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The comparison of maternal and neonatal outcomes between emergency and planned cesarean deliveries in women with placenta previa

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ABSTRACT

Objectives: To compare maternal and neonatal outcomes concerning emergency or planned cesarean deliveries in pregnancies complicated by placenta previa (PP), and to evaluate factors related to blood transfusion requirement.

Methods: Three hundred sixty-three women with PP with (n = 80) and without (n = 283) placenta accreta spectrum (PAS) who delivered between May 2016 and May 2021 were retrospectively reviewed. The patients were allocated to two main groups as PAS and non-PAS and into two subgroups as emergency cesarean delivery (ECD) and planned cesarean delivery (PCD).

Results: One hundred twenty-eight deliveries were emergency and 155 were planned in non-PAS group. In PAS group 38 patients were delivered urgently and 42 were delivered as planned. General anesthesia was preferred more frequently in emergency cases. Gestational age, birth weight, and the 1st and 5th minute APGAR scores of the infants were significantly lower and neonatal intensive care unit (ICU) admission was significantly higher in the ECD cases ($p < 0.001$) in both PAS and non-PAS groups. The total amount of blood and blood product transfused ($p = 0.005$), length of hospital stay ($p = 0.022$) were higher in the ECD cases and adult ICU admission was significantly higher in the ECD cases in non-PAS group ($p = 0.016$). In multilinear regression analysis, the need for blood transfusion was found to increase with the number of previous cesarean sections, ECD, PP with PAS, general anesthesia, and uterine artery ligation.

Conclusions: In placenta previa, which is an obstetric condition associated with serious maternal and neonatal morbidity and mortality, adverse maternal and neonatal outcomes increase in cases of emergency cesarean delivery.

Keywords: Planned cesarean delivery, emergency cesarean delivery, hysterectomy, placenta previa, placenta accreta spectrum, blood transfusion

Placenta previa (PP), a unique obstetric condition associated with maternal and neonatal morbidity and mortality due to the potential for serious antenatal bleeding, peripartum hemorrhage, and preterm delivery, is defined as the extension and closure of the placental tissue on the internal cervical os [1]. The most accepted explanation in the etiology is the absence of the phenomenon called "trophotropism", atrophy, and

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migration in the natural development of the placenta, due to a defect in the endometrium caused by previous surgery, especially the decreased vascularity in the scar area of a previous cesarean section, which leads the placenta to settle in the lower uterine segment. PP was reported to complicate 0.38% of singleton pregnancies in the 2000s [2], and its prevalence has been reported as 0.56% in recent years [3]. This increasing trend is associated with the increasing rates of cesarean delivery in a dose-response manner [4]. Other risk factors are advanced maternal age, multiparity, smoking, multiple pregnancies, assisted reproductive technology (ART) use, and recurrent pregnancy loss [2, 5]. PP cases are at increased risk of intrapartum blood loss due to the inability of the lower uterine segment, where abnormal placental implantation occurs, to contract as effectively as the normal uterine segment, the possibility of transecting the placenta during uterine incision, and the increased risk of placenta accreta [6].

It should be kept in mind that the possibility of placenta accreta spectrum (PAS) increases if PP is detected in a pregnant woman with a previous cesarean section. PAS (accreta, increta, percreta) is a spectrum disorder ranging from abnormal adhesion to deep invasion, which is clinically important because the placenta does not separate spontaneously at delivery and causes life-threatening bleeding and necessitates blood transfusion, intensive care unit (ICU) admission and even hysterectomy [7]. It has been reported that PP is associated with a three to five-fold increase in the risk of preterm birth, admission to the neonatal intensive care unit (NICU), neonatal and perinatal death [8]. The main causes of neonatal morbidity and mortality are problems related to preterm birth [9].

The aim of our study was to compare the effects of an emergency or planned cesarean delivery on maternal and neonatal outcomes in both PAS and non-PAS PP cases, and secondarily to evaluate factors affecting the need for blood transfusion in these patients.

