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The Impact of Anesthesia Type on Bleeding and Blood Transfusion Requirements in High-Risk Cesarean Sections

Yüksek Riskli Sezaryen Operasyonlarında Anestezi Tipinin Kanama ve Kan Transfüzyonu İhtiyacı Üzerine Etkisi

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Abstract: To evaluate the impact of the chosen anesthesia type on intraoperative and postoperative blood loss and blood transfusion requirements in cesarean sections for high-risk pregnancies. This retrospective cohort study included cesarean sections performed in high-risk pregnancies at Konya City Hospital between August 8, 2020 and December 31, 2024. Patients were divided into two groups: General anesthesia (GA) and Neuraxial anesthesia (NA). Preoperative and postoperative hemoglobin (Hb) and hematocrit (Hct) values were assessed, along with the administration of erythrocyte suspension (transfusion) for Hb <8 g/dL, length of hospital stay, and intensive care unit (ICU) admission. Statistical significance was set at $p<0.05$. Out of 14.450 cesarean sections performed during the study period, 125 cases diagnosed with high-risk pregnancy were retrospectively analyzed. Of these, 79 patients underwent surgery under GA and 46 under NA. While no differences were observed in preoperative Hb and Hct values between the groups, the GA group exhibited a significant decline in postoperative Hb (7.75±0.9 g/dL) and Hct (24.65±2.58%) ($p<0.001$). Blood transfusion was required in 82.6% of the GA group compared to 43% in the NA group ($p<0.001$). Additionally, the median hospital stay was 2 (2–3) days in the NA group versus 3 (3–4) days in the GA group, and ICU admission rates were 5.1% and 23.9%, respectively ($p=0.002$). In cesarean sections for high-risk pregnancies, patients receiving GA exhibited increased blood loss, higher transfusion requirements, and prolonged hospital stays compared to those receiving NA. These findings suggest that the choice of anesthesia significantly influences perioperative blood loss and transfusion needs.
Keywords: High-risk pregnancy, cesarean section, spinal anesthesia, general anesthesia, blood loss, transfusion.

Özet: Yüksek riskli gebeliklerde gerçekleştirilen sezaryen operasyonlarında tercih edilen anestezi tipinin intraoperatif ve postoperatif kanama ile kan transfüzyonu ihtiyacı üzerindeki etkisini değerlendirmeyi amaçlamaktadır. Bu retrospektif kohort çalışma Konya Şehir Hastanesinde 08 Ağustos 2020-31 Aralık 2024 tarihleri arasında yüksek riskli gebelerde gerçekleşen sezaryen operasyonlarını değerlendirme altına almıştır. Çalışmaya dahil edilen hastalar, Genel Anestezi (GA) Grubu ve Nöroaksiyel Anestezi (NA) Grubu olarak ikiye ayrılmıştır. Preoperatif ve postoperatif hemoglobin (Hb) ile hematokrit (Hct) değerleri, Hb <8 g/dL durumunda uygulanan eritrosit süspansiyonu (kan transfüzyonu), hastanede kalış süresi ve yoğun bakım ünitesi (YBÜ) ihtiyacı değerlendirilmiştir. İstatistiksel analizde $p<0.05$ anlamlı kabul edilmiştir. 08 Ağustos 2020 - 31 Aralık 2024 tarihleri arasında yapılan 14.450 sezaryen operasyonundan, yüksek riskli gebelik tanısı konulan 125 vaka retrospektif olarak incelenmiştir. Hastalar GA (n=79) veya NA (n=46) altında ameliyat geçirmiştir. Preoperatif Hb ve Hct değerlerinde gruplar arasında fark bulunmazken, postoperatif dönemde GA grubunda Hb (7.75±0.9 g/dL) ve Hct (%24.65±2.58) değerlerinde anlamlı düşüş saptandı ($p<0.001$). GA grubunda kan replasmanı ihtiyacı %82.6 iken, NA grubunda %43 olarak belirlendi ($p<0.001$). Ayrıca, NA hastalarında hastanede kalış süresi 2 (2–3) gün, GA'da ise 3 (3–4) gün; YBÜ yatış oranları sırasıyla %5.1 ve %23.9 olarak tespit edildi ($p=0.002$). Yüksek riskli gebeliklerde yapılan sezaryen operasyonlarında, GA uygulanan hastalarda NA'ya göre artan kan kaybı, daha yüksek transfüzyon ihtiyacı ve uzamış hastanede kalış süresi gözlenmiştir. Bu sonuçlar, anestezi seçiminin perioperatif kan kaybı ve transfüzyon gereksinimi üzerinde belirleyici etkisi olduğunu ortaya koymaktadır.
Anahtar Kelimeler: Yüksek riskli gebelik, sezaryen doğum, spinal anestezi, genel anestezi, kan kaybı, transfüzyon.

