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Original Research

Predictive Model of Cesarean Hysterectomy Accompanying Cesarean Section in Patients with Placenta Previa

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Abstract

Background: The purpose of this study was to develop a model to predict cesarean hysterectomy accompanying cesarean section in patients with placenta previa. **Methods**: We retrospectively reviewed 926 patients diagnosed with placenta previa who had cesarean section from January 2011 to December 2021. We analyzed data by independent *t*-test and Pearson's chi-squared test. Multivariate logistic regression analysis was used to develop a predictive model and identify factors predictive for cesarean hysterectomy accompanying cesarean section. **Results**: A total of 44 cesarean hysterectomies (4.8%) were performed in 926 patients with placenta previa. History of cesarean section (1 (odds ratio (OR) 13.57, 95% confidence interval (CI) 4.29–42.96), ≥2 (OR 83.28, 95% CI 21.98–315.55)), anterior placenta (OR 3.06, 95% CI 1.22–7.68), adherent placenta (OR 8.78, 95% CI 3.65–21.09), presence of lacuna (OR 3.74, 95% CI 1.55–9.04), and old maternal age (≥40 years (OR 4.65, 95% CI 1.60–13.49)) were factors selected to develop a model to predict cesarean hysterectomy. Based on this model, an equation was developed and tested for performance. This model using five factors yielded an area under the curve of 0.951 (95% CI 0.921–0.981) to predict the probability of cesarean hysterectomy accompanying cesarean section. **Conclusions**: Application of this predictive model may provide an effective prediction of cesarean hysterectomy in patients with placenta previa. Adequate pre-operative preparation and intraoperative strategies can be indicated based on this model.

Keywords: cesarean hysterectomy; cesarean section; placenta previa

1. Introduction

Cesarean hysterectomy is a surgical procedure performed at the time of delivery or in the postpartum period. The primary indication of cesarean hysterectomy is fatal uterine hemorrhage that cannot be controlled by conservative measurement. It results in a loss of fertility and is associated with increased maternal morbidity and mortality. For those with placenta previa, the placenta attaches over the cervical opening, and is associated with multiple adverse outcomes including massive hemorrhage and maternal mortality [1–4]. Placenta previa often occurs in combination with adherent placenta including placenta accreta, increta, and percreta [5]. These conditions may cause fatal peripartum hemorrhage, which is an indication for cesarean hysterectomy. The risk of cesarean hysterectomy accompanying cesarean section in patients with placenta previa is 30 times higher than that in patients without placenta previa [6]. A model to predict cesarean hysterectomy accompanying cesarean section would allow preoperative preparations including central venous catheter and sufficient blood products for massive transfusion. The predictive model would also be of great help in determining intraoperative strategies such as whether to attempt the removal of the placenta. The present study focused on developing a model to predict cesarean hysterectomy accompanying cesarean section in patients with placenta previa.

2. Materials and Methods

We retrospectively reviewed 926 patients with placenta previa who underwent cesarean section from January 2011 to December 2021 at the Department of Obstetrics and Gynecology of Chonnam National University Hospital. Clinical records, findings, obstetric ultrasound findings, and blood bank data were reviewed. We diagnosed placenta previa using preoperative transvaginal or transabdominal ultrasonography. Patients with low-lying placenta were excluded from the study. Low-lying placenta was diagnosed by ultrasonography as the presence of lower margin of the placenta within 2 cm of the internal cervical opening. Patients who had vaginal delivery and delivered before 24 weeks were also excluded. Patients who underwent cesarean hysterectomy within 24 hours after cesarean section were included. Cesarean hysterectomy was performed when there was massive hemorrhage after cesarean delivery. We defined massive hemorrhage as receiving more than four units of packed red blood cells (PRCs) or blood loss exceeding 1500 mL [7]. Clinical factors included maternal age, gestational age at delivery, number of parity, previous abortion, previous cesarean section, multifetal gestation, presentation part when delivery, whether the operation was emergent, whether the bleeding occurred before operation, and whether artificial reproductive technologies had been performed. Maternal age was classified into three groups (<35, 35–39, ≥40 years) to be included