METHODS

After the approval of Bursa Yüksek İhtisas Training and Research Hospital Clinical Research Ethics Committee (2011-KAEK-25 2021/04-10), 363 women with PP who delivered between May 2016 and May 2021 were retrospectively reviewed. Age, body mass index (BMI), obstetric history (gravida, parity, abortion, previous uterine surgery, number of prior cesarian deliveries), gestational age at delivery, delivery under emergency or elective conditions, type of anesthesia used, surgical maneuvers to control bleeding, intraoperative complications, pathology results in patients who underwent cesarean hysterectomy and lower segment resection, re-laparotomy, amount of blood transfusion, need for follow-up in the adult ICU, hospital length of stay, postoperative complications, infants birth weight, sex, 1st and 5th minute Apgar scores, NICU administration, and neonatal death were noted. Singleton pregnancies complicated by PP after the 24th gestational week were included in the study. Pregnancies with intrauterine fetal death, fetal anomalies, multiple gestations, and insufficient data were excluded.

Patients in whom peripartum ultrasound findings were compatible with an invasion of the placental tissue (loss or irregularity of the retroplacental hypoechoic plane 'clear zone', myometrial thinning < 1 mm, abnormal placental lacunae with turbulent flow, bladder wall interruption, placental bulge) and the invasion was confirmed by the intraoperative difficult manual removal of the placenta or the pathologic examination of the hysterectomy and segmental resection materials were defined as the PAS group. Patients in whom the placenta covered the internal cervical os but without signs of invasion were defined as the non-PAS group. The antenatal diagnosis was obtained from medical records. The definition of emergency and planned cesarean section was made according to the patient's clinic at the time of administration for delivery, regardless of the gestational week (GW), prenatal diagnosis, and the working hours and shift hours of the hospital. The elective surgery of patients who were diagnosed by ultrasound during pregnancy follow-up, were hemodynamically stable, and did not have active vaginal bleeding and uterine contractions was defined as PCD. Emergency surgery was defined as surgery performed for uterine contraction, vaginal bleeding and hemodynamic instability, regardless of prenatal diagnosis.

Gestational age was calculated from the last menstrual period or first-trimester ultrasound. In our clinic, we mostly progress to surgery at 36 0/7-37 6/7 weeks of gestation for women with PP cases without PAS and 34 0/7–35 6/7 weeks of gestation for PP with PAS as

recommended by the American College of Obstetricians and Gyneclogosits (ACOG) [10]. Antenatal corticosteroids were not administered to the majority of the patients because those who were admitted for a planned section were > 34 weeks, and patients who underwent emergency cesarean section did not have time to wait for appropriate efficacy.

Surgical interventions to control bleeding after pharmacologic measures were suture of the placental bed, uterine artery ligation, internal iliac artery ligation (IIAL), balloon tamponade, and B-Lynch suturing according to the depth of invasion. Rapid use of radiologic interventions such as transarterial embolisation was not possible under the conditions of our hospital, thus they were not used in any of the cases. Segmental resection was performed in cases where the depth and surface area of the placenta accreta was limited and the entire placenta implantation area was accessible and visualizable. Hysterectomy was performed in cases where there was deep invasion and surgical maneuvers were insufficient. However, planned or not, patients who completed their fertility, had deep invasion in the preoperative (prior to the delivery) evaluation and were predicted to have massive bleeding underwent with the decision of preoperative cesarean section hysterectomy. The abdomen was entered through a mid-line vertical incision, the baby was delivered by performing a fundal longitudinal hysterotomy, the placenta was left in-situ, the uterine incision was closed, and hysterectomy was performed after bilateral IIAL to minimize blood loss.

Due to the retrospective design of the study and because the majority of patients received intraoperative and postpartum blood and blood product transfusions, the change in hemoglobin levels was not evaluated due to the high probability of bias.

Statistical Analysis

All statistical analyses were performed using the IBM SPSS Statistics version 20 (Chicago, IL). The normality of the distribution of continious variables was assessed using the Kolmogorov-Smirnov test. Categorical variables were assessed using the Chi-square test. Student's t-test was used for normally distributed continuous variables, and the Mann–Whitney U test was used for non-normally distributed variables. Multivariate logistic regression analysis was performed to identify risk factors for blood transfusion requirements. The results are reported as odds ratio (OR) and 95% confidence intervals (95% CI).

RESULTS

In this retrospective study spanning 5 years in our clinic, which is a referral tertiary center where the annual number of deliveries is approximately 12,000, the prevalence of PP was found as approximately 0.6% with 363 PP cases. Further evaluation showed that the rate of PAS cases among patients with PP was 22% (80/363). In this study, which included 128 emergency and 155 planned cesarean sections in non-PAS group and 38 emergency and 42 planned cesarean sections in PAS group, the mean maternal age was 32 years. Although no difference was observed between the groups in terms of demographic and clinical characteristics, general anesthesia was preferred in emergency cases in both groups, whereas spinal anesthesia was used in planned cases (Table 1).

