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Evaluation of the Relationship Between the Number of Cesarean Sections and Maternal and Neonatal Mortality and Morbidity in Patients with Placenta Percreta

Plasenta Perkretalı Hastalarda Sezaryen Sayısının Maternal ve Neonatal Mortalite ve Morbidite ile İlişkisinin Değerlendirilmesi

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Abstract

Background: Placental adhesion disorders (PAS), especially in cases such as placenta percreta, carry serious risks for maternal and infant health. These disorders are associated with complications such as bleeding, transfusion requirement and multiple organ failure. The main aim of this study was to examine the effect of the number of previous cesarean sections on maternal and neonatal outcomes in pregnant women with placenta percreta.

Materials and Methods: Between January 2021 and January 2023, 150 pregnant women admitted to Harran University Faculty of Medicine, Department of Obstetrics and Gynecology and diagnosed with placenta percreta were included in the study. Patients were divided into three groups according to the number of previous cesarean sections: 1-2 cesarean sections (Group 1), 3-4 cesarean sections (Group 2) and 5 or more cesarean sections (Group 3). Maternal (preoperative hemoglobin level, length of hospital stay, frequency of transfusion, postoperative complications) and neonatal outcomes (preterm delivery, APGAR scores, neonatal intensive care unit admission) were compared between the groups.

Results: The mean age was 33.3±4.9 years and the mean gestational age was 34.5±2.0 weeks. The preterm delivery rate was significantly higher in Group 3 (34%) compared to Group 1 (16%) (p=0.038). Hysterectomy rate increased from 10% in Group 1 to 58% in Group 3 (p<0.001). The complication rate was also higher in Group 3 compared to Group 1 (p=0.021). There was no significant difference between the groups in terms of neonatal outcomes (APGAR scores and intensive care unit admission). Patients who underwent hysterectomy had a longer hospital stay, higher complication rates, and higher rates of neonatal intensive care unit admission.

Conclusions: In cases of placenta percreta, an increasing number of previous cesarean sections increases the risk of hysterectomy, preterm delivery and maternal-neonatal morbidity. These findings suggest that preventing unnecessary cesarean deliveries may reduce the incidence of PAS and may have favorable maternal and infant health outcomes in such cases.

Keywords: Placenta percreta, Cesarean section, Maternal morbidity

Öz

Amaç: Plasental yapışma anomalileri (PYA), özellikle plasenta perkreta gibi durumlarda anne ve bebek sağlığı açısından ciddi riskler taşımaktadır. Bu anomaliler kanama, transfüzyon ihtiyacı ve çoklu organ yetmezliği gibi komplikasyonlarla ilişkilidir. Bu çalışmanın temel amacı, plasenta perkreta tanılı gebelerde geçirilmiş sezaryen sayısının maternal ve neonatal sonuçlar üzerindeki etkisini incelemektir.

Materyal ve metod: Ocak 2021 ile Ocak 2023 tarihleri arasında Harran Üniversitesi Tıp Fakültesi, Kadın Hastalıkları ve Doğum Anabilim Dalı'na başvuran ve plasenta perkreta tanısı konulan 150 gebe çalışmaya dahil edildi. Hastalar, geçirilmiş sezaryen sayısına göre üç gruba ayrıldı: 1-2 sezaryen (Grup 1), 3-4 sezaryen (Grup 2) ve 5 veya daha fazla sezaryen (Grup 3). Gruplar arasında maternal (preoperatif hemoglobin düzeyi, hastanede kalış süresi, transfüzyon sıklığı, postoperatif komplikasyonlar) ve neonatal sonuçlar (preterm doğum, APGAR skorları, yenidoğan yoğun bakım ünitesine kabul) karşılaştırıldı.

Bulgular: Ortalama yaş 33,3±4,9 yıl, ortalama gestasyonel hafta ise 34,5±2,0 hafta idi. Preterm doğum oranı, Grup 1'e (%16) kıyasla Grup 3'te (%34) anlamlı düzeyde daha yüksekti (p=0,038). Histerektomi oranı Grup 1'de %10 iken, Grup 3'te %58'e yükseldi (p<0,001). Komplikasyon oranı da Grup 1'e göre Grup 3'te daha yüksekti (p=0,021). Neonatal sonuçlar (APGAR skorları ve yoğun bakım ünitesine kabul) açısından gruplar arasında anlamlı bir fark saptanmadı. Histerektomi uygulanan hastaların hastanede kalış sürelerinin daha uzun, komplikasyon oranlarının ve yenidoğan yoğun bakım ünitesine kabul oranlarının daha yüksek olduğu görüldü.

