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Anesthesia management in patients with abnormally invasive placenta: A single-center experience

Plasental invazyon anomalisi olan hastalarda anestezi yönetimi: Tek merkez deneyimi

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Abstract

Aim: Postpartum hemorrhage is a life-threatening obstetric emergent clinical situation accompanied by blood loss of more than 500 ml after vaginal delivery and more than 1000 ml after cesarean section. This situation, frequently encountered in placental adhesion anomalies, is essential in terms of follow-up, treatment, and multidisciplinary management. We aimed to retrospectively evaluate the perioperative anesthesia management, transfusion requirement, and postoperative intensive care unit requirement of patients diagnosed with placental invasion anomaly who had an intraoperative hemorrhage

Methods: In our single-center study, a total of 58 female patients diagnosed with of placental invasion anomaly with a cesarean section between 2017-2020 were examined. Patients under 18 years of age and missing data were excluded from the study. Demographic data of patients (age, American Society of Anesthesiologists score (ASA)), diagnosis, duration of operation, perioperative laboratory findings, anesthesia type, perioperative hemodynamics (highest heart rate, lowest mean arterial pressure, shock index), amount of bleeding, blood products, and fluids used, surgical interventions (B-Lynch, Bacri balloon application, uterine artery ligation, hysterectomy), intraoperative vasopressor/inotrope use, ICU stay, laboratory results in the first 24 hours postoperatively, and total hospital stay were recorded.

Results: In the preoperative evaluation, 27 (46.5%) patients were diagnosed with placenta accreta, and placenta previa was diagnosed in 19 (32.7%) patients. Perioperatively mean of 3.08 ± 1.7 units of Red blood cell was used. In patients with postoperative intensive care unit hospitalization, the highest intraoperative lactate value was 3.5±1.8 mmol/L, shock index was 1.3±0.3 (0.6-1.8). In patients given intraoperative fibrinogen concentrate, the intraoperative shock index was 1.5±0.2 (0.9-1.8), the amount of intraoperative bleeding was 2575±302.2 ml, and the fibrinogen levels measured in the first 24 hours after surgery were 294.7±79.7 mg/dl.

Conclusions: Anesthesia management of patients diagnosed with abnormal placental invasion is important because of significant hemorrhage. Due to unstable hemodynamics, preoperative blood product preparation with a multidisciplinary approach and a postoperative intensive care unit plan should be made for these patients.

Keywords: Fibrinogen, intensive care units, postpartum hemorrhage, placental invasion anomaly, transfusion.

Öz

Amaç: Doğum sonu kanama, vajinal doğum sonrası 500 ml'den fazla, sezaryen sonrası 1000 ml'den fazla kan kaybının eşlik ettiği hayatı tehdit eden acil obstetrik bir klinik durumdur. Plasental adezyon anomalilerinde sıklıkla karşılaşılan bu durum takip, tedavi ve multidisipliner yönetim açısından önemlidir. Plasental invazyon anomalisi tanısı konan ve intraoperatif kanaması olan hastaların perioperatif anestezi yönetimi, transfüzyon gereksinimi ve postoperatif yoğun bakım gereksinimini retrospektif olarak değerlendirmeyi amaçladık.

Yöntemler: Tek merkezli çalışmamızda 2017-2020 yılları arasında sezaryen ile plasenta invazyon anomalisi tanısı alan toplam 58 kadın hasta incelendi. 18 yaş altı ve eksik verisi olan hastalar çalışma dışı bırakıldı. Hastaların demografik verileri (yaş, Amerikan Anestezistler Derneği skoru (ASA), tanı, operasyon süresi, perioperatif laboratuvar bulguları, anestezi tipi, perioperatif hemodinami (en yüksek kalp hızı, en düşük ortalama arter basıncı, şok indeksi), kanama miktarı, kan ürünleri ve kullanılan sıvılar, cerrahi girişimler (B-Lynch, Bacri balon uygulaması, uterin arter ligasyonu, histerektomi), intraoperatif vazopressör/inotrop kullanımı, yoğun bakımda kalış, postoperatif ilk 24 saat laboratuvar sonuçları ve hastanede toplam kalış süresi kaydedildi.

