



From Safety to Risk: Maternal Morbidity in Women Undergoing Multiple Repeat Cesarean Deliveries

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Abstract

Aim: The global rise in cesarean delivery (CD) rates, especially in low- and middle-income countries, has increased the prevalence of multiple repeat cesarean deliveries (MRCs), raising concerns about associated maternal and neonatal morbidity. The objective of this study was to assess clinical outcomes related to MRCs by comparing women with four or more prior CDs to those with fewer.

Material and Method: This study was retrospectively conducted involving 15,811 women with singleton pregnancies who underwent CD and had a history of at least one prior CD between January 2018 and December 2022. Participants were categorized into two groups: Group 1 (≤ 3 prior CDs) and Group 2 (≥ 4 prior CDs). Maternal demographics, intraoperative and postoperative outcomes, as well as neonatal outcomes, were analyzed and evaluated across the groups.

Results: Women in Group 2 had significantly higher rates of placenta previa (7.4% vs. 0.23%), placenta accreta (1.9% vs. 0.04%), cesarean hysterectomy (1.5% vs. 0.007%), intra-abdominal adhesion (7.3% vs. 1.21%), bladder injury (1.06% vs. 0.095%), and blood transfusion (8.7% vs. 2.6%) than those in Group 1 (all $p < 0.001$). Neonatal outcomes were also adversely affected in Group 2, with lower gestational age at delivery (37.6 vs. 38.4 weeks) and increased NICU admission rate (10.2% vs. 7.6%; $p < 0.001$).

Conclusion: MRCs are significantly associated with increased maternal and neonatal morbidity, particularly in women with four or more previous CDs. These findings emphasize the need for comprehensive prenatal counseling, surgical preparedness, and efforts to reduce primary CD rates, while promoting trial of labor after CD when clinically appropriate.

Keywords: Cesarean delivery, maternal, multiple repeat, neonatal, outcomes

INTRODUCTION

Cesarean delivery (CD) is an essential and frequently performed obstetric surgical procedure used to address complications of vaginal delivery, such as cephalopelvic disproportion, fetal distress, obstetric hemorrhage, abnormal presentation, and other emergent conditions, effectively serving as a critical intervention to safeguard maternal and neonatal health. While, as a surgical procedure, CD entails inherent risks, including anesthetic complications, infection, bleeding, thromboembolism, and surgical injury (1). Compared with primary CD, multiple repeat cesarean deliveries (MRCs) are associated with increased risks, including dense adhesion, bladder and bowel injury, placenta previa (PP), intensive care unit (ICU) admission and placenta accreta (PA) (2). Additionally, neonates delivered via CD are at an increased risk for infection, respiratory complications, and admission to the neonatal intensive care unit (NICU) (3).

The global incidence of CD has increased significantly in recent decades, driven by multiple factors, including changes in maternal characteristics, evolving professional practice patterns, medico-legal considerations, socio-economic and cultural influences, and the growing utilization of assisted reproductive technologies (4). Based on 2021 data from the OECD in 2021, Israel recorded the lowest rate of CDs among its member countries at 148 per 1,000 live births, however Mexico had the highest rate at 586, closely followed by Türkiye, which had the second highest rate at 573 per 1,000 live births (5). In addition, findings from the Türkiye Demographic and Health Survey indicate a significant increase in Türkiye's CD rate, from 8% in 1993 to 37% in 2008 and further to 52% in 2018, reflecting a significant upward trend over a 25-year period (6-8). Nevertheless, in 1985, the World Health Organization stated that the optimal CD rate at the population level should be between 10% and 15%, as rates above this threshold are not associated with additional reductions in maternal or perinatal mortality (9).

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The increasing incidence of CD in developing countries has led to a growing number of women undergoing MRCs. Vaginal birth after CD represents a viable strategy to reduce CD rates; however, it is not routinely offered in all hospitals in Türkiye. Moreover, many clinicians recommend sterilization to women after two or three CD because of the risk of uterine rupture, postpartum hemorrhage and other complications. However, sterilization is frequently declined by women in Türkiye, where large families are socially and culturally encouraged.

The maximum number of CDs that a woman can safely undergo remains a subject of ongoing debate. Therefore, the primary objective of this study was to assess the safety of MRCs and establish the maximum number that can be performed without significantly increasing maternal or neonatal risk. In addition, the study aimed to compare operative outcomes, clinical findings, maternal morbidity, and neonatal outcomes between women with a history of four or more CDs and those with three or fewer.