Sonuç: Plasenta perkreta vakalarında, artan geçirilmiş sezaryen sayısı; histerektomi, preterm doğum ve maternal-neonatal morbidite riskini artırmaktadır. Bu bulgular, gereksiz sezaryen doğumların önlenmesinin, PYA insidansını azaltabileceğini ve bu tür vakalarda anne ve bebek sağlığı açısından olumlu sonuçlar doğurabileceğini düşündürmektedir.

Anahtar Kelimeler: Plasenta perkreta, Sezaryen, Maternal morbidite

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Introduction

Placenta accreta spectrum (PAS) disorders, characterized by the abnormal adhesion of the placenta to the uterine wall, are a significant obstetric emergency that can lead to serious complications for both mother and baby. Placenta percreta, the most severe form of these disorders, is defined by the placenta completely penetrating the myometrium and invading surrounding tissues and organs(1). Especially in undiagnosed cases, it can lead to life-threatening consequences for the mother due to the risk of massive hemorrhage during delivery. A significant increase in the incidence of PAS has been observed in recent years, with the rise in cesarean delivery rates being the most important cause. A history of previous cesarean section is one of the most significant risk factors for the development of PAS, and this risk increases exponentially with the number of cesarean sections(2). It is also thought that in vitro fertilization techniques have been effective in the recent increase in the frequency of PAS disorders.

The management of PAS disorders is of great importance due to high-risk cases requiring surgical intervention. Although uterus-preserving surgical approaches can be applied in some patients, hysterectomy becomes inevitable, especially in advanced cases(3). While maternal outcomes associated with PAS are well known, more research is needed on the neonatal effects of this condition. Placenta percreta cases are often associated with preterm birth, which increases the incidence of complications such as respiratory distress and the need for intensive care in newborns(4). This study aims to evaluate the relationship between the number of previous cesarean deliveries and maternal and neonatal outcomes in pregnant women diagnosed with placenta percreta.

Materials and Methods

Ethical approval was obtained from the Harran University Clinical Research Ethics Committee (approval no: HRÜ/23.05.10, date: March 27, 2023). The study was conducted in compliance with the World Health Organization's Declaration of Helsinki and Good Clinical Practices.

Pregnant women who presented to the Harran University Faculty of Medicine, Department of Obstetrics and Gynecology between January 2021 and January 2023 and were diagnosed with placenta percreta based on sonographic evaluation were planned to be included in the study. All patients were initially evaluated for PAS spectrum due to suspected placenta previa, and definitive diagnosis of percreta was confirmed by both prenatal imaging (USG/MRI) and intraoperative findings. Those without a history of previous cesarean delivery were not included. Between the specified dates, 286 cases of placenta percreta and placenta previa were identified. 123 patients with no prior history of cesarean section and 4 patients who had undergone abdominal surgery were excluded from the study. The patients were planned to be divided into three groups based on the number of cesarean sections: 1-2 cesarean sections, 3-4, and those with 5 or more cesarean sections. The decision for cesarean hysterectomy was made by a multidisciplinary team based on intraoperative criteria, including uncontrolled massive hemorrhage, the depth and extent of placental invasion into adjacent organs (e.g., bladder), and maternal hemodynamic instability.

Information regarding placenta percreta patients was retrospectively evaluated from the hospital database and patient files. The patients' age, gravida, parity, number of living children, and gestational age were assessed. The type of operation (uterus-preserving, hysterectomy) was included in the analyses. Our study aimed to evaluate the relationship between the number of cesarean sections and maternal and neonatal outcomes. The evaluated maternal and neonatal outcomes are as follows;

Maternal outcomes:

- Hemoglobin level
- Length of hospital stay
- Transfused blood products and amount
- Postoperative complications

Neonatal outcomes:

- First and fifth minute APGAR scores
- Need for Neonatal ICU

Inclusion criteria for the study:

1. Patients diagnosed with placenta previa by ultrasonography (USG) or magnetic resonance imaging (MRI).
2. Any of the placenta accreta spectrum (PAS) disorders (placenta accreta, increta, or percreta).
3. Diagnosis confirmed by specialist radiologists and obstetrician-gynecologists.
4. Patients who have undergone at least one previous cesarean section.
5. Singleton pregnancies.
6. The period from the 20th week of gestation onwards.