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1. Introduction

Cesarean section (CS) is one of the most commonly performed obstetric procedures worldwide and is associated with significant complications for both the mother and the fetus (1). Although modern medical advancements have rendered cesarean operations safer, this procedure still carries a higher risk of maternal mortality and morbidity compared to vaginal delivery (2, 3). High-risk pregnancies, in particular, increase the likelihood of complications during these operations, rendering cesarean sections more complex (4). High-risk pregnancies encompass various medical conditions, including preeclampsia, placenta previa, gestational diabetes, and multiple pregnancies (5). In these cases, severe complications such as postpartum hemorrhage are frequently observed, and obstetric bleeding remains one of the leading causes of maternal death (6). Although the widespread practice of hospital births and interventions like blood transfusions have reduced maternal mortality rates, obstetric hemorrhage continues to be a significant global public health issue (7, 8).

The type of anesthesia is a critical factor influencing blood loss and the need for blood transfusion during cesarean sections (9-11). Spinal anesthesia (SA) and general anesthesia (GA) are the most commonly used techniques, each with its own advantages and disadvantages (12). However, the literature still lacks sufficient research regarding which anesthesia method results in reduced bleeding and a lower need for blood transfusion in high-risk pregnancies. This study aims to comprehensively evaluate the impact of anesthesia type on blood loss and transfusion requirements during cesarean sections in high-risk pregnancies.

2. Materials and Methods

This retrospective study was conducted using patient data from cesarean sections performed for high-risk pregnancies at the Konya City Hospital operating rooms between August 5, 2020, and December 31, 2025. The data of the patients included in the study were accessed through our hospital's electronic patient information management system (HBYS).

This study was approved by the KTO Karatay University Ethics Committee on November 28, 2024 (Ethics Approval No: 2024/013) and was conducted in accordance with the Helsinki Declaration and relevant ethical guidelines.

2.1. Patient Selection

Inclusion criteria required the participants to be high-risk pregnancy cases undergoing cesarean delivery at Konya City Hospital within the last four years. High-risk pregnancies were defined as those complicated by conditions such as preeclampsia, eclampsia, and placental abnormalities (including placenta previa, placenta accreta, placenta increta, or placenta percreta), as well as gestational diabetes and multiple pregnancies. In addition, participants were required to be pregnant individuals aged 18 years or older, classified as ASA II–III, and to have undergone cesarean delivery under either general or neuraxial anesthesia with complete data records available and a hemoglobin level of 8 g/dL or higher. Exclusion criteria eliminated patients who delivered by methods other than cesarean section, cases with incomplete or erroneous data records, and patients with specific medical conditions—such as coagulopathies—that could independently increase the need for blood transfusion. Furthermore, patients referred from the emergency department to another center or those not monitored postoperatively, as well as patients who underwent platelet replacement therapy, were excluded from the study.

2.2. Measurements

Demographic and clinical data of patients meeting the inclusion criteria were extracted from patient records. These data included age, ASA classification, comorbidities, and the type of anesthesia administered.

To assess blood loss, preoperative and postoperative hemoglobin (Hb) and hematocrit (Hct) values were recorded (i.e., preoperative Hb, preoperative Hct, postoperative Hb, and postoperative Hct). In patients with hemoglobin levels below 8 g/dL, the administered erythrocyte suspension (ES) replacement was considered equivalent to a blood transfusion, and the number of ES units provided was documented.

Additionally, the total length of hospital stay (in days), the requirement for intensive care, and the number of days spent in the intensive care unit (ICU) were recorded.

2.3 . Statistical Methods

Data analysis for this study was performed using IBM SPSS Statistics 20.0 (IBM-SPSS Inc., Chicago, IL, USA). Continuous variables are presented as mean ± standard deviation or median (25th–75th percentile), depending on the distribution, while categorical variables are expressed as numbers and percentages.

Normality of the data distribution was assessed using the Kolmogorov-Smirnov test, skewness and kurtosis values (accepted within the range of –2 to +2), as well as histograms and Q-Q plots. For continuous variables, the Independent Samples T-Test was applied when parametric assumptions were met, and the Mann-Whitney U test was used when these assumptions were not met. Categorical variables were analyzed using the Chi-square test. A p-value of <0.05 was considered statistically significant.

3. Results

Over the four-year period, a total of 14.450 cesarean sections were performed at the hospital. Among these cases, 125 were defined as high-risk pregnancies and met the inclusion criteria for the study. Of the included patients, 46 underwent cesarean sections under GA while 79 underwent the procedure under NA (spinal or epidural).