Bulgular: Ameliyat öncesi değerlendirmede 27 (%46,5) hastaya plasenta akreata, 19 (%32,7) hastaya plasenta previa tanısı konuldu. Perioperatif ortalama 3,08 ± 1,7 ünite eritrosit süspansiyonu kullanıldı. Ameliyat sonrası yoğun bakımda yatan hastalarda en yüksek intraoperatif laktat değeri 3.5±1.8 mmol/L, şok indeksi 1,3±0,3 (0,6-1,8) idi. İntraoperatif fibrinojen konsantresi verilen hastalarda; intraoperatif şok indeksi 1,5±0.2 (0,9-1,8), intraoperatif kanama miktarı 2575±302,2 ml ve ameliyat sonrası ilk 24 saatte ölçülen fibrinojen seviyeleri 294.7±79,7mg/dl bulundu.

Sonuç: Anormal plasental invazyon tanısı konulan hastalarda anestezi yönetimi, belirgin kanama nedeniyle önemlidir. Stabil olmayan hemodinami nedeniyle bu hastalarda multidisipliner yaklaşım, preoperatif kan ürünü hazırlığı ve postoperatif yoğun bakım planı yapılmalıdır.

Anahtar Kelimeler: Fibrinojen, yoğun bakım ünitesi, doğum sonu kanama, plasental invazyon anomalisi, transfüzyon.

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Introduction

Pathological attachment of the placenta to the myometrium is defined as abnormal invasive placentation (AIP). AIP is divided into three groups according to the depth of invasion; placenta accreta (PA) (placental villi are in direct contact with myometrium), placenta increta (PI) (placental villi invaded myometrium), placenta percreta (placental tissue crosses the serosa and penetrates adjacent structures including the bowel and bladder) [1].

In AIP cases, hemodynamics can be severely impaired due to intraoperative bleeding, and massive blood transfusion is often required. Many complications such as uterine rupture, bowel and bladder injury, and the need for a postoperative intensive care unit (ICU) may ocur in cases of AIP. In addition, AIP is the most common cause of peripartum hysterectomies [2].

Postpartum hemorrhage (PPH) is a life-threatening obstetric emergent clinical situation accompanied by blood loss of more than 500 ml after vaginal delivery and more than 1000 ml after cesarean section. It can occur in the first 24 hours after birth; or between 24 hours and 12 weeks after birth [3]. It is seen in 1-4% of all births and ranks in the top 5 among the conditions that cause maternal deaths worldwide [4, 5]. PPH may emerge after vaginal delivery or cesarean section, either as an early or a late complication of several obstetric conditions, including uterine atony, placental retention, abnormalities of placentation, and placenta previa (PP). Furthermore, PP is frequently complicated by the invasion of placental villi beyond the decidua basalis, causing placenta accreta or increta, referred to as placenta accreta spectrum (PAS) disorders.

The activation of physiological mechanisms can limit postpartum bleeding. However, despite the contraction of the myometrium and the activation of intravascular hemostatic factors, it may not be possible to control the bleeding. Therefore, managing anesthesia applications with pharmacological and surgical methods for bleeding prevention is vitally important [6].

In the presence of significant bleeding, it may be necessary to determine the amount of bleeding, the need for massive transfusion, the early introduction of shock protocols, and to apply for advanced surgical procedures.

The shock index (SI), calculated by dividing heart rate by systolic blood pressure (HR/SBP) in trauma and sepsis patients, is used as an indicator of hemodynamic instability and hypovolemia. This parameter can be more helpful than any standard vital parameter for estimating the need for intensive care in women with PPH. The normal range for non-pregnant adults is 0.5 to 0.7, and an SI of >0.9 has been associated with increased mortality [7]. In PPH patients, SI <0.9 was specified as a safe range, and SI ≥1.7 level was stated to require urgent intervention [8].