7. The location of the placenta was clearly determined by ultrasonography.

Exclusion criteria for the study:

1. Patients who have undergone abdominal surgery other than cesarean section (e.g., gynecological operations, fibroid removal, endometriosis surgery).
2. Previous hysterotomy or uterine rupture.
3. Patients who received radiotherapy to the pelvic region.
4. Those with multiple pregnancies (twins, triplets, etc.).
5. Pregnancies where an anomaly was detected in the baby or the baby died in utero.
6. Pregnancy of less than 20 weeks.
7. Cases where the location of the placenta could not be clearly determined.
8. Pregnancies considered high-risk due to chronic maternal diseases (e.g., uncontrolled diabetes, high blood pressure, heart failure, kidney failure).
9. History of active infection or sepsis.
10. History of bleeding disorders or coagulation problems.

Statistical Analysis

Statistical analyses were performed using the SPSS version 22.0 package program. Descriptive statistics were expressed as number, percentage, mean and standard deviation, and median. The conformity of variables to normal distribution was examined using visual (histograms and probability plots) and analytical methods ("Kolmogorov-Smirnov", "Shapiro-Wilk tests"). Numerical variables determined according to their distribution status were compared between two groups using the "Independent Samples T-test" and among more than two groups using the One-Way ANOVA test. Post-hoc analyses were performed with "Tamhane's correction" following the ANOVA test. Numerical variables not showing a normal distribution were analyzed between two groups with the "Mann-Whitney U test" and among more than two groups with the Kruskal-Wallis test. "Chi-square analysis" and "Fisher's Exact test" were used for the comparison of nominal data. In statistical analyses, comparisons with a p-value below 0.05 were considered statistically significant.

Results

The mean age of the 150 patients included in the study was 33.3±4.9, the mean gravida was 6.0±2.1, the median parity was 4, the number of living children was 4 (range 1-9), and the mean C/S count was found to be in the range of 3.4±1.5. The mean gestational age was 34.5±2.0 weeks. While 68% of the patients underwent uterus-preserving surgery, 32% were treated with hysterectomy. The descriptive characteristics of the patients are shown in Table 1.

Table 1. Descriptive characteristics of the participants

Feature	Total (n=150)	Group 1 (C/S 1-2) (n=50)	Group 2 (C/S 3-4) (n=50)	Group 3 (C/S ≥5) (n=50)
Age	33.3±4.9	32.9±5.7	33.5±5.1	33.6±3.7
Gravida	6.0±2.1	5.0±2.3	5.8±1.8	7.3±1.4
Parity*	4 (1-9)	3 (1-9)	4 (1-9)	6 (4-9)
Living*	4 (1-9)	3 (1-9)	4 (1-9)	5 (3-9)
C/S count	3.4±1.5	1.6±0.4	3.4±0.5	5.2±0.5
Gestational week	34.5±2.0	34.8±1.5	34.9±2.0	33.9±2.3
Uterus-preserving	102 (68.0)	45 (90.0)	36 (72.0)	21 (42.0)
Hysterectomy	48 (32.0)	5 (10.0)	14 (28.0)	29 (58.0)

*Median (min-max), ** N(%), C/S; cesarean section

The mean hemoglobin level of the patients was 11.4±1.5 g/dl. The mean length of hospital stay was 4.5±2.0 days. 65.3% of the cases received packed red blood cells (RBC), and 45.3% received fresh frozen plasma (FFP) transfusion. Complications were observed in 13.3% of the patients. The complications were bladder injury (8.0%), postoperative ileus (4.0%), and hematoma (1.3%) (Table 2).

Table 2. Maternal outcomes and their distribution				
Feature	**Group 1 (n=50)**	**Group 2 (n=50)**	**Group 3 (n=50)**	**P-value**
Hemoglobin (g/dl)	11.6±1.6	11.4±1.7	11.3±1.2	0.783
Hospital stay (days)	4.2±1.9	4.7±2.2	4.5±1.8	0.574
RBC transfusion (N, %)	32 (64.0)	31 (62.0)	35 (70.0)	0.725
RBC units (mean±SD)	2.2±1.1	2.5±1.8	3.2±2.0	0.042
FFP transfusion (N, %)	21 (42.0)	17 (34.0)	30 (60.0)	0.028
FFP units (mean±SD)	1.1±0.5	1.8±1.1	1.7±1.0	0.031
Complication (N, %)	3 (6.0)	6 (12.0)	11 (22.0)	0.059
*N(%), RBC: Red blood cell, FFP: Fresh frozen plasma, ICU: Intensive care unit, SD: Standard deviation				

The 1st-minute APGAR score of the newborns was 5.9±1.0, and the 5th-minute APGAR score was 7.1±1.0. 63.3% of the newborns were admitted to the NICU (Table 3).