MATERIAL AND METHOD

This retrospective case-control study was conducted in the Department of Perinatology at a tertiary care center between January 2018 and December 2022, involving women aged 20 to 45 years with singleton pregnancies and a history of at least one prior CD. Participants with multiple gestations were excluded, as multiple pregnancies are a well-established primary risk factor for both maternal and neonatal morbidity. This study was carried out in compliance with the ethical standards of the Declaration of Helsinki and was approved by the institutional ethics committee of University of Health Sciences Etlik Zübeyde Hanım Health Care Training and Research Hospital (Date: 20.05.2021, Reference Number: 07/10).

Clinical data were obtained from electronic patient records and included maternal age, parity, maternal body mass index, antenatal follow-up, operative time, intraoperative and postoperative complications, PP, PA, need for hysterectomy, blood transfusion, admission to ICU, length of hospital stay and incidence of bladder and bowel injury and wound infection. Neonatal data collected included gestational age, birth weight, Apgar scores <7 at 5 minutes, and admission to NICU. Patients were divided into two groups based on the number of their prior CDs. Group 1 included women with three or fewer prior CDs, while Group 2 included those with four or more.

All patients underwent abdominal ultrasound and, when clinically indicated, transvaginal ultrasound with color Doppler imaging, performed using a Voluson E6 device (GE Healthcare, Milwaukee, WI, USA). Gestational age was estimated using the date of the last menstrual period and verified through an ultrasound examination. If PP was suspected during routine ultrasound examination, the diagnosis was established by transvaginal ultrasound at 32 weeks' gestation, defined as complete coverage of the cervical os or a placental edge within 20 mm of the os (10). The diagnosis was confirmed by a repeat transabdominal or transvaginal ultrasound examination performed between 32 and 34 weeks' gestation. The diagnosis of PA was made according to the ultrasound criteria defined by the European

Working Group on Abnormally Invasive Placenta (11). The definitive diagnosis of PA was confirmed by clinical evidence of placental invasion observed during delivery or by histopathological examination of hysterectomy specimens, in accordance with the International Federation of Gynecology and Obstetrics guidelines (12). If PA was suspected, the standard practice was to anticipate the condition, counsel the patient about potential complications and the possible need for blood transfusion, and obtain informed consent for hysterectomy.

Scar dehiscence was defined as the separation of a previous cesarean scar while the overlying peritoneum remains intact. Uterine rupture was characterized by a complete, full-thickness tear of a prior cesarean scar, typically associated with partial or total displacement of the fetus into the abdominal cavity. Adhesions involving the anterior uterine wall and peritoneum, the omentum, and the bladder were documented. Intraoperative visceral injuries were defined as unintentional damage sustained during a surgical incision or tissue dissection, including bladder and bowel injuries, such as accidental intussusception into the intestine or seromuscular damage that required surgical repair. Wound infection was diagnosed when the CD incision exhibited drainage of serosanguinous or purulent fluid accompanied by induration and tenderness. Estimated blood loss was calculated by summing the volume collected in the suction canister and the weight difference between dry and blood-soaked gauze and surgical towels, assuming that 1 g equals 1 mL. Blood transfusion was indicated in cases where the preoperative hemoglobin (Hb) level was below 10 g/dL, intraoperative estimated blood loss exceeded 20% of the total blood volume, or the postoperative Hb level was below 8.5 g/dL. In accordance with the criteria set by the Turkish Ministry of Health, a minimum of four antenatal visits was considered indicative of regular antenatal care.

Data Analysis

Statistical analysis was performed using SPSS version 26.0 (SPSS Inc., Chicago, IL, USA). Continuous variables were presented as mean±standard deviation (SD) for normally distributed data or as median values for non-normally distributed data, while categorical variables were expressed as percentages. Comparisons between the two groups for normally distributed variables were performed using the independent samples t-test. The Mann-Whitney U test was applied to variables without normal distribution. The Pearson chi-square test was used to compare categorical variables.

RESULTS

Over the study period, 56,854 deliveries occurred at our hospital, of which 15,811 (27.8%) were CDs. The sociodemographic and clinical characteristics of the study population are presented in Table 1. Of the CDs, 6,702 (42.4%) were primary CDs, whereas 9,109 (57.6%) were performed in women with at least one prior CD. More than half of the participants (51.6%) were under 30 years of age. The majority of participants were of Turkish nationality (81%), followed by Syrian nationals (15.9%) and individuals from other nationalities (3.1%). Moreover, 81% received regular antenatal care, and only 3% reported smoking during pregnancy.