Fibrinogen and antifibrinolytic agent (tranexamic acid) applications also have an important place in the management of bleeding. The average level of fibrinogen in term pregnancy is 350 to 650 mg/dL, which is almost twice that of non-pregnant adults (200 to 400 mg/dL) [9]. A fibrinogen level >200 mg/dL in pregnant women is considered the minimum required level for adequate coagulation. It is recommended that attempts be made to increase the fibrinogen level to >300 mg/dL in cases of active bleeding and resuscitation [10]. There is now a focus on the importance of fibrinogen replacement during significant hemorrhage [11].

In our study, we aimed to retrospectively evaluate the perioperative anesthesia management, transfusion requirement, and postoperative intensive care (ICU) condition of patients with postpartum hemorrhage.

Material and methods

Study

The files of the cases who underwent cesarean section with the diagnosis of placental invasion anomaly between 2017 and 2020 were retrospectively reviewed. This study was a cross-sectional study. Ethical approval for this study was provided by the Ethical Committee of Bakırköy Dr. Sadi Konuk Training and Research Hospital, Istanbul, Turkey on, 16 September 2021 (Ethical number: 2021/270). The study was planned by the Helsinki Declaration and revised in Brazil in 2013. Informed consent was not obtained from the patients because the study was retrospective and only medical data were shared, and no personal information of the patients was shared.

Patients

The number of patients determined in the study was determined according to the data obtained from the retrospectively scanned files. During the study period, sixty-one patients over the age of 18 were identified from the scanned files. Unfortunately, three patients were excluded from the study due to missing data (Figure 1).

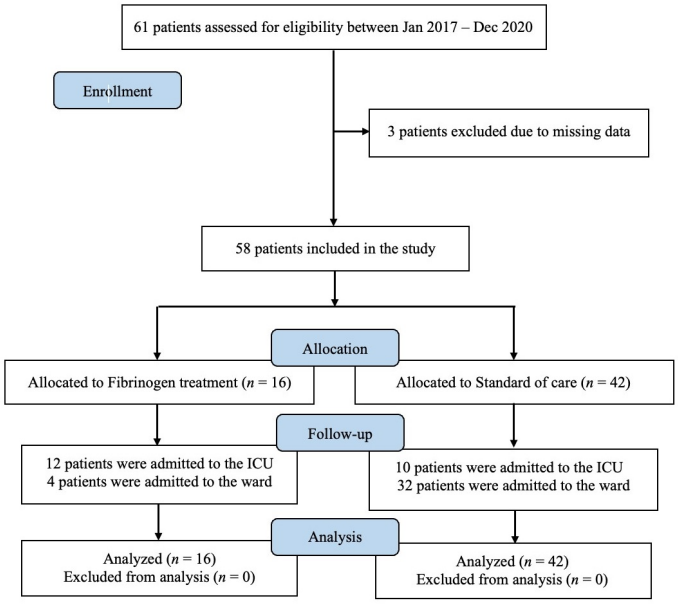

Figure 1. Flowchart of the study. ICU: intensive care unit.

Anesthesia Management

In the risk assessment of AIP cases in our hospital, in the preoperative ultrasonography (USG) examination, a preliminary diagnosis is made with USG findings such as the absence of the typical retroplacental hypoechoic region and thinning of the hyperechoic area between the uterus serosa and the bladder. Definitive diagnosis and determination of the depth of invasion are made by intraoperative observation and histopathological examination of the uterus.

Electrocardiography (ECG), peripheral oxygen saturation ($Sp0_2$), and non-invasive blood pressure are routinely monitored in our patients who were operated on with a prediagnosis of AIP.

As a method of anesthesia, while regional anesthesia can be applied in consultation with the surgical team in selected cases with uncomplicated minimally invasive placentation, general anesthesia is preferred in most cases.

According to the protocol in cesarean section operations in our clinic, anesthesia induction is supplied with intravenous (IV) propofol and rocuronium for general anesthesia if the patient's hemodynamics is stable. In the maintenance of anesthesia, sevoflurane is used until the delivery, and fentanyl is administered for analgesia after the delivery.