Neonatal outcomes; In both non-PAS and PAS groups, gestational age at delivery, birth weight and 1st and 5th minute APGAR scores were significantly lower and NICU admission was significantly higher in the ECD cases ($p < 0.001$) (Table 2).

Of the 283 non-PAS patients, 131 delivered preterm (< 37th GW) and 152 delivered term (> 37th GW) infants. While 70.2% of preterm deliveries were ECD, 23.7% of term fetuses were delivered urgently ($p < 0.001$). Fourty-nine patients delivered before 37th GW and 31 patients delivered after 37th GW in PAS group. While 61.2% of preterm deliveries were emergency cesarean, 25.8% of term fetuses were delivered urgently ($p = 0.003$). Birth weight, 1st and 5th minute APGAR scores were significantly lower and NICU admission was significantly higher in infants born before 37 weeks of gestation in both PAS and non-PAS groups ($p < 0.001$) (Table 3).

Intraoperative maneuvers performed to control bleeding did not differ in both groups whether the cases were planned or emergency. The need for hysterectomy and re-laparotomy was higher in women with PAS, regardless of whether they were emergencies or planned. Although there was no difference in terms of intraoperative complications between the groups, all of the seven bladder injuries were in PAS group, five in the ECD and two in the PCD cases. The

Table 1. Demographics and baseline characteristics

		PAS negative (n = 283)			PAS positive (n = 80)		
	Total cohort (n = 363)	ECD (n = 128)	PCD (n = 155)	*p* value	ECD (n = 38)	PCD (n = 42)	*p* value
Materal age (year)	32 (16-45)	31.14 ± 5.5	32.19 ± 5.76	0.12	30.39 ± 6.93	32.07 ± 5.37	0.228
BMI (kg/m2)	25 (16.5-42)	24.82 (16.5-42)	25.50 (17.10-41.50)	0.604	25.33 ± 4.21	26.99 ± 5.73	0.148
Gravity	3(1-14)	3(1-8)	3 (1-14)	0.498	3 (1-8)	3 (1-10)	0.167
Parity	2 (0-7)	2 (0-7)	2 (0-7)	0.463	2 (0-5)	2 (0-6)	0.263
No. of curretage	0 (0-6)	0 (0-5)	0 (0-6)	0.909	0 (0-6)	0 (0-3)	0.613
Comorbidity				0.382			0.338
None	344 (94.8)	117 (91.4)	148 (95.5)		38 (100)	41 (97.6)	
GDM	6 (1.7)	3 (2.3)	2 (1.3)			1 (2.4)	
GHT	7 (1.9)	4 (3.1)	3(1.9)				
Hypothyroidy	1 (0.3)	-	1 (0.6)				
Hydronephrosis	1 (0.3)	-	1 (0.6)				
Hearth Disease	1 (0.3)	1 (0.8)	-				
Preeclampcia	2 (0.6)	2 (1.6)	-				
Covid-19	1 (0.3)	1 (0.8)	-				
No. of cesarean	1 (0-5)	0 (0-5)	0 (0-4)	0.469	2 (0-2)	2 (0-4)	0.657
Previous myomectomy				0.527			0.051
Yes	13 (3.6)	5 (3.9)	4 (2.6)		-	4 (9.5)	
No	350 (96.4)	123 (96.1)	151 (97.4)		38 (100)	38 (90.5)	
Anesthesia method				**< 0.001**			**0.026**
Spinal anesthesia	201 (55.4)	65 (50.8)	114 (73.5)		6 (15.8)	16 (38.1)	
General anesthesia	162 (44.6)	63 (49.2)	41 (26.5)		32 (84.2)	26 (61.9)	

Data presented as mean ± SD, n (%) or median (min-max). *P* value < 0.05 was statistically significant. SD = standard deviation, PAS = Placenta accrete spectrum, ECD = emergent cesarean delivery, PCD = planned cesarean delivery, BMI = body mass index, GDM = gestational diabetes mellitus, GHT = gestational hypertension.