as a factor in the multivariate logistic regression. Preoperative hemoglobin (Hb), estimated blood loss (EBL) during operation, and number of transfused PRCs within 24 hours after operation were measured. Hb was classified into two groups (Preoperative Hb <11.0 (g/dL) or not) and included as a factor in the multivariate logistic regression. Adherent placenta, including placenta accreta, increta, and percreta was diagnosed clinically during operation or pathologically after operation. The presence of lacuna, a type of placenta previa (complete, partial, or marginal), and the location of the placenta (anterior, posterior, or lateral) were diagnosed by preoperative transvaginal or transabdominal ultrasonography. Presence of lacuna was diagnosed as presence of an irregular lake-like area of low echogenicity within the placenta parenchyma. We used an independent *t*-test for continuous variables. The chi-squared test was used for categorical values. Multivariate logistic regression was used to assess the association between cesarean hysterectomy and the included variables to develop a model to predict the cesarean hysterectomy accompanying cesarean section. Based on these analyses, we developed an equation to predict the probability of cesarean hysterectomy accompanying cesarean section. The performance of developed model was tested by area under the receiver operating characteristic curves (AUCs). We performed statistical analyses using SPSS (version 29.0, IBM Corp., Armonk, NY, USA). Then, 95% confidence intervals (CI) were calculated and p-values < 0.05 indicated statistical significance. The Hosmer-Lemeshow test was used to evaluate the goodness of the developed model and p-values ≥ 0.05 indicated that the developed model is statistically significant.

3. Results

Of 926 patients included in the data to develop the predictive model, 44 (4.8%) underwent cesarean hysterectomy accompanying cesarean section and 882 (95.2%) underwent cesarean section only. Characteristics of the included patients with or without cesarean hysterectomy are shown in Table 1. Maternal age, parity, previous cesarean delivery, type of placenta previa, presence of lacuna, location of placenta, preoperative Hb, and adherent placenta showed a statistically significant difference according to cesarean hysterectomy ($p < 0.001$). Previous abortion and preoperative bleeding were also significantly associated with cesarean hysterectomy ($p < 0.05$). EBL and number of transfused PRCs were higher in patients with cesarean hysterectomy and were significantly different ($p < 0.001$) but were excluded as factors for the predictive model because they were calculated after the operation.

Based on this analysis, we developed a model to predict cesarean hysterectomy accompanying cesarean section. Factors that showed statistically significant differences were included in the model. Results of logistic regression analysis are shown in Table 2. First, we developed model 1 using all statistically significant factors ($p <$ 0.05) in Table 1. Significant factors in model 1 were maternal age (<35 years (reference (Ref)), ≥40 (odds ratio (OR) 4.03, 95% CI 1.31–12.40)), previous cesarean delivery (0 (Ref), 1 (OR 9.01, 95% CI 1.91–42.53), ≥2 (OR 37.68, 95% CI 5.54–256.50)), presence of lacuna (OR 3.24, 95% CI 1.31–8.00), anterior location of placenta (OR 2.80, 95%

Table 1. Characteristics of patients with or without cesarean hysterectomy.

Characteristics (n = 926)	Cesarean hysterectomy		*p*-value
	Yes (n = 44)	No (n = 882)	
Maternal age (years)	36.98 (± 4.17)	34.45 (± 4.41)	<0.001
<35 (%)	11 (25.0)	461 (52.3)	<0.001
35–39 (%)	17 (38.6)	307 (34.8)	<0.001
≥40 (%)	16 (36.4)	114 (12.9)	<0.001
Gestational age (week)	35.68 (± 1.68)	36.06 (± 2.09)	0.120
Parity (%)			
0	2 (4.5)	420 (47.6)	<0.001
1	18 (1.0)	360 (40.8)	<0.001
≥2	24 (54.5)	102 (11.6)	<0.001
Previous abortion (%)			
0	18 (40.9)	518 (58.7)	0.004
1	8 (18.2)	186 (21.1)	0.004
≥2	18 (40.9)	478 (20.2)	0.004
Previous cesarean (%)			
0	4 (9.1)	704 (79.8)	<0.001
1	21 (47.7)	159 (18.0)	<0.001
≥2	19 (43.2)	19 (2.2)	<0.001
Multifetal gestation (%)	2 (4.5)	43 (4.9)	0.921
Presentation part (%)			
Vertex	35 (79.5)	781 (88.5)	0.072
Others	9 (20.5)	101 (11.5)	0.072
Emergency operation (%)	19 (43.2)	259 (29.4)	0.051
Preoperative bleeding (%)	25 (56.8)	366 (41.5)	0.045
ART (%)	5 (11.4)	132 (14.9)	0.894
Type of PP (%)			
Complete	43 (97.7)	628 (71.2)	<0.001
Partial or Marginal	1 (2.3)	254 (28.8)	<0.001
Presence of lacuna (%)	23 (52.3)	96 (10.9)	<0.001
Location of placenta (%)			
Anterior	35 (79.5)	312 (35.4)	<0.001
Posterior or Lateral	9 (20.5)	570 (64.6)	<0.001
Preoperative Hb (g/dL)	10.77 (± 1.64)	11.58 (± 1.30)	<0.001
<11.0 (g/dL) (%)	20 (45.5)	619 (70.2)	<0.001
≥11.0 (g/dL) (%)	24 (54.5)	263 (29.8)	<0.001
Estimated blood loss (mL)	8107 (± 7434)	1106 (± 693)	<0.001
Transfused PRCs (units)	20.70 (± 16.17)	2.42 (± 2.68)	<0.001
Adherent placenta (%)			
Accreta or increta	17 (38.6)	46 (5.2)	<0.001
Percreta	8 (18.2)	0	<0.001