Table 3. Neonatal outcomes and their distribution				
Feature	**Total (n=150)**	**Group 1 (C/S 1-2) (n=50)**	**Group 2 (C/S 3-4) (n=50)**	**Group 3 (C/S ≥5) (n=50)**
APGAR 1st min	5.9±1.0	5.9±1.0	6.0±1.0	5.8±1.0
APGAR 5th min	7.1±1.0	7.2±0.9	7.1±1.1	7.0±0.9
NICU*	95 (63.3)	31 (62.0)	28 (56.0)	36 (72.0)
* N(%), NICU: Neonatal intensive care unit				

Descriptive characteristics were compared among the groups. The mean age of Group 1 was 32.9±5.7 years, Group 2 was 33.5±5.1 years, and Group 3 was 33.6±3.7 years. However, the mean age of the groups was similar (p=0.735).

A significant difference was observed between the groups in terms of gravida (p<0.001). In post-hoc analyses, the mean gravida of Group 3 was found to be higher than that of Group 2 and Group 1. A significant difference was detected between the groups in terms of maternal parity and the number of living children. In pairwise analyses, the parity and number of living children of Group 3 were higher than Group 2, and those of Group 2 were higher than Group 1.

A significant difference was observed among the groups in terms of gestational age (p=0.025). In the pairwise analysis, the gestational age of Group 2 was seen to be higher than that of Group 3 (p=0.035). When pregnancies less than 34 weeks were classified as preterm birth, the preterm birth rate was 16% in Group 1, 20% in Group 2, and 34% in Group 3. The frequency of preterm birth in Group 3 was significantly higher than in Group 1 (p=0.038), but there was no difference in terms of preterm birth among the other groups.

There was a significant difference between the groups in terms of operation type (p<0.001). In the pairwise analysis, the hysterectomy rate of Group 3 was higher than that of Group 2 (p=0.002), and the hysterectomy rate of Group 2 was higher than that of Group 1 (p=0.022). The hysterectomy rate increased as the number of cesarean sections increased.

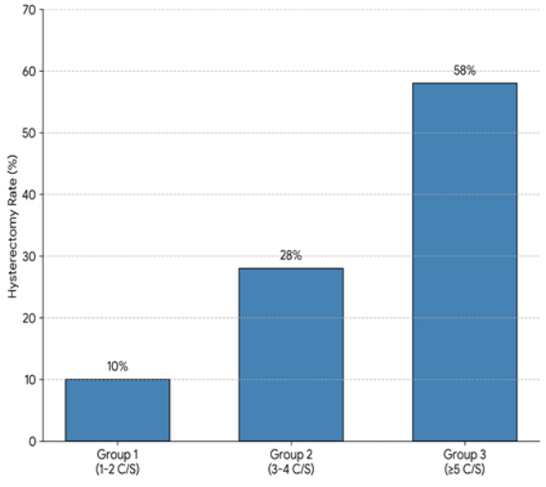

Figure 1. Comparison of hysterectomy rates among the three groups based on the number of previous cesarean sections. As illustrated in the figure, a linear trend of increasing hysterectomy rates was observed corresponding to the number of previous cesarean sections (p < 0.001).

Maternal outcomes were compared among the groups. The mean hemoglobin level of Group 1 was 11.6±1.6 g/dl, Group 2 was 11.4±1.7 g/dl, and Group 3 was 11.3±1.2 g/dl. Hemoglobin levels were similar among the groups (p=0.783). The mean length of hospital stay was 4.2±1.9 days in Group 1, 4.7±2.2 days in Group 2, and 4.5±1.8 days in Group 3. However, the length of hospital stay was similar among the groups (p=0.574).