Table 1. Demographic and clinical features of the study population

Variables		Number	Percentage
Maternal age (years, mean±SD)	<30	8158	51.6
	30–35	4727	29.9
	>35	2926	18.5
Parity (n, %)	1	6702	42.4
	2	4111	25.8
	3	2830	17.9
	4	1582	10.2
	≥5	586	3.7
Number of previous cesarean deliveries (n, %)	1	6702	42.4
	2	4111	25.8
	3	2830	17.9
	≥4	2168	13.9
Nationality (n, %)	Turkish	12809	81
	Syrian	2510	15.9
	Others	492	3.1
BMI (kg/m², n, %)	<25	21500	52
	25–30	14500	35.1
	>30	5352	12.9
Had regular antenatal care	Yes	13441	85
	No	2370	15
Smoking (during pregnancy)	Yes	475	3
	No	15336	97

BMI: body mass index, SD: standard deviation

As shown in Figure 1, the most frequent indication for CD among patients undergoing a primary CD was failure to progress, accounting for 59.5% of cases. This was followed by breech presentation (12.5%), fetal distress (11.0%), and intrauterine growth restriction (8.6%). In patients with MRCDs, the most commonly reported indication was a previous CD, also comprising 59.5% of cases, as illustrated in Figure 2. Other reported indications in this group included breech presentation (4.5%), fetal distress (3.7%), oligohydramnios (3.5%), preeclampsia (2.9%), and transverse lie (0.2%).

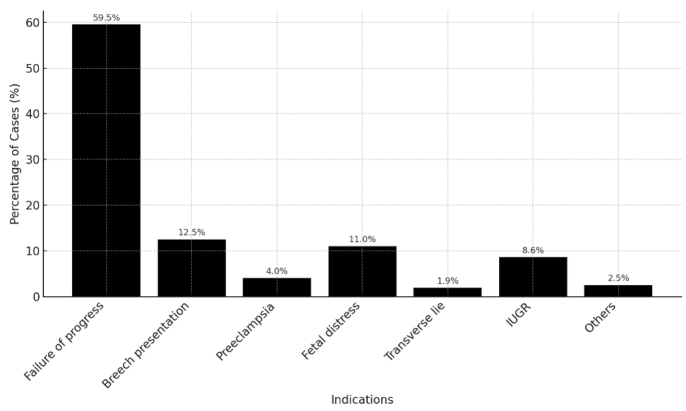


Figure 1. Distribution of indications for primary cesarean delivery

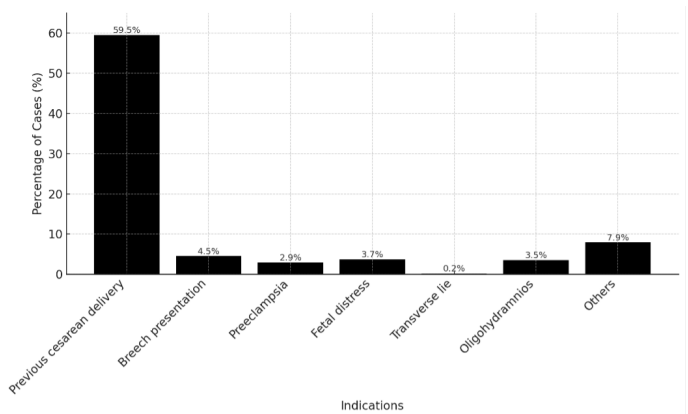


Figure 2. Distribution of indications for multiple repeat cesarean deliveries

As shown in Table 2, Group 1 included 13,643 patients (86.3%), while Group 2 included 2,168 patients (13.7%). Women in Group 2 were significantly older and had higher parity than those in Group 1 (both $p<0.001$). Additionally, the prevalence of gestational diabetes mellitus (24.6% vs. 15.2%; $p<0.001$) and the rate of pregnancy-induced hypertension or preeclampsia was higher (8.9% vs. 11.8%; $p=0.002$) in Group 2. Preoperative and postoperative hemoglobin levels did not differ significantly between the groups.

