manifestation for detection of PAS as FIGO recommended: Placenta lacunae, loss of hypoechoic space, abnormalities of uterus-bladder interface and color Doppler abnormalities, including hypervascularity and bridging vessels. All the 105 patients had at least one ultrasound examination 2 weeks earlier than delivery. Other information and clinical outcomes including gestational weeks, intraoperative hemorrhage, hysterectomy rate and blood transfusion were searched from our electronic medical record system.

Placenta accreta scoring system and FIGO clinical classification were used on each patient, according to their demographic and pregnancy characters together with ultrasound reports and intraoperative findings. As ultrasound staging were based on placenta previa patients, we only used ultrasound staging for patients diagnosed with placenta previa. Our PAS scoring systems using 6, 8, and 10 points as cutoff level, for suspected of placenta percreta, risk for massive bleeding over 1500 mL and hysterectomy. Prenatal US staging over stage 2 and FIGO clinical grading over grade 3 were thought to be placenta percreta. For patients underwent hysterectomy, our final diagnosis was based on pathological findings, while for patients conserved their uterus, pathological findings were sometimes limited as the whole level myometrium couldn't reached, and in these situations we used FIGO clinical classification to assist final diagnosis.

2.2. Management of PAS patients

Our PAS professional group performed all the operations. If hysterectomy was decided to be performed either pre operation or during laparotomy, no uterine contractors would be used. Other patients underwent postpartum oxytocin treatment together with prostaglandin right after the birth of neonatal in order to accelerate uterus contraction and separate placenta safely. Abdominal aorta balloon was supposed to full up before manual removal of placenta. Uterine tourniquet, suture, ligation of uterine artery and uterine tamponade would be used if necessary. Thirty-five of patients received pre-operative intra-aortic balloon placement for hypervascularity under color Doppler. Nine of them received hysterectomy due to uncontrolled bleeding during operation, one patient needed a second time operation for heavy postoperative bleeding. Intraoperative hemorrhage was estimated by suction and weighing of swabs. Gestational weeks, hysterectomy rate and amount of blood transfusion were also counted.

2.3. Statistical analysis

Continuous data were recorded by median after testing for normality. Post-operative hemoglobin was recorded by mean. Categorical data were written in number (n%). Kruskall–Wallis test were used to compare differences between mean values in nonparametric ways, Chi-square test were used for comparing rates, while a two-tailed $P \leq .050$ was considered statistically significant. Receiver operating characteristic curve were also used to access each scoring system. SPSS 24.0 was used for statistical analyses.

3. Results

Among them, 22/105 (21%) were accreta, 27/105 (26%) were increta, 56/105 (53%) were percreta (Percentage of each evaluation criteria also showed in Fig. 1). Ultrasound findings showed signs of PAS in 93/105 (88.6%) patients. Among them,

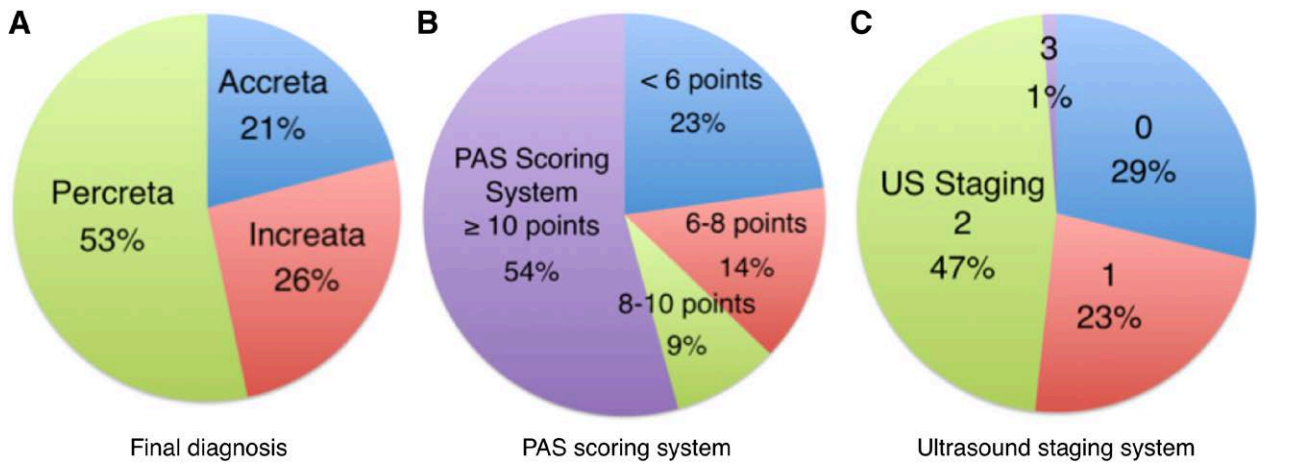

Figure 1. Percentage of accreta, increta and percreta and each evaluation criteria. (a) Final diagnosis according to FIGO classification or pathology report. (b) PAS scoring system. (c) Ultrasound staging. FIGO = International Federation of Gynecology and Obstetrics, PAS = placenta accreta spectrum.