The characteristics are presented as the number (%) or mean (± standard deviation).

Abbreviations: ART, assisted reproductive technology; PP, placenta previa; Hb, hemoglobin; PRCs, packed red blood cells.

Table 2. Results of multivariate logistic regression analyses identifying the association between cesarean hysterectomy and clinical characteristics.

	Model 1		Model 2	
	OR (95% CI)	*p*-value	OR (95% CI)	*p*-value
Age (years)				
<35	Ref	-	Ref	-
35–39	1.31 (0.46–3.77)	0.616	-	-
≥40	4.03 (1.31–12.40)	0.015	4.65 (1.60–13.49)	<0.005
Parity				
0	Ref	-	-	-
1	1.43 (0.18–11.62)	0.741	-	-
≥2	2.20 (0.23–21.27)	0.494	-	-
Previous abortion				
0	Ref	-	-	-
1	1.17 (0.35–3.89)	0.796	-	-
≥2	1.48 (0.55–3.97)	0.436	-	-
Previous cesarean				
0	Ref	-	Ref	-
1	9.01 (1.91–42.53)	0.006	13.57 (4.29–42.96)	<0.001
≥2	37.68 (5.54–256.50)	<0.001	83.28 (21.98–315.55)	<0.001
Preoperative bleeding	1.19 (0.48–2.95)	0.700	-	-
Complete PP	3.71 (0.46–29.93)	0.219	-	-
Lacuna	3.24 (1.31–8.00)	0.011	3.74 (1.55–9.04)	0.003
Anterior placenta	2.80 (1.07–7.37)	0.037	3.06 (1.22–7.68)	0.017
Preop Hb <11.0 (g/dL)	1.60 (0.67–3.84)	0.291	-	-
Adherent placenta	7.97 (3.17–20.08)	<0.001	8.78 (3.65–21.09)	<0.001

Abbreviations: OR, odds ratio; CI, confidence interval; Ref, reference group; PP, placenta previa; Hb, hemoglobin.

CI 1.07–7.37), and adherent placenta (OR 7.97, 95% CI 3.17–20.08). Then, model 2 was developed using only five factors: maternal age (<35 years (Ref), ≥40 (OR 4.65, 95% CI 1.60–13.49)), previous cesarean delivery (0 (Ref), 1 (OR 13.57, 95% CI 4.29–42.96), ≥2 (OR 83.28, 95% CI 21.98–315.55)), presence of lacuna (OR 3.74, 95% CI 1.55–9.04), anterior location of placenta (OR 3.06, 95% CI 1.22–7.68), and adherent placenta (OR 8.78, 95% CI 3.65–21.09). All factors in model 2 were statistically significant ($p < 0.05$). The *p*-values of the Hosmer-Lemeshow test were ≥0.05 for the two models, indicating they were suitable.

The predictive accuracy, as measured using AUCs, of model 1 was 0.953 (95% CI 0.924–0.983), whereas that of model 2 was 0.951 (95% CI 0.921–0.981). Both model 1 and 2 showed good discriminatory performance (Table 3, Fig. 1). Therefore, model 2 was selected as a predictive model of cesarean hysterectomy accompanying cesarean section considering the number of factors. Based on the information of model 2 (Table 4), an equation to predict the probability of cesarean hysterectomy was developed.