Table 2. Demographic and clinical characteristics between the groups

	Group 1 (number of CDs ≤3, n=13643)	Group 2 (number of CDs ≥4, n=2168)	p-value
Maternal age (years, mean±SD)	27.78±6.93 (18-39)	34.93±2.90 (24-45)	<0.001
Parity (mean±SD)	2.63±1.29 (1-4)	3.52±1.42 (3-7)	<0.001
Preop Hb (g/dL, mean±SD)	10.1±1.4	10.2±0.8	0.264
Postop Hb (g/dL, mean±SD)	10±1.2	9.5±1.1	0.052
Medical problems (n, %)			
Pregestational diabetes	615 (4.51)	106 (4.90)	0.0639
Gestational diabetes mellitus	2074 (15.2)	533 (24.6)	<0.001
PIH/preeclampsia	1214 (8.9)	256 (11.8)	0.002
Anemia	314 (2.3)	54 (2.5)	0.585
Hypothyroidism	368 (2.7)	63 (2.9)	0.756

PIH: pregnancy induced hypertension, SD: standard deviation

As shown in Table 3, intraoperative outcomes were compared between the participants in Group 1 and Group 2. The operative time was significantly longer in Group 2 (68.42 vs. 54.35 minutes), with greater estimated blood loss (1015.4 vs. 605.3 mL) and longer hospital stay (4.7 vs. 3.3 days) than those Group 1 (all $p<0.001$). The incidence of midline abdominal incision (6.1% vs. 1.7%), PP (7.4% vs. 0.23%),

cesarean hysterectomy (1.5% vs. 0.007%), intra-abdominal dense adhesions (7.3% vs. 1.21%) and blood transfusion (8.7% vs. 2.6%) were all significantly higher in Group 2 (all $p<0.001$). Additionally, uterine scar dehiscence or rupture (0.14% vs. 0.007%), bowel injury (0.046% vs. 0%), wound infection (0.322% vs. 0.088%), and admission to ICU (0.14% vs. 0.007%) were more common in Group 2 (all $p<0.001$).

Table 3. Comparison of intraoperative outcomes between groups

Variables	Group 1 (n=13643)	Group 2 (n=2168)	p-value
Operative time (minutes, mean±SD)	54.35±15.4	68.42±18.5	<0.001
Type of abdominal incision (n, %)			
Midline	232 (1.7)	132 (6.1)	<0.001
Pfannenstiel	13411 (98.3)	2036 (93.9)	
Length of hospital stay (days, mean±SD)	3.3±0.5	4.7±0.3	<0.001
Estimated blood loss (mL, mean±SD)	605.3±150.5	1015.4±175.4	<0.001
Blood transfusion (n, %)	355 (2.6)	189 (8.7)	<0.001
Placenta previa (n, %)	31 (0.23)	160 (7.4)	<0.001
Placenta accreta (n, %)	5 (0.04)	41 (1.9)	<0.001
Cesarean Hysterectomy (n, %)	1 (0.007)	32 (1.5)	<0.001
Uterine scar dehiscence or rupture (n, %)	1 (0.007)	3 (0.14)	<0.001
Intra-abdominal dense adhesion (n, %)	165 (1.21)	158 (7.3)	<0.001
Bladder injury (n, %)	13 (0.095)	23 (1.06)	<0.001
Bowel injury (n, %)	0	1 (0.046)	<0.001
Wound infection (n, %)	12 (0.088)	7 (0.322)	<0.001
ICU admission (n, %)	1 (0.007)	3 (0.14)	<0.001

ICU: intensive care unit, SD: standard deviation

Neonatal outcomes were compared between patients in Group 1 and Group 2 are shown in Table 4. Gestational age at delivery was significantly lower in Group 2 (37.6±0.2 vs. 38.4±1.8 weeks; $p<0.001$). The

rate of preterm delivery before 37 weeks (2.3% vs. 0.2%) and NICU admission rates (10.2% vs. 7.6%) were significantly higher in Group 2 than those in Group 1 (both $p<0.001$).