In patients with expected perioperative bleeding such as placental invasion anomaly, abruption, and uterine atony; wide vascular accesses (14-16 gauge) are provided, radial artery cannulation is provided after the Allen test, invasive blood pressure monitoring and blood gas analyzes are followed for close perioperative hemodynamic monitoring. In addition, an intraoperative USG-guided 7F central jugular catheter is inserted in patients with excessive bleeding, impaired hemodynamics, and needing a massive blood transfusion.

Hemodynamically unstable patients need inotropes/vasopressors, undergo massive transfusion, and are admitted to the postoperative intensive care unit for whom close hemodynamic follow-up was decided. Patients with stable postoperative hemodynamics are extubated, taken to the recovery room, and followed up there. Patients with stable vitals and a Modified Aldrete score >8 are sent to the service. For elective cases diagnosed with placental invasion anomaly, 5-6 units of Red Blood Cell (RBC) and 5-6 unites of fresh frozen plasma (FFP) are prepared in our blood center, and fibrinogen concentrate is requested.

Since the laboratory fibrinogen level was not requested from the preoperative patients or because the surgeries were emergent; in the gynecology and obstetrics clinic and anesthesiology and reanimation clinic, 2 gr of fibrinogen concentration was given to the patients with Hb <10 mg/dL, perioperative ≥2000ml bleeding, unstable hemodynamics despite adequate blood product replacement, and suspected bleeding diathesis.

In cases of cesarean section performed under regional anesthesia in our clinic, after adequate asepsis/antisepsis is provided in the sitting position; bupivacaine + fentanyl, which is calculated according to the patient's height (average 10 mg bupivacaine + 10 mcg fentanyl), was applied by a 25G spinal needle through the L3-L4 intrathecal space. It was possible to use general anesthesia for patients who develop intraoperative PPH and whose hemodynamics are impaired.

Variables

The data in our study were obtained from the patient file, our hospital's electronic information center, and anesthesia observation files. In addition, demographic data of patients (age, ASA score), diagnosis, duration of operation, perioperative laboratory findings, anesthesia type, perioperative hemodynamics (highest heart rate, lowest mean arterial pressure (MAP)), shock index), amount of bleeding, blood products and fluids used, surgical interventions (B-Lynch, Bacri balloon application, uterine artery ligation, hysterectomy), intraoperative vasopressor/inotrope use, ICU stay, laboratory results in the first 24 hours postoperatively, and total hospital stay were recorded.

The patients were divided into two groups fibrinogen administered and non-administered. In addition, the patients who were hospitalized in the postoperative intensive care unit and those who were not hospitalized were also evaluated.

Statistical analysis

Statistical analysis was performed using Statistical Package of Social Sciences version 21 (IBM SPSS Statistics; IBM Corp., Armonk, NY). Categorical measurements were presented as numbers and percentages, and numerical measurements were presented as mean and standard deviation. Student t-tests were used for data with normal distribution, Mann Whitney-U test with non-normal distribution, and chi-square test for categorical data.

Results

During the study period, 61 patients were identified from the scanned files. Three patients were excluded due to the missing data. The mean age of 58 patients included in the study was 33.6 ± 5.0 years; 81% of the patients were evaluated as emergent. General anesthesia was administered to 36 (62.1%) patients, and in 4 emergency cases that started with spinal anesthesia was switched the general anesthesia due to bleeding and unstable hemodynamics. The mean operation time was founded as 146.3 ± 32.9 minutes. In the preoperative evaluation, 27 (46.5%) patients were diagnosed with placenta accreta, and placenta previa was diagnosed in 19 (32.7%) patients.

Table 1. Demographic and clinical chraacteristics of the patients (n=61).