The probability for cesarean hysterectomy accompanying cesarean section in patients with placenta previa was: $e^x/1+e^x$ (x = –6.856 (constant) + 2.608 (previous cesarean = 1) + 4.422 (previous cesarean ≥2) + 2.172 (adherent placenta) + 1.119 (anterior placenta) + 1.320 (presence of lacuna) + 1.536 (maternal age ≥40)).

Table 3. Comparison of the performance of the developed predictive models.

Model	Number of factors	AUC	SE	95% CI
Model 1	10	0.953	0.015	0.924–0.983
Model 2	5	0.951	0.015	0.921–0.981

Abbreviations: AUC, area under the receiver operating characteristic curve; SE, standard error; CI, confidence interval.

Table 4. Coefficient of the final predictive model.

	Coefficient
Age (years)	-
≥40	1.536
Previous cesarean	-
1	2.608
≥2	4.422
Lacuna	1.320
Anterior placenta	1.119
Adherent placenta	2.172

4. Discussion

We developed a model to predict cesarean hysterectomy accompanying cesarean section in patients with placenta previa. Placenta previa is associated with various maternal complications, including antepartum bleeding, intrapartum, postpartum hemorrhages, blood transfusion, sep-

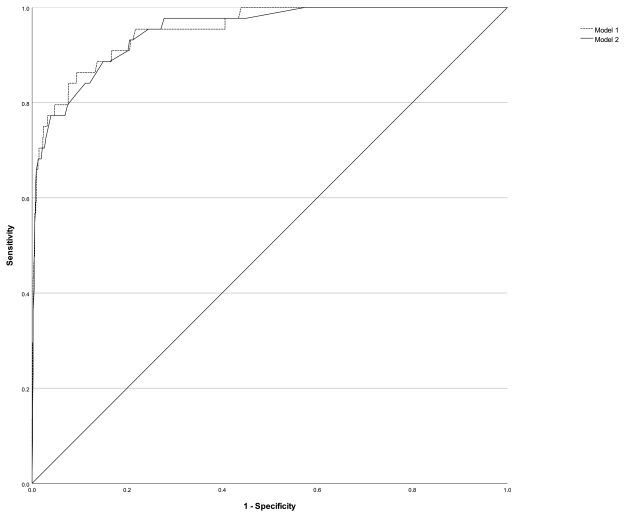

Fig. 1. Comparison of the receiver operating characteristic (ROC) curves in the developed prediction models.

ticemia, thrombophlebitis, and cesarean hysterectomy [8]. In the final predictive model we developed, maternal age ≥40 years, previous cesarean delivery, presence of lacuna, anterior placenta, and adherent placenta were significantly associated with cesarean hysterectomy.

Adherent placenta, also known as placenta accreta, is rare (about 1/2500) but known to increase the risk of obstetric hemorrhage, antepartum and postpartum hemorrhage, uterine perforation, and it can be an indication for cesarean hysterectomy accompanying cesarean section [9]. The mortality of placenta percreta, the most severe form of adherent placenta, is as high as 7% [10]. Although a definite diagnosis of adherent placenta is made clinically during operation or pathologically after operation, adherent placenta is included in this predictive model because of its high mortality and morbidity rates [11]. Therefore, diagnosing adherent placenta before operation is crucial, but not easy to diagnose. A number of studies have investigated the diagnosis of adherent placenta using ultrasonography. Presence of several vascular lacunae within the placenta, absence of the hypoechoic zone between the placenta and the myometrium, thin thickness of retroplacental myometrium (<1 mm), abnormalities of the uterine serosa-bladder interface, and the extension of the placenta into the myometrium, serosa, or bladder are associated with adherent placenta [12,13]. Adherent placenta is diagnosed before operation as the presence of more than two ultrasonographic findings among the five findings in our center. Despite the limitation of diagnosis using ultrasonography, findings suggestive of adherent placenta should be regarded as the presence of adherent placenta because of its high mortality and morbidity rates. In our final predictive model, adherent placenta significantly increased the risk of cesarean hysterectomy (OR 8.78, 95% CI 3.65–21.09).