Table 2. Neonatal outcomes

		PAS negative (n = 283)			PAS positive (n = 80)		
	Total cohort (n = 363)	ECD (n = 128)	PCD (n = 155)	*p* value	ECD (n = 38)	PCD (n = 42)	*p* value
Gestational age	37 (25-40)	35 (25-39)	37 (34-40)	**< 0.001**	34 (25-40)	37 (25-40)	**< 0.001**
Birth weight (g)	2840 (600-4100)	2557.5 (600-3850)	3000 (1920-4100)	**< 0.001**	2100.13 ± 796.40	2833.21 ± 545.47	**< 0.001**
Fetal sex				0.800			0.535
Female	170 (46.8)	60 (46.9)	75 (48.4)		18 (47.4)	17 (40.5)	
Male	193 (53.2)	68 (53.1)	80 (51.6)		20 (52.6)	25 (59.5)	
1st min Apgar	9 (2-9)	9 (2-9)	9 (7-9)	**< 0.001**	8 (2-9)	9 (4-9)	**< 0.001**
5th min Apgar	10 (5-10)	10 (5-10)	10 (9-10)	**< 0.001**	9 (5-10)	10 (6-10)	**0.01**
Admission to NICU				**< 0.001**			**0.001**
Yes	67 (18.5)	36 (28.1)	7 (4.5)		18 (47.4)	6 (14.3)	
No	296 (81.5)	92 (71.9)	148 (95.5)		20 (52.6)	36 (85.7)	

Data presented as mean ± SD, n (%) or median (min-max). *P* values < 0.05 were statistically significant. SD = standard deviation, PAS = placenta accreta spectrum, ECD = emergency cesarean delivery, PCD = planned cesarean delivery, NICU = neonatal intensive care unit.

total amount of blood and blood product transfused was significantly higher and hospital stay was longer ($p = 0.022$) in patients with ECD with or without PAS ($p = 0.005$) and adult ICU admission was significantly higher in the ECD cases in non-PAS group ($p = 0.016$)(Table 4). There was no maternal death.

Bakri balloon tamponade (BBT) is used effectively and intensively in our clinic. Intraoperative BBT was performed in 55 emergency and 115 planned cesarean deliveries with PP, but it was found to fail in nine patients while the patients were still in the operating room and hysterectomy was performed. There was no need for re-laparotomy in patients who underwent BBT.

Two hundred ten of 363 patients required blood and blood products transfusion, 58.5% of whom were in the ECD patients. In the multilinear regression analysis, the need for blood transfusion was found to increase with the number of previous cesarean sections (OR = 2.21, 95% CI: 0.716-1.396), emergency cesarean section (OR = 9.9, 95% CI: 0.561-1.783), PP with PAS (OR = 6.53, 95% CI: 0.251-3.977), general anesthesia (OR = 2.93, 95% CI: 0.813-1.230), and uterine artery ligation (OR = 2.092, 95% CI: 0.919-1.088) (Table 5).

DISCUSSION

In this retrospective study, the maternal and neonatal outcomes of the 363 cases of PP with PAS and without PAS were compared in terms of whether they were delivered under emergency or planned conditions. Although a high rate of antenatal diagnosis was made (78%), our data demonstrated that 166/363 (45.7%) cases were emergency cesarean sections. To avoid adverse neonatal outcomes due to prematurity, 53 patients who were planned to deliver at late preterm-early term gestational weeks had to deliver urgently before the specified date. General anesthesia was preferred in emergency cases in both PAS and non-PAS patients. In a study conducted by the anesthesia clinic of our hospital, evaluating 4874 patients who underwent emergency cesarean section for 3 years, regional anesthesia rate was 78.5% in all emergency cesarean sections. However it has been reported

Table 3. Neonatal outcomes by gestational week at birth

	PAS negative (n = 283)			**PAS positive (n = 80)**		
	Delivery < 37 weeks (n = 131)	**Delivery > 37 weeks (n = 152)**	***p* value**	**Delivery < 37 weeks (n = 49)**	**Delivery > 37 weeks (n = 31)**	***p* value**
Delivery type			**< 0.001**			**0.003**
ECD	92 (70.2)	36 (23.7)		30 (61.2)	8 (25.8)	
PCD	39 (29.8)	116 (76.3)		19 (38.8)	23 (74.2)	
Birth weight (g)	2470 (600-3800)	3060 (1530-4100)	**< 0.001**	2350 (595-3400)	3100 (2290-3700)	**< 0.001**
Fetal gender			0.722			0.644
Female	64 (48.9)	71 (46.7)		20 (40.8)	15 (48.4)	
Male	67 (51.1)	81 (53.3)		29 (59.2)	16 (51.6)	
1-min Apgar	9 (2-9)	9 (7-9)	**< 0.001**	8(2-9)	9(5-9)	**< 0.001**
5-min Apgar	10 (5-10)	10 (9-10)	**< 0.001**	9(5-10)	10(6-10)	**< 0.001**
Admission to NIC			**< 0.001**			**0.045**
Yes	35 (26.7)	8 (5.3)		19 (38.8)	5 (16.1)	
No	96 (73.3)	144 (94.7)		30 (61.2)	26 (83.9)	