12/105 (11.4%) patients were failed to be recognized of PAS by prenatal ultrasound examination, which got a PAS score range from 0 to 5, ultrasound stage 0 or not applicable (8/12 without placenta previa) and clinical grading from 1 to 2. They had Cesarean section for breech position, advanced maternal age or Cesarean section history. They were finally diagnosed as placenta accreta or increta during operation using FIGO clinical classification. In our study, 9 patients went through hysterectomy were identified by pathology as placenta percreta.

3.1. Sensitivity and specificity of different scoring systems

For recognizing placenta percreta at a cut off level of 6 points, our PAS scoring system shows a sensitivity of 98.1%, with a specificity of 31.4%, with a total accuracy of 74.3%. Except for 18 patients failed to be valued by prenatal US staging system as they were not placenta previa, others reached a sensitivity of 71.2%, with a specificity of 85.7%, with a total accuracy of 77.0% at a cut off level of stage 2.

When doing ROC analysis, we found that both of placenta accreta scoring system, prenatal ultrasound staging system can give a rather clear prediction of placenta percreta, with their area under curve were 0.872 (95% confidential interval [CI]: 0.793–0.951) and 0.864 (95%CI: 0.779–0.949), *P* value were .000 compared with clinical classification (Fig. 2).

3.2. Scoring systems and their relationships with intraoperative outcomes

When considered intraoperative outcomes, we found that their gestational week of delivery ranged from 13 to 39 weeks, with 12 of them considered placenta increta or percreta prenatally and chose to terminate their pregnancy at 13 to 26 weeks without live birth.

PAS scoring system, prenatal US staging and FIGO clinical classification showed their relationships with preterm birth ($P = .000$), hysterectomy rate ($P = .040, .031, .000$) and intraoperative bleeding ($P = .000$). All 3 methods could predict the usage of blood products as staging goes up (red blood cell, plasma and autologous blood transfusion, $P < .005$, only 1 patient received platelet transfusion for 1 unit). Only PAS scoring system and FIGO clinical classification showed their abilities in estimating the usage of fibrinogen ($P = .035, .000$). (Table 1)

3.3. Scoring systems and their abilities for predicting preterm birth rate, hysterectomy rate and the amount of intraoperative bleeding

We finally compared different criteria to see if they could be used for predicting preterm birth rate, hysterectomy rate and the amount of intraoperative bleeding.

Our PAS scoring system had the ability to predict a preterm delivery due to PAS <34 weeks at 12 points with a sensitivity of 71.1% and specificity of 81.0%, intraoperative massive bleeding over 2000 mL at 12 points with a sensitivity of 68.0% and specificity of 62.9% and hysterectomy at 12 points with a sensitivity of 100% and specificity of 60.3%.

We found that PAS scoring system had the best potential for prediction of preterm birth before 34 weeks, with their area under curve were 0.839 (95%CI: 0.754–0.924) for PAS scoring system, 0.766 (95%CI: 0.663–0.870) for prenatal US staging and 0.737 (95%CI: 0.632–0.842) for FIGO clinical classification, *P* value were .000. Each of placenta accreta scoring system, ultrasound staging and clinical classification can give a rather clear prediction of intraoperative massive bleeding over 2000 mL, with their area under curve were 0.726 (95%CI: 0.614–0.839), 0.702 (95%CI: 0.586–0.817) and 0.836 (95%CI: 0.741–0.932), *P* value were .001, .003, and .000 for intraoperative bleeding. FIGO clinical classification had the best potential for prediction of hysterectomy, with their area under curve were 0.817 (95%CI: 0.710–0.924) for PAS scoring system, 0.769 (95%CI: 0.637–0.900) for prenatal US staging and 0.908 (95%CI: 0.824–0.993) for FIGO clinical classification, *P* value were .000 (Fig. 3).