The anterior placenta and presence of the main portion of the placenta extending to at least the lower anterior segment increase the risk of massive hemorrhage during operation [14]. In our predictive model, anterior placenta increased the risk of cesarean hysterectomy (OR 3.06, 95% CI 1.22–7.68) compared to other placenta locations. The presence of lacuna within the placenta parenchyma, has a role in the prediction of clinical outcomes. Sonographic findings of intra-placenta lacuna in patients with placenta previa increased the number of massive transfusions and cesarean hysterectomies required [15]. In our developed model, the presence of lacuna significantly increased the risk of cesarean hysterectomy (OR 3.74, 95% CI 1.55–9.04). Previous cesarean delivery was the most common risk factor that increased the risk of obstetric hemorrhage and cesarean hysterectomy. Previous cesarean delivery was also associated with adherent placenta and placenta previa [16,17]. In patients with placenta previa and one or more previous cesarean deliveries, the risk of adherent placenta was dramatically increased [18]. In our predictive model, previous cesarean delivery increased the risk of cesarean hysterectomy dramatically, especially in those with previous cesarean ≥2 (OR 83.28, 95% CI 21.98–315.55). Old maternal age is well known to be associated with cesarean hysterectomy [2]. In our predictive model, maternal age ≥40 years increased the risk of cesarean hysterectomy (OR 4.65, 95% CI 1.60–13.49).

The predictive model developed using these five factors showed good performance (AUC 0.951, 95% CI 0.921–0.981) but it has several limitations. First, this model did not consider the severity of adherent placenta. Adherent placenta, also known as placenta accreta spectrum is classified into three grades (grade 1: placenta adherenta or creta, grade 2: placenta increta, grade 3: placenta percreta) [19]. Because of the small number of cases of placenta percreta in our study (n = 8), this classification of grades was not used as a factor in the model. The deeper and larger the adherent placenta inside the myometrium of the uterus, the higher the risk of severe hemorrhagic complications and cesarean hysterectomy. Therefore, the grade of adherent placenta should be considered when using this predictive model. Many studies have reported very high sensitivity and specificity rates for obstetric ultrasonography for the diagnosis of adherent placenta. But none of these features (or combinations of features) associated with adherent placenta reliably predict the depth of invasion or type of placenta accreta [20]. Magnetic resonance imaging (MRI) is another tool used for the antenatal diagnosis of adherent placenta but it is unclear whether MRI improves the diagnosis of adherent placenta beyond that achieved with ultrasonography [21]. Several studies revealed that MRI may be useful to assess the depth of invasion in suspected increta and percreta [21–23]. Although a definite diagnosis and grade of adherent placenta are made during or after operation, the severity of adherent placenta using these tools and clinical factors should be considered before operation. Second, the predictive model we developed was based on a retrospec-

tive study, so the real performance of the model should be confirmed in a prospective study.

Despite these limitations, the predictive model of cesarean hysterectomy accompanying cesarean section in patients with placenta previa we developed would be great practical help in determining the preoperative preparations and intraoperative strategies. If a high probability of cesarean hysterectomy is expected, the insertion of a central venous catheter, consultation with anesthesiologists, and preparation of sufficient blood products should be done before operation [24,25]. Prophylactic internal iliac balloons can be placed by an interventional radiologist and inflated intraoperatively if needed. As hybrid operative rooms are introduced, intraoperative multivessel embolization can be done after the cesarean delivery. In these cases, consultation with an interventional radiologist is necessary before operation [26]. Adequate determination of intraoperative strategies should also be done. If the probability of cesarean hysterectomy is high or severe adherent placenta (placenta increta, placenta percreta, or both) is predicted, cesarean hysterectomy should be done with the placenta left *in situ* after delivery of the fetus. Attempts at placental removal are associated with fatal hemorrhage and are strongly discouraged [27,28]. However, if the probability of cesarean hysterectomy is low and there are no signs of severe adherent placenta, uterine preservation can be done. Intraoperative observation for spontaneous placental separation followed by removal of the placenta by manual extraction or surgical excision can be done as long as preparations for cesarean hysterectomy are in place [29,30]. A study reported that Bakri balloon insertion after placental removal was successful at preventing hysterectomy [31].

5. Conclusions

In conclusion, the predictive model and equation we developed may help clinical doctors to predict the risk of cesarean hysterectomy accompanying cesarean section in patients with placenta previa, so that more precise counseling with patients can be made. Adequate preoperative preparation and intraoperative strategies can also be made to improve clinical outcomes based on this predictive model.