RBC transfusion was performed in 64% of Group 1, 62% of Group 2, and 70% of Group 3. However, no significant difference was observed between the groups in terms of RBC transfusion frequency. The frequency of FFP transfusion was 42% in Group 1, 34% in Group 2, and 60% in Group 3. A significant difference was observed in the frequency of FFP use among the groups (p=0.028). In pairwise analyses, the frequency of FFP use in Group 3 was seen to be higher than in Group 2. Furthermore, the comparison of RBC transfusion units among the three groups showed a statistically significant difference (p=0.042), and the comparison for FFP units also yielded a statistically significant difference (p=0.031).

The complication rate was 6% in Group 1, 12% in Group 2, and 22% in Group 3. In the three-group comparison, no significant difference was observed between the groups in terms of complications (p=0.059). However, in the pairwise analysis, the complication rate of Group 3 was found to be higher than that of Group 1 (p=0.021). Nevertheless, no significant difference was observed among the groups in terms of hemoglobin level, length of hospital stay, and transfusion frequency. Complications were categorized as major and minor. The major complication rate was 8.0% (bladder injury), while the minor complication rate was 5.3% (ileus and hematoma).

Neonatal outcomes were analyzed among the groups. The 1st-minute APGAR score of Group 1 was 5.9±1.0, Group 2 was 6.0±1.0, and Group 3 was 5.8±1.0. The 5th-minute APGAR score of Group 1 was 7.2±0.9, Group 2 was 7.1±1.1, and Group 3 was 7.0±0.9. No difference was found between the groups in terms of 1st-minute (p=0.796) and 5th-minute APGAR (p=0.714) scores.

Postnatal neonatal NICU admission rates were evaluated. 62% of Group 1, 56% of Group 2, and 72% of Group 3 were admitted to the NICU. No significant difference was observed in NICU admission rates among the groups (p=0.245).

Placenta percreta patients were divided into two groups: those who underwent uterus-preserving surgery (n=102) and those who underwent hysterectomy (n=48). Descriptive characteristics, maternal, and neonatal outcomes were compared between these groups. Gravida (p=0.004), parity (p<0.001), survival (p=0.004), and C/S count (p<0.001) were significantly higher in those who underwent hysterectomy. The frequency of preterm birth (<34 weeks) was higher in the hysterectomy group (p=0.005). The length of hospital stay was longer in pregnant women who underwent hysterectomy compared to those who underwent uterus-preserving surgery (p=0.006). Among maternal outcomes, the frequency of FFP transfusion (p=0.011) and complications (p=0.018) was higher in those who underwent hysterectomy. While no significant difference was found in APGAR scores among neonatal outcomes, neonatal NICU admission rates (p=0.042) were higher in women who underwent hysterectomy (Table 4).

Table 4. Comparison between patients undergoing hysterectomy and uterus-preserving surgery

Feature	Uterus-preserving (n=102)	Hysterectomy (n=48)	p-value
Age	33.2±5.0	33.6±4.7	0.628
Gravida	5.7±2.1	6.7±1.9	0.004
Parity*	4 (1-9)	5 (2-8)	<0.001
Living*	4 (1-9)	5 (2-9)	0.004
C/S count	3.0±1.5	4.3±1.3	<0.001
Gestational week	34.8±1.6	33.9±2.5	0.003
Preterm birth (<34 wks)	17 (16.7)	18 (37.5)	0.005
Hemoglobin (g/dl)	11.6±1.4	11.1±1.7	0.061
Hospital stay (days)	4.2±1.7	5.1±2.4	0.006
RBC transfusion	62 (60.8)	36 (75.0)	0.088
RBC units	2.4±1.5	3.1±2.1	0.063

Table 4. Continued			
FFP transfusion	39 (38.2)	29 (60.4)	0.011
FFP units	1.4±0.8	1.7±1.1	0.261
Complication	9 (8.8)	11 (22.9)	0.018
APGAR 1st min	6.0±1.0	5.7±1.1	0.067
APGAR 5th min	7.2±0.9	7.0±1.0	0.271
NICU	59 (57.8)	36 (75.0)	0.042
*Median (min-max), **N(%), C/S: Cesarean section, RBC: Red blood cell, FFP: Fresh frozen plasma, NICU: Neonatal intensive care unit			

The correlation between the number of cesarean sections and other clinical features was analyzed. In the correlation analysis, a negative correlation was found between the number of cesarean sections and gestational week (p=0.014) (Table 5).