Variable		Value ‡	Value §
Age (year)			33.6 ± 5
ASA grade	2	3 (91.4)	
	3	5 (8.6)	
Gravide			3.44±1.19
Parite			2.20±1.11
Gestational week			35.22±2.34
Cesarean section	0	3(5.1)	
	1	21 (36.2)	
	2	21 (36.2)	
	3	10 (17.2)	
	4	3 (5.1)	
Neonate	First min. APGAR score		6.10±1.9
	Fifth min. APGAR score		7.58±1.92
Diagnosis	Acreata	27 (46.5)	
	Perkreata	12 (20.6)	
	Previa	19 (32.7)	
Preoperative hemoglobin (g /dL)			11.1 ± 1.4
Preoperative platelet ($\times 10^4/\mu L$)			218.9 ± 61.4

§: mean ± standard deviation, ‡: n (%).
ASA: American Society of Anesthesiologists

Demographic data and preoperative characteristics of the patients are shown in Table 1. Intraoperative and postoperative findings of the patients are shown in Table 2. Total hysterectomy was performed in 32 (55.2%) cases, and partial resection was performed in two (3.4%) of them. On the other hand, three (5.2%) patients did not receive any additional surgical treatment. Besides medical measures to stop bleeding and approach for compression, only a cesarean section was performed. Fibrinogen concentrate was used in 25 (43.1%) patients. Noradrenaline infusion was started in 16 (27.6%) patients whose hemodynamics did not improve despite intraoperative fluid replacement and whose MAP was <60 mmHg. Forty units of oxytocin and 1 g of tranexamic acid were administered as an infusion to all patients. 25 (43.1%) patients were hospitalized in the postoperative ICU. No mortality was observed in the patients included in the study.

In patients given intraoperative fibrinogen concentrate, the intraoperative shock index was 1.5±0.2 (0.9-1.8), the amount of intraoperative bleeding was 2575±302.2 ml, and the fibrinogen levels measured in the first 24 hours after surgery were 294.7±79.7 mg/dl. In addition, it was shown that the shock index was higher ($p<0.001$), the amount of bleeding was higher ($p<0.001$), and the amount of RBC and FFP used was significantly higher ($p<0.001$) in patients who used fibrinogen concentrate compared to patients who did not use it (Table 3).

In patients with postoperative ICU hospitalization, the SI was 1.3±0.3 (0.6-1.8), and 14 (58.3%) of the patients were given vasopressor (noradrenaline) support. The duration of hospital stay was determined as 7.1±5.7 days, and intraoperative mean 4.3±1.7 (1-8) units of RBC was used (Table 4).

Table 2. Intraoperative findings of the study group.

		Mean±SD	n (%)
Anesthesia	General		36 (62.1)
	Spinal		22 (37.9)
Duration of operation (min)		146.3 ± 32.9	
Intraoperative crystalloid (mL)		2439.6 ± 593.2	
Intraoperative colloid (mL)		698.2 ± 246.7	
Intraoperative RBC Units		3.08 ± 1.7	43 (72.8)
İntraoperative massive transfusion			12 (20.3)
Postoperative RBC Units		0.8 ± 1.3	21 (35.5)
Intraoperative FFP Units		3±1.6	43 (72.8)
Intraoperative lowest Hb value in arterial blood (g/dL)		8.2± 1.9	
Intraoperative fibrinogen concentrate 2 gr			25 (43.1)
Shock index		1.01± 0.4	
Intraoperative highest lactate level in arterial blood (mmol/L)		2.1± 1.6	
Intraoperative highest BE levels in blood gas mEq/L		-5.2 ± 4.1	
Postoperative Hb (g/dL)		9.6 ± 0.8	
Postoperative platelet ($\times 10^4/\mu L$)		171.4 ± 60.1	
Surgery type	Hysterectomy		32 (55.2)
	Bilateral hypogastric + uterine artery ligation		7 (12.1)
	B-lynch suture + Bacri balloon + bilateral hypogastric artery ligation		9 (15.5)
	Bakri ballooon + uterin artery ligation		5 (8.6)
	Partial resection		2 (3.4)
	Only cesarean		3 (5.2)
Intraoperative vasopressor (noradrenalin) support			16 (27.6)
Postoperative Hb (g/dL)		9.6 ± 0.8	
Postoperative RBC Units		0.8 ± 1.3	
Postoperative FFP Units		0.6 ± 1.1	
Postoperative ICU stay			25 (43.1)
Total hospital stay (day)		5.6 ± 4.3	

RBC: Red blood cell, FFP: fresh frozen plasma, ICU: intensive care unit, Hb: Hemoglobin.