Availability of Data and Materials

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

Author Contributions

MGC, JWK, and YHK designed the study and developed the project. MGC collected data, analyzed statistics, and edited the manuscript. JWK and YHK revised the manuscript. All authors contributed to editorial changes in the manuscript. All authors read and approved the final manuscript.

Ethics Approval and Consent to Participate

The study was conducted in accordance with the Declaration of Helsinki and was approved by the Institutional Review Board at Chonnam National University Medical Hospital (IRB No. CNUH-2023-008). All methods were carried out in accordance with relevant guidelines and regulations. Informed consent from the involved patients was waived for this study due to its retrospective nature.

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Conflict of Interest

The authors declare no conflict of interest. Yoon Ha Kim is serving as one of the Editorial Board members of this journal. We declare that Yoon Ha Kim had no involvement in the peer review of this article and has no access to information regarding its peer review. Full responsibility for the editorial process for this article was delegated to Hironori Takahashi and Osamu Samura.

References

[1] Engelsen IB, Albrechtsen S, Iversen OE. Peripartum hysterectomy-incidence and maternal morbidity. Acta Obstetricia et Gynecologica Scandinavica. 2001; 80: 409–412.

[2] Huque S, Roberts I, Fawole B, Chaudhri R, Arulkumaran S, Shakur-Still H. Risk factors for peripartum hysterectomy among women with postpartum haemorrhage: analysis of data from the WOMAN trial. BMC Pregnancy and Childbirth. 2018; 18: 186.

[3] van den Akker T, Brobbel C, Dekkers OM, Bloemenkamp KWM. Prevalence, Indications, Risk Indicators, and Outcomes of Emergency Peripartum Hysterectomy Worldwide: A Systematic Review and Meta-analysis. Obstetrics and Gynecology. 2016; 128: 1281–1294.

[4] Vandenberghe G, Guisset M, Janssens I, Leeuw VV, Roelens K, Hanssens M, *et al*. A nationwide population-based cohort study of peripartum hysterectomy and arterial embolisation in Belgium: results from the Belgian Obstetric Surveillance System. BMJ Open. 2017; 7: e016208.

[5] Lal AK, Hibbard JU. Placenta previa: an outcome-based cohort study in a contemporary obstetric population. Archives of Gynecology and Obstetrics. 2015; 292: 299–305.

[6] Crane JM, Van den Hof MC, Dodds L, Armson BA, Liston R. Maternal complications with placenta previa. American Journal of Perinatology. 2000; 17: 101–105.

[7] Trikha A, Singh PM. Management of major obstetric haemorrhage. Indian Journal of Anaesthesia. 2018; 62: 698–703.

[8] Gibbins KJ, Einerson BD, Varner MW, Silver RM. Placenta previa and maternal hemorrhagic morbidity. The Journal of Maternal-fetal & Neonatal Medicine. 2018; 31: 494–499.

[9] Read JA, Cotton DB, Miller FC. Placenta accreta: changing clinical aspects and outcome. Obstetrics and Gynecology. 1980; 56: 31–34.

[10] O'Brien JM, Barton JR, Donaldson ES. The management of placenta percreta: conservative and operative strategies. American Journal of Obstetrics and Gynecology. 1996; 175: 1632–1638.