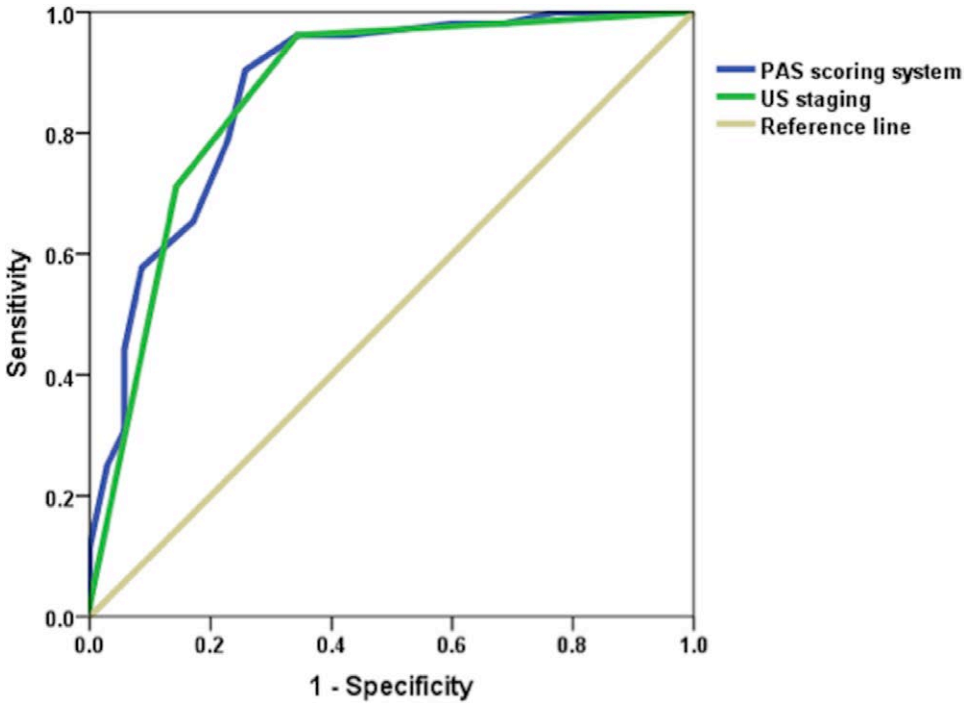

Figure 2. Comparison between PAS scoring system and ultrasound staging with final diagnosis. PAS = placenta accreta spectrum.

Table 1

Scoring systems and their relationships with intraoperative outcomes.

		Gestational weeks at termination*	Hysterectomy†	Intraoperative bleeding*	Blood transfusion*			
					Red blood cell	Plasma	Autologous blood transfusion	Fibrinogen
PAS scoring system	*P*	.000	.040	.000	.000	.000	.000	.035
	<6	37	0/24 (0.0)	600	0	0	0	0
	6-8	35	0/15 (0.0)	1000	0	0	100	0
	8-10	34	0/9 (0.0)	1000	400	70	0	0
	≥10	34	9/57 (15.8)	1500	400	0	350	0
US staging	*P*	.000	.031	.000	.002	.001	.000	.089
	0	36	0/25 (0.0)	700	0	0	0	0
	1	35	1/20 (5.00)	1200	400	35	224	0
	≥2	34	8/42 (19.0)	1750	400	100	395	0
Clinical classification	*P*	.000	.000	.000	.000	.000	.000	.000
	1	37	0/22 (0.0)	600	0	0	0	0
	2	35	0/27 (0.0)	1000	0	0	0	0
	3a	34	1/33 (3.03)	1200	0	0	265	0
	3b–3c	34	8/23 (34.8)	2200	1200	600	410	2

PAS = placenta accreta spectrum.

*Kruskall–Wallis test.

†Chi-square test.