Table 3. Comparison of the intraoperative findings of the patients with and without fibrinogen application.

		Patients with fibrinogen (n=16)	Patients without fibrinogen (n=42)	p
Duration of operation (min) §		137.1±29.7	149.8±33.7	0.192
Shock index †		1.5±0.2 (0.9-1.8)	0.8±0.3 (0.5-1.6)	<0.001
Intraoperative bleeding (mL) §		2575±302.2	1582.1±392.4	<0.001
Intraoperative RBC units		5.0±1.3 (3-8)	2.3±1.1 (1-6)	<0.001
Postoperative RBC units †		1.8±1.7 (0-5)	0.6±1.0 (0-4)	0.005
Intraoperative FFP units †		4.7±1.2 (2-7)	2.3±1.1 (1-6)	<0.001
Postoperative FFP units †		1.0±1.4 (0-4)	0.5±1.1 (0-4	0.149
Intraoperative crystalloid (mL) §		2906.2±685.5	2261.9±447.1	<0.001
Diagnosis ‡	Acreata	7 (43.8%)	20 (47.6%)	0.882
	Perkreata	4 (25%)	8 (19%)	
	Previa	5 (31.2%)	14 (33.3%)	
Preoperative hemoglobin (g/dL) §		9.4±0.6	11.6±1.2	<0.001
Postoperative hemoglobin (g/dL) §		9.5±0.9	9.6±0.8	0.592
Intraoperative lowest Hb value in arterial blood (g/dL) §		6.7±1.5	8.8±1.7	<0.001
Intraoperative highest lactate in arterial blood (mmol/L) §		3.8±2.0	1.5±0.8	<0.001
Postoperative fibrinogen (mg/dL) §		294.7±79.7	299.9±83.8	0.972
İntraoperative vasopressor (noradrenalin) support ‡		8 (50%)	7 (16.7%)	0.010
Postoperative ICU stay ‡		12 (75%)	10 (23.8%)	<0.001
Total hospital stay (day) †		7.6±6.6 (3-31)	4.9±2.8 (2-17)	0.025

§: mean ± standard deviation, ‡: n (%), †: mean ± standard deviation (min-max).
RBC: Red blood cell, FFP: fresh frozen plasma, ICU: intensive care unit, Hb: Hemoglobin.

Discussion

In this retrospective study, we aimed to evaluate the anesthesia management and postoperative outcomes of patients with placental invasion anomaly and intraoperative bleeding.

We observed that a large amount of bleeding occurs in patients with AIP and that intraoperative blood products are needed. In addition, regardless of fibrinogen level, it was observed that patients with bleeding more than 2000 ml had almost the same postoperative fibrinogen levels compared to patients with less bleeding, with the use of fibrinogen concentrate, and postoperative ICU requirement was observed in patients who developed PPH.

Postpartum hemorrhage is frequently seen in maternal deaths and is a life-threatening phenomenon. In many studies, the anesthesiologist's approach, blood product transfusion, management, choice of ideal anesthetic manner, and postoperative care in life-threatening major bleeding cases have been examined [12, 13]. In these studies, no superiority over the other has been stated, and inferences can be made at the recommendation level. This retrospective study found that patients with placental invasion anomalies and who underwent major obstetric surgery due to postpartum hemorrhage had high shock indexes, high lactate levels, and increased bleeding. Therefore, hysterectomy was performed in 32 (55.2%) of the patients included in our study, and methods such as bilateral hypogastric artery + uterine artery

Table 4. Comparison of the intraoperative findings of the patients with and without ICU stay.