Data presented as mean ± SD, n (%) or median (min-max). *P* values < 0.05 were statistically significant. SD = standard deviation, PAS = placenta accreta spectrum, ECD = emergency cesarean delivery, PCD = planned cesarean delivery, NICU = neonatal intensive care unit.

Table 4. Surgical approach and maternal outcomes

		PAS negative (n = 283)			PAS positive (n = 80)		
	Total cohort (n = 363)	ECD (n = 128)	PCD (n = 155)	*p* value	ECD (n = 38)	PCD (n = 42)	*p* value
Abruptio placenta				-			0.290
Yes	1 (0.3)	-	-		1 (2.6)	-	
No	362 (99.7)	128	155		37 (97.4)	42 (100)	
Uterine rupture				-			0.132
Yes	2 (0.6)	-	-		2 (5.3)	-	
No	361 (99.4)	128	155		36 (94.7)	42 (100)	
B-Lynch suture				0.228			-
Yes	4 (1.1)	3 (2.3)	1 (0.6)		-	-	
No	359 (98.9)	125 (97.7)	154 (99.4)		38 (100)	42 (100)	
Uterine artery ligation				0.847			0.934
Yes	6 (1.7)	2 (1.6)	2 (1.3)		1 (2.6)	1 (2.4)	
No	357 (98.3)	126 (98.4)	153 (98.7)		37 (97.4)	41 (97.6)	
Hypogastric artery ligation				0.677			0.845
Yes	27 (7.4)	1 (0.8)	2 (1.3)		11 (28.9)	13 (31)	
No	336 (92.6)	127 (99.2)	153 (98.7)		27 (71.1)	29 (69)	
Bakri balloon				0.136			0.494
Yes	137 (37.7)	45 (35.2)	68 (43.9)		10 (26.3)	14 (33.3)	
No	226 (62.3)	83 (64.8)	87 (56.1)		28 (73.7)	28 (66.7)	
Uterine lower segment resection				-			0.286
Yes	12 (3.3)	-	-		4 (10.5)	8 (19)	
No	351 (96.7)	128	155		34 (89.5)	34 (81)	
Hysterectomy				0.453			0.165
Yes	58 (16)	2 (1.6)	1 (0.6)		29 (76.3)	26 (61.9)	
No	305 (84)	126 (98.4)	154 (99.4)		9 (23.7)	16 (38.1)	
Relaparotomy				-			0.918
Yes	4 (1.1)	-	-		2 (5.3)	2 (4.8)	
No	359 (98.9)	128	155		36 (94.7)	40 (95.2)	
Blood transfusion	1 (0-12)	1 (0-7)	0 (0-5)	**0.024**	4 (0-12)	2.5 (0-8)	**0.030**
Fresh-frozen Plasma	0 (0-20)	0 (0-7)	0 (0-4)	**0.002**	4 (0-20)	2 (0-8)	**0.01**
Bladder injury				-			0.184
Yes	7 (1.9)	-	-		5 (13.2)	2 (4.8)	
No	356 (98.1)	128	155		33 (86.8)	40 (95.2)	
Bowel injury				0.270			-
Yes	1 (0.3)	1 (0.8)	-		-	-	
No	362 (99.7)	127 (99.2)	155		38	42	
Ureteral injury				0.270			-
Yes	1 (0.3)	1 (0.8)	-		-	-	
No	362 (99.7)	127 (99.2)	155		38	42	
Pulmonary emboli				-			0.290
Yes	1 (0.3)	-	-		1 (2.6)	-	
No	362 (99.7)	128	155		37 (97.4)	42	
Wound infection				-			0.498
Yes	3 (0.8)	-	-		2 (5.3)	1 (2.4)	
No	360 (99.2)	128	155		36 (94.7)	41 (97.6)	
Intensive care unit				**0.016**			0.511
None	210 (57.8)	73 (57)	109(70.3)		11 (28.9)	17 (40.5)	
Intermediate intensive care	109 (30)	45 (35.2)	31(20)		18 (47.4)	15 (35.7)	
Intensive care	44 (12.2)	10 (7.8)	15(9.7)		9 (23.7)	10 (23.8)	
Hospital stay after delivery (day)	3 (1-19)	3 (1-19)	3 (1-19)	**0.039**	7 (2-14)	5 (3-11)	**0.003**