[11] Jauniaux E, Chantraine F, Silver RM, Langhoff-Roos J. FIGO consensus guidelines on placenta accreta spectrum disorders: Epidemiology. International Journal of Gynaecology and Obstetrics. 2018; 140: 265–273.
[12] Berkley EM, Abuhamad AZ. Prenatal diagnosis of placenta accreta: is sonography all we need? Journal of Ultrasound in Medicine. 2013; 32: 1345–1350.
[13] Comstock CH, Bronsteen RA. The antenatal diagnosis of placenta accreta. BJOG: An International Journal of Obstetrics and Gynaecology. 2014; 121: 171–182.
[14] Baba Y, Matsubara S, Ohkuchi A, Usui R, Kuwata T, Suzuki H, *et al*. Anterior placentation as a risk factor for massive hemorrhage during cesarean section in patients with placenta previa. The Journal of Obstetrics and Gynaecology Research. 2014; 40: 1243–1248.
[15] Yang JI, Lim YK, Kim HS, Chang KH, Lee JP, Ryu HS. Sonographic findings of placental lacunae and the prediction of adherent placenta in women with placenta previa totalis and prior Cesarean section. Ultrasound in Obstetrics & Gynecology. 2006; 28: 178–182.
[16] Allahdin S, Voigt S, Htwe TT. Management of placenta praevia and accreta. Journal of Obstetrics and Gynaecology. 2011; 31: 1–6.
[17] Choi SJ, Song SE, Jung KL, Oh SY, Kim JH, Roh CR. Antepartum risk factors associated with peripartum cesarean hysterectomy in women with placenta previa. American Journal of Perinatology. 2008; 25: 37–41.
[18] Silver RM, Landon MB, Rouse DJ, Leveno KJ, Spong CY, Thom EA, *et al*. Maternal morbidity associated with multiple repeat cesarean deliveries. Obstetrics and Gynecology. 2006; 107: 1226–1232.
[19] Jauniaux E, Ayres-de-Campos D, Langhoff-Roos J, Fox KA, Collins S. FIGO classification for the clinical diagnosis of placenta accreta spectrum disorders. International Journal of Gynaecology and Obstetrics. 2019; 146: 20–24.
[20] Jauniaux E, Collins S, Burton GJ. Placenta accreta spectrum: pathophysiology and evidence-based anatomy for prenatal ultrasound imaging. American Journal of Obstetrics and Gynecology. 2018; 218: 75–87.
[21] D'Antonio F, Iacovella C, Bhide A. Prenatal identification of invasive placentation using ultrasound: systematic review and meta-analysis. Ultrasound in Obstetrics & Gynecology. 2013; 42: 509–517.
[22] Esakoff TF, Sparks TN, Kaimal AJ, Kim LH, Feldstein VA, Goldstein RB, *et al*. Diagnosis and morbidity of placenta accreta. Ultrasound in Obstetrics & Gynecology. 2011; 37: 324–327.
[23] Gielchinsky Y, Mankuta D, Rojansky N, Laufer N, Gielchinsky I, Ezra Y. Perinatal outcome of pregnancies complicated by placenta accreta. Obstetrics and Gynecology. 2004; 104: 527–530.
[24] Dahlke JD, Mendez-Figueroa H, Maggio L, Hauspurg AK, Sperling JD, Chauhan SP, *et al*. Prevention and management of postpartum hemorrhage: a comparison of 4 national guidelines. American Journal of Obstetrics and Gynecology. 2015; 213: 76.e1–76.e10.
[25] Kocaoglu N, Gunusen I, Karaman S, Ergenoglu AM, Firat V. Management of anesthesia for cesarean section in parturients with placenta previa with/without placenta accreta: a retrospective study. Ginekologia Polska. 2012; 83: 99–103.
[26] Melber DJ, Berman ZT, Jacobs MB, Picel AC, Conturie CL, Zhang-Rutledge K, *et al*. Placenta Accreta Spectrum Treatment With Intraoperative Multivessel Embolization: the PASTIME protocol. American Journal of Obstetrics and Gynecology. 2021; 225: 442.e1–442.e10.
[27] Eller AG, Porter TF, Soisson P, Silver RM. Optimal management strategies for placenta accreta. BJOG: An International Journal of Obstetrics and Gynaecology. 2009; 116: 648–654.
[28] Warshak CR, Ramos GA, Eskander R, Benirschke K, Saenz CC, Kelly TF, *et al*. Effect of predelivery diagnosis in 99 consecutive cases of placenta accreta. Obstetrics and Gynecology. 2010; 115: 65–69.
[29] Fox KA, Shamshirsaz AA, Carusi D, Secord AA, Lee P, Turan OM, *et al*. Conservative management of morbidly adherent placenta: expert review. American Journal of Obstetrics and Gynecology. 2015; 213: 755–760.
[30] Perez-Delboy A, Wright JD. Surgical management of placenta accreta: to leave or remove the placenta? BJOG: An International Journal of Obstetrics and Gynaecology. 2014; 121: 163–170.
[31] Pala Ş, Atilgan R, Başpınar M, Kavak EÇ, Yavuzkır Ş, Akyol A, *et al*. Comparison of results of Bakri balloon tamponade and caesarean hysterectomy in management of placenta accreta and increta: a retrospective study. Journal of Obstetrics and Gynaecology. 2018; 38: 194–199.