		Patients without ICU stay (n=36)	Patients with ICU stay (n=22)	p
Duration of operation (min) §		141.1±32.7	155±32.1	0.120
Shock index †		0.7±0.2 (0.5-1.5)	1.3±0.3 (0.6-1.8)	<0.001
Intraoperative bleeding (mL) §		1609.7±441.2	2259.0±557.7	<0.001
Relaparotomy ‡	None	30 (83,3%)	16 (72,7%)	0.175
	Bleeding	6 (16,6%)	4 (18,1%)	
	Infection	0 (0)	2 (9,0%)	
Intraoperative RBC units		2.3±1.0 (1-6)	4.3±1.7(1-8)	<0.001
Postoperative RBC units †		0.6±1.0 (0-3)	1.5±1.6(0-5)	0.022
Intraoperative FFP units †		2.2±1.1(1-6)	4.1±1.5 (1-7)	<0.001
Postoperative FFP units †		0.4±0.9 (0-4)	1.1±1.4 (0-4)	0.011
Intraoperative crystalloid (mL) §		2208.3±472.9	2818.1±583.6	<0.001
Diagnosis ‡	Acreata	16 (44,4%)	11 (50%)	0.901
	Perkreata	8 (22,2%)	4 (18,1%)	
	Previa	12 (33,3%)	7 (31,8%)	
Preoperative hemoglobin (g/dL) §		11.6±1.3	10.0±1.1	<0.001
Postoperative hemoglobin (g/dL) §		9.7±0.8	9.5±.8	0.381
Intraoperative lowest Hb value in arterial blood (g/dL) §		8.9±1.6	7.1±1.8	<0.001
Intraoperative highest lactate in arterial blood (mmol/L) §		1.3±0.5	3.5±1.8	<0.001
Postoperative fibrinogen (mg/dL) §		303.3±73.8	290.5±95.4	0.202
Intraoperative vasopressor (noradrenalin) support ‡		1 (2,7%)	14 (63,6%)	<0.01
Postoperative ICU stay ‡		4 (11,1%)	12 (54,5%)	0.001
Total hospital stay (day) †		4.7±2.9	7.1±5.7	0.003

§: mean ± standard deviation, ‡: n (%), †: mean ± standard deviation (min-max).
RBC: Red blood cell, FFP: fresh frozen plasma, ICU: intensive care unit, Hb: Hemoglobin.

ligation, B-Lynch suture + Bacri balloon application were applied as uterus-sparing surgery.

In the retrospective study of Binici et al. [14], it was observed that blood loss was generally lower in patients with placental anomaly who underwent neuraxial anesthesia, the average amount of blood product used was lower than those in whom general anesthesia was administered, and the requirement of intensive care hospitalization in the postoperative period was lower in patients with neuraxial anesthesia. In our study, general anesthesia was applied to 36 (62.1%) patients, and 4 of 22 patients whose surgery started with spinal anesthesia were switched to general anesthesia due to bleeding and unstable hemodynamics.

In their retrospective study, Seyhan et al. [15] stated that general anesthesia may be a better option than neuraxial to ensure patient comfort and operational conditions in patients with significant bleeding.

While Kalelioglu et al. [16] study, that was presented 85 PPH cases who underwent hysterectomy and reported that 72 (84.7%) of the patients received intraoperative blood product transfusion, on the other hand, in our study, a 1:1 ratio of RBC: FFP transfusion was used in 43 (72.8%) patients intraoperatively. In the presented study, 12 (20.3%) patients were transfused with 3.08 ± 1.7 units of RBC and were given >4 units of RBC. Intraoperative 4.3±1.7(1-8) units of RBC were used in the patients hospitalized in ICU postoperatively, and no complications related to transfusion were observed.