Data presented as mean ± SD, n (%) or median (min-max). *P* values < 0.05 were statistically significant. SD = standard deviation, PAS = placenta accrete spectrum, ECD = emergency cesarean delivery, PCD = planned cesarean delivery.

Table 5. Multiple linear regression analysis for risk factors associated with blood transfusion requirement

	B	S.E.	*p* value	O.R.	95% CI	
					Lower	Upper
Materal age (year)	0.011	0.011	0.351	-0.935	0.955-1.048	
BMI (kg/m^2)	0.015	0.013	0.239	0.239	0.965-1.037	
Nunmber of cesareans	0.146	0.066	**0.028**	2.207	0.716-1.396	
ECD/PCD	1.703	0.172	**< 0.001**	9.928	0.561-1.783	
PAS	2.038	0.312	**< 0.001**	6.529	0.251-3.977	
Anesthesia method	0.418	0.143	**0.004**	2.926	0.813-1.230	
Hysterectomy	0.241	0.341	0.481	0.706	0.262-3.819	
Uterine lower segment resection	0.511	0.429	0.235	-1.191	0.697-1.435	
Hypogastric artery ligation	0.330	0.302	0.275	1.093	0.654-1.529	
Uterine artery ligation	1.090	0.521	**0.038**	2.092	0.919-1.088	
Relaparotomy	1.225	0.623	0.050	1.968	0.855-1.169	

B = standardized regression coefficient, SE = standard error, OR = odds ratio, CI = confidence interval, PAS = placenta accreta spectrum, ECD = emergency cesarean delivery, PCD = planned cesarean delivery. P-values with statistical significance ($p < 0.05$) are shown in bold.

that general anesthesia was applied 51% of class 1 emergency cesarean sections,including placenta previa cases, where there was maternal and fetal life-threatening conditions and high ASA(AmericanSociety of Anesthesiologists) scores [11].

Although ECD was found to be associated with worse neonatal outcomes, it was observed that prematurity (< 37th GW at delivery) was significantly higher in patients who were delivered urgently. In our study ,which conducted in a tertiary referral hospital with an available operating room, blood bank, experienced surgical team and appropriate neonatal care conditions twenty-four-hours-a-day,seven-days-a-week, adverse neonatal outcomes in the emergency cases appeared to be related to prematurity.

Although there was no difference in maternal outcomes in terms of the surgical approach and intraoperative complications, the need for blood transfusion was greater and hospital stay was longer in the ECD cases in both non-PAS and PAS groups. Adult ICU admission was greater in non-PAS group in cases of urgent delivery.

PP complicated approximately 0.6% of deliveries during the study period. Although our rate of PAS cases (22%) was similar to that in the study of Levin *et al*. [12] (PP: 0.6%; PAS: 19.2%), PAS cases were well above the 12,6% rate stated in the literature [13]. We concluded that this might be due to our hospital being an affiliated referral hospital.

Thirty-eight of our patients were nulliparous, one had a history of myomectomy, and three had a history of curettage due to recurrent pregnancy loss, but all were patients with non-PAS. The increase in placenta previa, especially placental invasion anomalies, with increasing cesarean section has been shown in many studies [12, 14]. However, other risk factors also affect the presence of PP. With advanced maternal age, the rate of sclerotic changes on intramyometrial arteries increases, which reduces placental blood flow [15]. In our study, we found that the mean maternal age was 32 years, which is consistent with other studies and very high [16]. Tuzovic *et al*. [17] showed that women aged over 30 years were at 2.5 times higher risk for developing PP. The increase in the rate of patients being multiparous with increasing maternal age may also contribute to the development of PP.