Table 5. Correlation of cesarean section count with other clinical features			
Variables	**C/S count**	**Gestational week**	**Age**
C/S count	-	r=-0.200 (p=0.014)	r=0.119 (p=0.147)
Gestational week	-0.200	-	r=-0.017 (p=0.835)
APGAR (1st min)	r=-0.050 (p=0.545)	r=0.425 (p<0.001)	-
APGAR (5th min)	r=-0.051 (p=0.538)	r=0.437 (p<0.001)	-

Discussion

Placenta accreta spectrum (PAS) disorders involve the abnormal adhesion of the placenta to the uterus and adjacent organs. The relationship between PAS disorders and cesarean delivery has long been known. The risk of PAS in pregnant women whose previous pregnancy ended in a cesarean delivery is higher compared to those with a history of vaginal delivery (4-5). PAS disorders, associated with complications such as bleeding, adjacent organ injuries, and hysterectomy, are linked not only to maternal but also to poor neonatal outcomes(6). Although the maternal and neonatal outcomes of placental invasion anomalies have been evaluated in many studies (7), the effect of the number of previous cesarean sections on maternal and neonatal outcomes in PAS cases has been evaluated in a limited number of studies (8). Therefore, our study aimed to evaluate maternal and neonatal outcomes according to the number of previous cesarean deliveries.

Since placental invasion anomalies are associated with bleeding at delivery, prenatal care should be prepared for the possible risk of transfusion. In a systematic review evaluating 34 studies and approximately 865 cases, it was stated that the best predictive features for PAS disorders were a history of cesarean delivery, and the most important complications were bleeding, blood transfusion, and hysterectomy (9). Although factors associated with bleeding in percreta cases have been evaluated in many studies (10-11), the effect of the number of pregnancies on bleeding is not fully known.

In our study, although approximately 65% of the cases received a transfusion, no difference was observed in terms of the number of cesarean sections and transfusion frequency. However, FFP transfusion was higher in pregnant women with five or more cesarean sections. Additionally, transfusion amounts were similar among the groups. Our findings suggest that there is no significant increase in transfusion frequency as the number of cesarean sections increases. Similar results have been reported before (8-12-13). A 2023 study by Alhashim et al. (11) examined factors affecting blood transfusion in placenta accreta cases. In the study, no difference was observed between transfused and non-transfused cases in terms of cesarean delivery history.

While these results are consistent with our findings, only percreta cases were evaluated in our study. In the study by Barut et al., percreta cases were divided into three groups according to the number of cesarean sections (1-2, 3-4, ≥5) and their blood transfusion needs were compared; similar to our findings, no difference was observed between the groups (12). In the study

by Oben et al. (7), the frequency of transfusion (erythrocytes and platelets) in patients with two or more cesarean sections was found to be similar to those with fewer than two cesarean sections.

In our study, intraoperative and postoperative complications in placenta percreta cases included bladder injury in 12 (8%) cases, postoperative ileus in 6 (4%) cases, and hematoma in 2 (1.3%) cases (total complication rate 13.3%). Although the operations were performed by experienced surgeons, the significant invasion of the placenta into the bladder resulted in bladder injuries, especially in percreta cases. However, there was no significant difference in the frequency of complications among the cesarean groups.

The relatively low complication rate may have influenced these results. In our study, the complication rates according to the cesarean groups were 6%, 12%, and 22%, respectively. Although the difference between these rates was not statistically significant, it was close to statistical significance (p=0.059). The low complication rate might have masked the observation of a statistically significant difference. In our study, a difference in complication rates was observed when only those with 1-2 cesarean sections were compared with those with more than 5, instead of a three-group analysis. While there are studies linking the number of cesarean sections with complication rates, different results have also been reported. Oben et al. (7) reported no difference in the frequency of complications among cesarean groups. In the study by Barut et al. (12), the complication rate among percreta cases was reported as 6.5% in those with a history of 1-2 cesarean sections, 15.1% in those with 3-4 cesarean sections, and 27.2% in those with five or more cesarean sections. This study indicated that there were differences in complication rates (12). The study by Friedrich et al. (13) stated that the number of cesarean sections was a determinant of bladder injury in urinary system diseases.