In their retrospective study, Okada et al. [17] investigated the relationship between lactate, fibrinogen levels, and shock index (SI) with massive transfusion requirements in case of postpartum hemorrhage. This study reported that SI was helpful in the early diagnosis of shock due to its ease and speed of application. Still since SI could not give an idea about the hemodynamic status in these cases, its relationship with massive transfusion requirements could not be examined. It has been shown that the follow-up of fibrinogen and lactate levels can give an idea about the massive transfusion requirement. It has been stated that lactate levels help predict massive transfusion requirements in case of postpartum hemorrhage. The precursors of impaired hemodynamics are the increased lactate level and shock index due to anaerobic metabolism caused by decreased tissue perfusion. The patients' lactate and shock index levels were found to be high in the presented study. Especially, lactate levels were 3.5±1.8 mmol/L (p<0.001), and the shock index was 1.3±0.3 (0.6-1.8) (p<0.001) in the patients who were hospitalized in the intensive care unit, were higher. The amount of blood product used was higher than those not hospitalized in the ICU (p<0.001), and which was also that was found to be compatible with the literature.

In their study, Sahin et al. [18] investigated the use of fibrinogen concentrates in obstetric hemorrhages. As a result of this study, it was observed that the use of appropriate fibrinogen reduces unnecessary blood product use, thus reducing the risk of volume overload and related complications. However, the study found no significant relationship between fibrinogen use and length of hospital and intensive care unit stay. In our study, fibrinogen concentrate was used in 25 (43.1%) patients, and the intraoperative bleeding amount of these patients was 2575±302.2 ml, and 5±1.36 units of RBC were used, and postoperative Hb values were 9.53±0.94 g/dL. Patients, who applied fibrinogen concentrate, were those with more intraoperative bleeding (p<0.001), more unstable hemodynamics, and higher SI (p<0.001). Despite this, postoperative Hb values of the patients differed from the group that was not applied fibrinogen. The postoperative fibrinogen levels of 294.7±79.7 mg/dl also suggest that it may help to maintain the fibrinogen level within normal limits despite excessive bleeding. In the study of Butwick et al. [19], practical use of fibrinogen concentrate, especially in cases with an expectation of 1000-1500 mL of total blood loss, can be evaluated for postpartum hemorrhage management; however, they stated that this use might be more reliable after the determination of fibrinogen levels. In our study, fibrinogen concentrate was used in patients with bleeding of 2000 ml or more, and although preoperative and intraoperative fibrinogen levels could not be measured, it was found within the postoperative normal limits. For obstetric authorities, it is acceptable that the fibrinogen level falls below 200 in such a level of bleeding.

In the literature, 50% of patients who underwent emergent surgery due to placental anomaly, required ICU in the postoperative period; on the other hand, 14.8% of patients operated under elective conditions required ICU [20]. In our study, 25 (43.1%) patients were admitted to the ICU. In addition, patients who have been operated on for abnormal placental invasion also need more supportive drug therapy [21]. In this study, in patients who were transferred to the ICU, the lowest Hb levels were found to be 7.3±1.8g/dL and the highest intraoperative

lactate level was found to be 3.5±1.8 mmol/L in intraoperative blood gas; and 14 (58.3%) patients were transferred to the ICU for close hemodynamic follow-up due to the increase in crystalloid and colloid fluid consumption, in need of intraoperative vasopressor support and intraoperative blood product.

We think that in our hospital, for the patients with placental insertion anomaly; the reasons such as good preoperative follow-up, the multidisciplinary approach of the surgical team and the anesthesia team, applying according to a specific PPH protocol, and the preoperative preparation of adequate blood products were helped us in obtaining our results. Therefore, we think that the results of our study will be helpful for meta-analyses.

The limitations of our study were its retrospective design, the inability to measure the preoperative fibrinogen level, and the low number of patients. We think that prospective studies with a more significant of patients and using devices such as noninvasive hemodynamic monitoring, thromboelastogram, or ROTEM to close following up of coagulation will make new contributions to the literature.

In conclusion, anesthesia management of patients diagnosed with abnormal placental invasion is important because of major hemorrhage. For these patients, preoperative blood product preparation with a multidisciplinary approach and a postoperative ICU plan should be made due to unstable hemodynamics.

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