Although studies have been performed to determine the most appropriate week of birth to balance neonatal and maternal risks in PP cases, optimal delivery timing remains controversial [10, 18, 19]. Prolonging pregnancy in women with PP will increase the probability of encountering unscheduled and preterm deliveries. It has been reported that the number of bleeding episodes and the need for blood transfusion

in the antenatal period [20], and the increased number of cesarean sections [21] can predict preterm births in women with PP. Although the appropriate gestational week interval for the delivery of these patients is not specified in the guidelines, it may contribute to individualization in planning the delivery time. The high rates of early gestational age at birth in ECD cases in both non-PAS nad PAS groups in our study was not suprising and suggested that the worse neonatal outcomes in ECD cases was mainly associated with prematurity. In the study of Durukan *et al*. [21], in which similar results were obtained, there was no difference in the NICU need of infants when they evaluated term infants (> 37th GW). Levin *et al*. [12] reported that adverse neonatal outcomes were related to emergency delivery and general anesthesia, and that early gestational age at birth and general anesthesia were independently associated and modifiable factors with neonatal adverse outcomes.

PP is associated with adverse outcomes such as peripartum hysterectomy, blood transfusion, postpartum hemorrhage, and sepsis due to massive antepartum and intrapartum hemorrhage. [22]. Asicioglu *et al*. [13] stated that intraoperative estimated blood loss, vascular and surrounding organ damage and hysterectomy rates were higher in emergency delivery cases with PP, and emergency cases required more blood transfusion.

In the current study, while intraoperative management, complications, hysterectomy, and re-laparotomy rates did not differ between emergency and planned deliveries, adult ICU admission and longer hospital length of stay were more common in the ECD group. The amount of blood and blood products transfused to patients with and without PAS was higher in emergency cases. Durukan *et al*. [21] reported that planned cesarian delivery was associated with higher hemoglobin values, lower rates of blood transfusion, shorter hospital stay, and better maternal outcomes in both PAS and non-PAS cases. In a study limited to patients with non-PAS PP, Erfani *et al*. [19] reported that composite maternal morbidity would not be affected by ECD or PCD in their tertiary center. However, when the results of the aforementioned study were examined in detail, it was seen that there was no difference in terms of intraoperative complications but the lenght of hospital stay was longer in the emergency cesarean section group, similar to our study.

A recent study listed risk factors associated with blood transfusion in PP cases as previous cesarean section, anterior PP, major PP, preoperative bleeding, and emergency cesarean section [23]. In our current study, in which data on antenatal bleeding episodes and estimated blood loss were missing, we found that the need for blood transfusion in PP cases was associated with the increasing number of previous cesarean sections, emergency cesarean section, PAS, uterine artery ligation and general anesthesia. These findings may be useful in the risk assessment of patients and communication with the blood bank during the preoperative preparation process.

Limitations

The limitations of the study were its retrospective design and the fact that antenatal bleeding episodes and estimated blood loss were not evaluated. On the other hand, the large sample size, the evaluation of patients with both PAS and non-PAS, and that all surgeries were performed in the same fashion by an experienced surgical team are the strengths of the study.

CONCLUSION

Emergency cesarean delivery had negative effects on maternal and neonatal outcomes in women with PP. Efforts should be made to prolong pregnancy, as prematurity has a significant effect on adverse neonatal outcomes. It is beneficial to perform planned deliveries with these patients in reference hospitals where experienced surgical teams, consultant subspecialty surgeons, suitable operating room conditions, blood banks, and ICUs are available to care for both mother and infant.

Ethical approval

Ethics approval for this retrospective study was granted by the Clinical Research Ethics Committee of Bursa Yüksek İhtisas Traning and Research Hospital on 28/04/2021 with the Registration Number: 2011-KAEK-25 2021/04-10 The study complied with the principles of the Declaration of Helsinki. All patients signed informed consent forms before undergoing surgery, allowing their medical records to be used for research purposes.

Authors' Contribution

Study Conception: FNT, NNY, NKE, EKİ, FY; Study Design: FNT, NNY, NKE, EKİ, FY; Supervision: FNT, NNY, NKE, EKİ, FY; Funding: FNT, EKİ, FY; Materials: N/A; Data Collection and/or Processing: FNT, EKİ, FY; Statistical Analysis and/or Data Interpretation: FNT, NNY, NKE; Literature Review: FNT, NNY, NKE, EKİ, FY; Manuscript Preparation: FNT, NNY, NKE and Critical Review: FNT, NNY, NKE, EKİ, FY.

Conflict of interest

The authors disclosed no conflict of interest during the preparation or publication of this manuscript.

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