In our study, no difference was observed in the length of hospital stay among the cesarean section number groups. Placenta percreta increases the length of hospital stay compared to normal pregnancies, but our findings suggest that the length of hospital stay does not increase with an increasing number of cesarean sections. Similar findings have been reported previously. A recent study indicated that the length of hospital stay was not affected by an increasing number of cesarean sections. The fact that the length of hospital stay did not increase while complications increased with the number of cesarean sections may have been influenced by the non-monitoring of complications that prolong the hospital stay or major complications, or by the good management of complications (12).

A national study reported that the mean gestational week in normal cesarean deliveries was 39 weeks, whereas in Placenta percreta cases, it was approximately 34 weeks (14). Placenta percreta can lead to adverse neonatal outcomes associated with preterm birth.

In our study, it was observed that the gestational week of patients who underwent cesarean section due to placenta percreta was earlier in cases with more than 5 cesarean sections. Correlation analysis showed that as the number of cesarean sections increased, the gestational age decreased. In a 2021 study by Oben et al. (7), 194 pregnant women with PAS disorder were compared according to the number of their cesarean sections. The study stated that there was no difference in the preterm birth rate between pregnant women with fewer than two cesarean deliveries and those with more cesarean deliveries (27.8% & 22.1%) (7).

In our study, these rates are 16% in pregnant women with 1-2 cesareans, 20% in those with 3-4 cesareans, and 34% in those with 5 or more cesareans. While no difference was found in the frequency of preterm birth between those with 1-2 and 3-4 cesareans in our study, the frequency of preterm birth was higher in those with 5 or more cesareans. The different categorization of the number of cesareans and the inclusion of pregnant women with 5 or more cesareans in our study might have resulted in a significant relationship between the number of cesareans and the frequency of preterm birth. In the study by Oben et al. (7), although there was no difference between the groups in terms of the number of cesareans, the rate of preterm birth requiring hospitalization was seen to be higher in those with 2 or more cesareans.

It is known that planned preterm cesarean section in placental adhesion anomalies leads to poor neonatal outcomes (15-16). However, previous studies have evaluated the relationship between poor newborn outcomes and preterm birth rather than the number of cesarean sections. Our study evaluated the effect of the number of cesarean sections on newborn outcomes. However, in our study, no difference was observed in the rates of newborn NICU admission among the cesarean section number groups. However, the newborn NICU admission rate was higher in cases who underwent hysterectomy compared to those who underwent uterus-preserving surgery (75% and 57%, respectively). Our findings suggest that neonatal outcomes are related to hysterectomy rather than the number of cesarean sections.

It is known that placenta percreta causes lower APGAR scores compared to normal deliveries (17-18). However, data on the effect of the number of cesarean sections on neonatal

outcomes in placenta percreta patients are limited. In our study, no difference was found in APGAR scores between the cesarean groups. However, a correlation was observed between gestational age and APGAR scores. Our findings suggest that the number of cesarean sections in percreta cases does not affect neonatal outcomes. The study by Barut et al. (12) also reported no difference in APGAR scores between groups in terms of the number of cesarean sections in placenta percreta cases. It was stated in that study that although there was no direct relationship between the number of cesarean sections and APGAR scores, neonatal outcomes could worsen as the complication rate and hysterectomy frequency increase with the number of cesarean sections (12).

Despite the development of uterus-preserving methods, hysterectomy is still the most common treatment option in PAS treatment. Hysterectomy may be the only option for bleeding in placenta accreta spectrum disorders. In our study, hysterectomy was required in 32% of 150 placenta percreta cases, and hysterectomy rates increased as the number of cesarean sections increased. The hysterectomy rate, which was 10% in the group with 1-2 cesarean sections, increased to 58% in those with more than 5 cesarean sections. Although the hysterectomy rate in percreta cases has been extensively evaluated (19-20), hysterectomy rates according to the number of cesarean sections have been examined in a limited number of studies (12).

In the study by Marcellin et al. (21), the hysterectomy rate in 51 placenta percreta cases was reported as 52.9%. However, hysterectomy rates according to the number of cesarean sections were not evaluated in that study. In the study by Barut et al. (12), the hysterectomy rate was reported as 10.9% in those with a history of 1-2 cesarean sections, 28.3% in those with a history of 3-4 cesarean sections, and 54.5% in those with a history of 5 or more cesarean sections. These findings showed that hysterectomy rates increase as the number of cesarean sections increases, and therefore the number of cesarean sections may be associated with maternal and neonatal outcomes (12).