When comparing the included patients based on demographic and clinical characteristics (age, ASA classification, and existing high-risk pregnancy conditions), no statistically significant differences were found between the two groups (p>0.05) (Table 1). The mean age of the 79 patients who received NA was 30±6 years, while that of the 46 patients who received GA was 31±6 years (p=0.303). In terms of ASA classification, 87.3% of patients in the NA group were classified as ASA II and 12.7% as ASA III, whereas in the GA group, the proportions were 73.9% and 26.1%, respectively (p=0.079). Furthermore, no significant differences were observed between the groups regarding additional comorbidities examined under the category of high-risk pregnancy conditions (i.e., multiple pregnancies, preeclampsia/eclampsia, diabetes, and placental anomalies) (p>0.05).

Table 1. Demographic and Clinical Characteristics of Patients by Anesthesia Type

Characteristic		NA Group (n=79)	GA Group (n= 46)	*p*
Age (years, mean ± SD)		30±6	31±6	0.303
ASA Classification, n (%)	2	69 (87.3%)	34 (73.9%)	0.079
	3	10 (12.7%)	12 (26.1%)	
High-risk pregnancy condition, n(%)	Multiple Pregnancies	26 (32.9%)	12 (26.1%)	0.070
	Preeclampsia/Eclampsia	34 (43%)	22 (47.8%)	
	Diabetes	10 (12.7%)	1 (2.2%)	
	Placental Anomalies	9 (11.4%)	11 (23.9%)	

NA: neuraxial anesthesia; GA: general anesthesia; continuous variables are expressed as mean ± SD, and categorical variables are presented as n (%).

Regarding preoperative Hb and Hct values, no significant differences were observed between the NA and GA groups (p=0.250 and p=0.700, respectively). However, postoperative Hb and Hct levels were significantly lower in the GA group (p<0.001 for both) (Table 2).

In terms of blood transfusion, 57% of the patients in the NA group did not receive any transfusion, whereas only 17.4% of the GA group avoided transfusion. Moreover, the requirement for two or more units of blood was significantly higher in the GA group (69.6% vs. 12.7%, p<0.001) (Table 2).

When comparing the total hospital length of stay, a two-day stay was most common in the NA group (55.7%), whereas a three-day stay was most frequent in the GA group (41.3%). Additionally, the rates of hospital stays lasting four days or longer were significantly higher in the GA group; specifically, the proportion of patients with a six-day stay was 1.3% in the NA group compared to 8.7% in the GA group (p<0.001) (Table 2).

Regarding ICU admission, 94.9% of patients in the NA group did not require ICU care, compared to 76.1% in the GA group (p=0.002). Consequently, ICU admission was necessary for 23.9% of the GA group, while only 5.1% of the NA group required it (p=0.002) (Table 2).

Table 2. Distribution of Primary and Secondary Outcomes by Groups

Variable		NA Group (n = 79)	GA Group (n = 46)	*p*
Preoperative Hb (g/dL)		10.54±1.42	10.86±1.63	0.250
Preoperative Hct (%)		33.46±3.86	33.75±4.17	0.700
Postoperative Hb (g/dL)		8.88±1.42	7.75±0.9	<0.001
Postoperative Hct (%)		28.17±4.03	24.65±2.58	<0.001
Blood Transfusion (Units)	0	45 (57%)	8 (17.4%)	<0.001
	1	24 (30.4%)	6 (13%)	
	2	9 (11.4%)	24 (52.2%)	
	3	1 (1.3%)	4 (8.7%)	
	4	0 (0%)	4 (8.7%)	
Total Hospital LOS (Days)	2	44 (55.7%)	10 (21.7%)	<0.001
	3	26 (32.9%)	19 (41.3%)	
	4	6 (7.6%)	9 (19.6%)	
	5	2 (2.5%)	4 (8.7%)	
	6	1 (1.3%)	4 (8.7%)	
Total Hospital LOS (Days)		2 (2-3)	3 (3-4)	<0.001
ICU LOS (Days)	0	75 (94.9%)	35 (76.1%)	0.002
	1	3 (3.8%)	6 (13%)	
	2	1 (1.3%)	3 (6.5%)	
	3	0 (0%)	2 (4.3%)	
ICU Admission	No	75 (94.9%)	35 (76.1%)	0.002
	Yes	4 (5.1%)	11 (23.9%)	

NA: neuraxial anesthesia; GA: general anesthesia; LOS: Length of Stay; Hb: hemoglobin; Hct: hematocrit; ICU: intensive care unit; variables are presented as mean ± SD, n(%) or median (25–75 percentiles).

4. Discussion

This study demonstrated that, in cesarean sections performed for high-risk pregnancies, NA is associated with less intraoperative and postoperative bleeding and a reduced need for blood transfusion compared to GA.