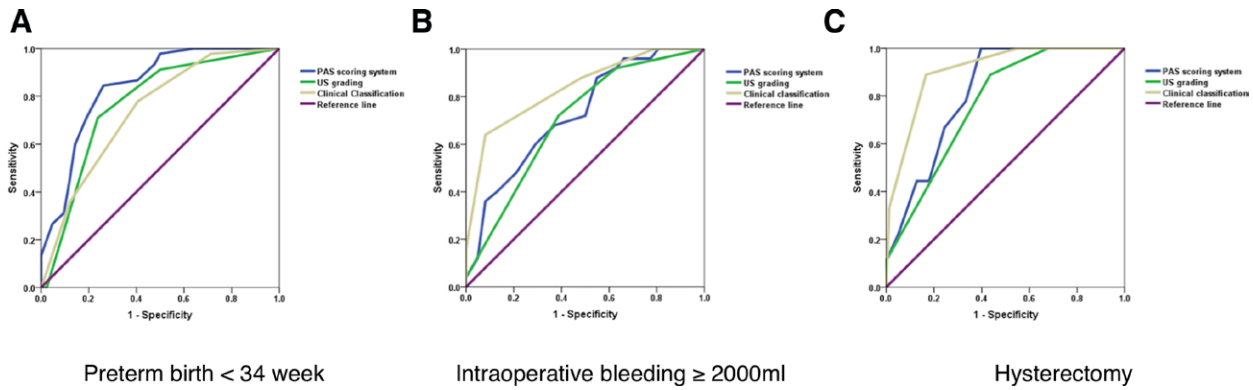

Figure 3. Comparison between different scoring systems and their abilities in predicting preterm birth before 34 week (a), intraoperative bleeding over 2000 mL (b) and hysterectomy (c).

4. Discussion

We found that PAS scoring system, prenatal ultrasound staging and FIGO clinical classification had the ability to identify PAS disorders with favorable accuracy, with their different strengths and limitations.

Adding patient's history of obstetrics and gynecology operation may assist its usage on detecting PAS patients, as risk factors of PAS disorders were rather clear. Our PAS scoring system was designed for screening placenta percreta from patients suspected with PAS disorders, which used both gestational information and ultrasound manifestations. Many other scoring systems were designed under similar framing.[4–6,9,10] Clinical informations including gestational histories, previous abortion or miscarriage were also counted in our scoring system. Beside history of Cesarean section or abortion, Tanimura et al took all kinds of uterine surgeries which might harm endometrium into account, together with magnetic resonance imaging screening report, and reached a sensitivity and specificity of 91.30% and 98.0%.[7]

For ultrasonic manifestations, placenta previa, vascular lacunae, obscure boundaries between the placenta and the myometrium, uterine serosa-posterior bladder wall interface, sub-placental hypervascularity were also frequently used as our PAS scoring system shows.[4,5,7,8,10] Other criteria like size and numbers of lacunae, myometrium thickness, disruption of the myometrium and cervix invaded were also applied and confirmed to be useful.[4–7,9] Our PAS scoring system including similar ultrasound descriptions with other studies.

Ultrasound staging has its unequivocal advantage for its great convenience during clinical usage to detect high-risk PAS patients and send them to superior hospital, but it is depending on the placenta location. FIGO Clinical classification showed it advantage in predicting blood loss and maternal complications, but it could only be done during operation, not prenatally. Though limited its usage for guiding pre-operational preparation, it provided a comprehensive description of different kinds of PAS and could thus promote international communication and cooperation under the same criteria, and it could directly reflex the relationship between PAS classification and maternal-fetal outcome.

Our PAS scoring system had more comprehensive application nationally for it is not based on placenta previa or previous Cesarean section, but considered its utility, it may not as concise and brief as prenatal ultrasound staging. Like myomectomy or hysteroscopy, some uterus scars or damage were not resulted from Cesarean section, thus placenta previa or low lying placenta may not occure in those patients. In this way, the location of placenta could be lateral or posterior, not just previa, to develop to PAS disorders. Prenatal ultrasound staging could only be used in placenta previa patients that have risk to

become PAS disorders, but for patients do not have placenta previa, its sensitivity and specificity were not sure. In our study, there were 18 patients finally considered PAS during operation, but not applicable for prenatal ultrasound staging. For further evaluating the usage of prenatal ultrasound staging on non-placenta previa patients, we use its criteria in all of the 105 PAS patients and found that it still showed favorable performance (see Table S4, http://links.lww.com/MD/H862, Supplemental Content, which shows ultrasound staging used in patients with or without placenta previa and their relationships with intraoperative outcomes and Figure S1, http://links.lww.com/MD/H863, Supplemental Content, which shows percentage of accreta, increta and percreta of ultrasound staging used in patients with or without placenta previa). It could predict a PAS disorders related preterm birth (<34 weeks) with area under curve of 0.729 (95%CI: 0.625–0.834), intraoperative massive bleeding over 2000 mL with area under curve of 0.749 (95%CI: 0.647–0.851) and hysterectomy with area under curve of 0.806 (95%CI: 0.693–0.918), P = .001, .000, .003, respectively. In this way, prenatal ultrasound staging has the potential to be used more widely.

As raised by Frederic Chantraine et al, there is a kind of special situation called uterine window or Cesarean scar dehiscence.[14] Though disappear of myometrium and plenty of blood flow can be seen under ultrasound examination, as well as placenta bulge can be seen under serosa during operation, this protruding part is not belonging to PAS disorders. The placenta just lying on the surface of the scar, without growing into it. In this kind of situation, we still should be alert of uterine rupture. Special care should be paid on ultrasound examination related with myometrium thickness and blood flow. Management of uterine window was not difficult as placenta could be easily removed. More studies on differential diagnosis need to be done.