In our study, cases who underwent hysterectomy were compared with those who underwent uterus-preserving surgery. The length of hospital stay was longer and the complication rate was higher in those who underwent hysterectomy. Similar results have been reported before. In a recent study by Alina et al. (22), hysterectomy and conservative treatment in PAS disorders were compared. The study stated that complications were more frequent in the hysterectomy group, and the frequency of preterm birth and the need for transfusion were higher (22). In the study by Sentilhes et al. (19), similar to our findings, the complication rate was seen to be higher in placenta percreta cases who underwent hysterectomy. In that study, unlike our findings, hysterectomy was associated with the amount of blood loss (19).

In our study, 75% of the hysterectomy cases and 60.8% of those who underwent uterus-preserving surgery received a transfusion. No significant difference was found in terms of transfusion between the cases who underwent hysterectomy and those who underwent uterus-preserving surgery. However, in our study, the FFP transfusion rates in those who underwent hysterectomy were found to be significantly higher than the RBC transfusion rates.

There are also studies reporting results that contradict our findings. In the study by Wang et al. (23), 140 patients who underwent hysterectomy were compared with 140 patients who underwent conservative treatment. The study stated that maternal and neonatal outcomes (gestational age, preterm birth, low birth weight) were similar between the two groups except for blood transfusions (23). However, the inclusion of placenta increta cases in this study and the selection of patients into treatment groups may have affected the results. In our study, only percreta cases were evaluated, and patients were not selected according to the treatment method.

The study by Amsalem et al. (24) reported no difference in intraoperative and postoperative complications between the cesarean hysterectomy and conservative surgery groups. However, only 26 cases were evaluated in that study.

In our study, the total complication rate in percreta cases was found to be 13.3% and the frequency of bladder injury was 8%. Although our study was not designed to evaluate the frequency of complications, similar results have been reported in PAS diseases. In a study conducted by Friedrich et al. (13) in Israel, the frequency of bladder injury in 312 PAS cases was reported as 9.3%.

In a study conducted by Giuseppe et al. (25) in Italy in 2023, the total complication rate in 156 PAS cases with a prenatal diagnosis was reported as 11%, and the frequency of urinary system injury was 7.6%. However, all PAS cases were evaluated in these studies. It was stated that in Grade 3c PAS cases, the complication rates increased to 17.8% and the urinary system injury frequency to 13.7%. Therefore, it can be said that the complication rates in our study are lower than in these studies. The adoption of a multidisciplinary approach for PAS diseases in our hospital, making the necessary preparations in the antenatal period, and having sufficient experience for PAS diseases in our center may have led to lower complication rates.

Our study had some limitations. In our study, the diagnosis

of placenta percreta was made clinically and radiologically. However, the definitive diagnosis of PAS diseases is made by pathological evaluation. On the other hand, placenta percreta can be diagnosed at a higher rate in the antenatal period compared to milder PAS disorders (4-26). Another limitation of our study was the lack of a control group. As the number of cesarean deliveries increases, maternal and neonatal outcomes also worsen in pregnancies without placenta percreta (27). In studies with a control group, the relationship between the number of cesarean sections and maternal and neonatal outcomes in percreta cases can be shown more comprehensively. Finally, our study categorized patients with 5 or more cesarean sections as a single group. Future studies with larger cohorts could perform sub-analyses on patients with 5, 6, and 7+ cesarean sections to further delineate the risks in this specific high-parity population.

Conclusion

The incidence of placenta percreta is increasing with the rise in cesarean delivery rates. Since placenta percreta can be associated with poor maternal and neonatal outcomes, it is important to reduce non-indicated cesarean deliveries as well as to manage the cases well. In our study, it was seen that as the number of cesarean deliveries increased in percreta cases, the frequency of preterm birth and hysterectomy also increased. In addition, the frequency of postoperative complications was higher, especially in pregnant women with a history of more than 5 cesarean sections. Although a direct relationship between the number of cesarean deliveries and neonatal outcomes such as APGAR and newborn NICU admission could not be shown, the newborn NICU admission rate was higher in cases who underwent hysterectomy. Therefore, a high number of cesarean deliveries may be associated with poor neonatal outcomes.

Complication rates can be reduced with the antenatal diagnosis of placental adhesion anomalies. Pre-identification of cases like Placenta Percreta, especially those with severe adhesion, and knowing the features associated with poor maternal and neonatal outcomes can facilitate the prenatal management of patients and improve maternal and neonatal outcomes.

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