Both spinal and general anesthesia used for cesarean delivery have their respective advantages and disadvantages; neither technique can be considered ideal on its own (13, 14). It is well established that high-risk pregnancies are accompanied by an increased risk of surgical complications and hemorrhage (5). In this patient population, meticulous anesthetic management is crucial to minimize perioperative blood loss and, consequently, the need for transfusion. Notably, the negative impact of GA on uterine contractility, leading to increased blood loss, is a critical issue that warrants careful consideration in high-risk pregnancies (10, 15).

Several studies have reported that general anesthesia is associated with a higher risk of maternal blood loss compared to spinal anesthesia. Nonetheless, GA is frequently preferred in emergency settings due to its rapid administration (2). Najam et al. demonstrated that regional anesthesia (spinal or epidural) is superior to general anesthesia in reducing intraoperative blood loss and transfusion requirements (12). Similarly, Hong et al. observed more stable hemodynamic parameters and lower blood loss in patients who received epidural anesthesia (15), while Andrews et al. reported that inadequate uterine tone and hemodynamic fluctuations in patients receiving GA were linked to increased blood loss (9). Other studies have indicated that GA results in significant declines in postoperative hemoglobin (Hb) and hematocrit (Hct) values, which correspond to a greater need for transfusion due to increased blood loss. In our study, although preoperative blood parameters were similar between the NA and GA groups in high-risk pregnancies undergoing cesarean section, the GA group exhibited a significant decrease in postoperative Hb and Hct values and a higher requirement for blood transfusion. These findings, in line with several previous studies, suggest that NA may be more advantageous in high-risk pregnancies.

Studies have also shown that the choice of anesthetic technique in cesarean delivery can affect the length of hospital stay. Postoperative hospital stay is closely related to the amount of intraoperative and postoperative blood loss and may serve as an important determinant in anesthetic management. Havas et al. found that patients receiving spinal anesthesia had a quicker return of postoperative gastrointestinal function and a shorter hospital stay

(an average of 48 hours) compared to those receiving GA (an average of 52 hours) (16). Similarly, Oh et al. demonstrated that patients receiving general or epidural anesthesia experienced longer hospital stays than those receiving spinal or combined spinal-epidural anesthesia (17). Furthermore, Fassoulaki et al. reported that patients undergoing cesarean delivery with NA were discharged earlier compared to those who underwent GA (18). Consistent with these findings, our study revealed that the GA group had a longer total hospital length of stay, suggesting that increased bleeding and related complications may delay discharge. Moreover, GA has been shown to increase the rate of intensive care unit (ICU) admissions following cesarean section. Wiskott et al. reported that patients receiving GA required more blood products, which, in turn, increased the likelihood of ICU admission (19). In accordance with these data, our study found that patients receiving NA had lower ICU admission rates compared to those receiving GA, underscoring the potential role of NA in reducing the need for intensive care.

This study has several limitations. First, its retrospective design introduces the risk of data inaccuracies and incomplete records, which may limit the generalizability of the findings. Second, as a single-center study, the results may vary with clinical practices and patient profiles at different institutions; multicenter studies with larger and more diverse populations are needed to confirm these findings. Third, blood loss was estimated based on the difference between preoperative and postoperative hemoglobin levels; however, factors such as perioperative fluid replacement, urine output, and third-space losses may affect this estimation. Additional methods may be necessary to more precisely assess the actual blood loss. Fourth, potential confounding factors such as surgical technique, surgeon experience, and intraoperative hemodynamic changes were not fully controlled, and these variables may influence blood loss and transfusion requirements. Fifth, the decision for intraoperative transfusion was made by the surgeon or anesthesiologist based on the amount of bleeding and hemodynamic parameters. However, in some cases, postoperative evaluation revealed that transfusion was performed despite the patient's Hb level being >8 mg/dL, considering clinical stability as well. This suggests that individual variations in patient management may exist and that a standardized blood transfusion protocol was not applied. This situation presents a significant limitation that may have influenced our results. Finally, only the transfusion of packed red blood cells was evaluated, with other blood products such as platelets, fresh frozen plasma, or other components not included in the analysis. A broader evaluation of total transfusion needs would be beneficial in future studies.

In conclusion, this study demonstrates that the type of anesthesia used in high-risk cesarean deliveries significantly affects the need for intraoperative and postoperative blood transfusions. Patients receiving general anesthesia experienced greater blood loss, an increased need for transfusion, and prolonged hospital stays compared to those receiving neuraxial anesthesia. These findings suggest that anesthetic management may play an important role in controlling bleeding and reducing transfusion requirements. Future prospective, multicenter studies should further evaluate the effects of anesthesia type on bleeding management and maternal outcomes.

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