Our study was the first one that using a PAS scoring system aimed for placenta percreta regardless of placenta previa or previous Cesarean section history. We also made comparison with independent ultrasonic staging and intraoperative clinical grading, and proved their ability of prognosis.

There were several limitations of our study. First, this study had a retrospective design, which the results could be biased when compared to a prospective study. Second, PAS was a rare obstetric complication and the case number is rather small. Studies with a prospective and multicenter design shall be done.

5. Conclusion

Our placenta accreta scoring system had good accordance with pre-operational ultrasound staging and FIGO clinical classification, also had a wider area of application. Pre-operational ultrasound staging is a more convenient way for evaluating PAS patients before delivery. PAS Scoring over 12 points related to selective preterm delivery ≤34 weeks, intraoperative bleeding >2000 mL and hysterectomy, which needed carefully prepared before operation.

Author contributions

Huixia Yang and Jie Yan designed the study; Xinrui Yang wrote the manuscript; Xinrui Yang and Weiran Zheng performed statistical analyses and analyzed the data; Huixia Yang coordinated the study over the entire time.
Data curation: Xinrui Yang, Weiran Zheng.
Formal analysis: Xinrui Yang.
Methodology: Xinrui Yang.
Supervision: Jie Yan, Huixia Yang.
Validation: Jie Yan, Huixia Yang.
Writing – original draft: Xinrui Yang, Weiran Zheng.
Writing – review & editing: Xinrui Yang, Weiran Zheng.

References

[1] Silver RM, Branch DW. Placenta accreta spectrum. N Engl J Med. 2018;378:1529–36.
[2] Jauniaux E, Ayres-de-Campos D, Langhoff-Roos J, et al. FIGO Placenta Accreta Diagnosis and Management Expert Consensus Panel. FIGO classification for the clinical diagnosis of placenta accreta spectrum disorders. Int J Gynaecol Obstet. 2019;146:20–4.
[3] Jauniaux E, Collins S, Burton GJ. Placenta accreta spectrum: pathophysiology and evidence-based anatomy for prenatal ultrasound imaging. Am J Obstet Gynecol. 2018;218:75–87.
[4] Rac MW, Dashe JS, Wells CE, et al. Ultrasound predictors of placental invasion: the placenta accreta index. Am J Obstet Gynecol. 2015;212:343.e1–7.
[5] Chong Y, Zhang A, Wang Y, et al. An ultrasonic scoring system to predict the prognosis of placenta accreta: a prospective cohort study. Medicine. 2018;97:e12111.
[6] Luo L, Sun Q, Ying D, et al. Scoring system for the prediction of the severity of placenta accrete spectrum in women with placenta previa: a prospective observational study. Arch Gynecol Obstet. 2019;300:783–91.
[7] Tanimura K, Morizane M, Deguchi M, et al. A novel scoring system for predicting adherent placenta in women with placenta previa. Placenta. 2018;64:27–33.
[8] Knight JC, Lehnert S, Shanks AL, et al. A comprehensive severity score for the morbidly adherent placenta: combining ultrasound and magnetic resonance imaging. Pediatr Radiol. 2018;48:1945–54.
[9] Tovbin J, Melcer Y, Shor S, et al. Prediction of morbidly adherent placenta using a scoring system. Ultrasound Obstet Gynecol. 2016;48:504–10.
[10] Marsoosi V, Ghotbizadeh F, Hashemi N, et al. Development of a scoring system for prediction of placenta accreta and determine the accuracy of its results. J Matern Fetal Neonatal Med. 2020;33:1824–30.
[11] Zhu L, Xie L. Value of ultrasound scoring system for assessing risk of pernicious placenta previa with accreta spectrum disorders and poor pregnancy outcomes. J Med Ultrason (2001). 2019;46:481–7.
[12] Cali G, Forlani F, Lees C, et al. Prenatal ultrasound staging system for placenta accreta spectrum disorders. Ultrasound Obstet Gynecol. 2019;53:752–60.
[13] Jauniaux E, Chantraine F, Silver RM, et al. FIGO consensus guidelines on placenta accreta spectrum disorders: epidemiology. Int J Gynaecol Obstet. 2018;140:265–73.
[14] Collins SL, Alemdar B, van Beekhuizen HJ, et al. Evidence-based guidelines for the management of abnormally invasive placenta: recommendations from the International Society for Abnormally Invasive Placenta. Am J Obstet Gynecol. 2019;220:511–26.