Table 4. Neonatal characteristics and neonatal outcome

Variables	Group 1 (n=13643)	Group 2 (n=2168)	p-value
Gestational age (weeks, mean±SD)	38.4±1.8	37.6±0.2	<0.001
Birth weight (grams, mean±SD)	3149±468	3089±238	0.256
Apgar score ≤7 at 5 minutes (n, %)	109 (0.8)	22 (1)	0.581
5. minutes Apgar score (mean±SD)	7.4±1.3	7.5±1.4	0.0152
Delivery at <37 weeks (n, %)	26 (0.2)	5 (2.3)	<0.001
NICU admission (n, %)	1037 (7.6)	221 (10.2)	<0.001

NICU: neonatal intensive care unit, SD: standard deviation

DISCUSSION

The increasing global prevalence of CDs, particularly in low- and middle-income countries, has raised significant concerns regarding the short- and long-term consequences of MRCDs (2-3). Although primary CD can be vital for ensuring the well-being of women and their offspring in specific obstetric situations, the growing trend towards repeat procedures, often influenced by a history of prior CD rather than new medical indications, poses substantial clinical, surgical, and public health challenges.

Cultural expectations favoring larger families, prevalent in many regions globally, particularly within Arabian and Turkish communities, have contributed to a rise in CD rates and, consequently to an increase in MRCDs and their related complications. To provide accurate counseling on the safety of MRCDs, numerous studies have been conducted to investigate the risks and outcomes associated with these procedures.

One of the most critical complications associated with MRCDs is abnormal placentation, particularly PP and PA. Marshall et al. reported that the risk of PP is 1% with one previous CD, while this risk increases to 2.8% with three or more (13). Similarly, Makoha et al. reported that the risk of PP, PA and caesarean hysterectomy were substantially increased with the fifth and sixth CD compared with the third CD (14). Consistent with previous findings, the study observed a significantly higher rate of PP among women with four or more previous CDs than among those with fewer (7.4% vs. 0.23%), along with an increased rate of PA (1.9% vs. 0.04%). Similarly, Jauniaux et al. reported that the rate of PA increased from 4.1% in women with one previous CD to 13.3% in those with two or more (15). Likewise, Silver et al. identified a dose-dependent relationship, noting that the risk of PP increased from 0.9% after one CD to 3.4% after four or more. They also found that even in the absence of PP or PA, the risk of cesarean hysterectomy increased with the number of previous CDs (16). Consequently, a major cause of emergency cesarean hysterectomy is massive bleeding due to abnormal placental invasion. Consistent with this, this study found increased estimated blood loss (1015.4 vs 605.3 mL) and a significantly higher rate of cesarean hysterectomy in Group 2 compared with Group 1 (1.5% vs. 0.007%).

Tulandi et al. reported that adhesions form in up to 90% of patients following multiple abdominal surgeries, creating dense fibrotic bands that complicate dissection and increase the risk of iatrogenic injury (17). Furthermore, the literature demonstrates a progressive increase in the incidence of intraperitoneal adhesions with the number of prior CDs. Reported adhesion rates range from 12% to 46% in patients with two prior CDs and from 26% to 75% in those with three prior CDs (17,18). Rashid et al. found that the adhesion rate in patients with five or more prior CDs was 54%, compared with 15% in a control group with two to three prior CDs (19). Similarly, Kaplanoglu et al. reported an adhesion rate of 19.4% in women with three or fewer prior CDs, rising to 58.6% in those with four or more prior CDs, suggesting that the fourth CD may represent a critical threshold for adhesion formation (20). The presence of adhesions is known to complicate subsequent abdominal surgery, leading to prolonged operative times, an increased need for blood transfusion, and a higher risk of injury to adjacent structures, such as bowel, ureter and bladder (17-19). Consistent with these observations, our study demonstrated significant technical challenges in women with MRCDs, with Group 2 exhibiting higher rates of intraabdominal dense adhesions (7.3% vs. 1.21%), bladder injury (1.06% vs. 0.095%), and blood transfusion (8.7% vs. 2.6%) compared with Group 1. Bladder injury is an uncommon but well-recognized complication of MRCDs, particularly among women with previous low transverse incisions, owing to adhesions between the bladder and the anterior uterine wall (21). These findings reflect the cumulative effect of repeated surgical trauma on pelvic anatomy, as observed in our cohort of 15,811 cesarean deliveries.

Another significant complication associated with MRCDs was the increased risk of uterine scar dehiscence or rupture, which contributes to increased maternal and offspring morbidity and mortality. The study confirmed that the prevalence of uterine scar dehiscence and rupture increased with the number of previous CDs, as evidenced by the higher rate observed in Group 2. These results align with the findings of Uygur et al. (18) and Qublan et al. (22), who likewise reported a heightened risk of uterine scar complications associated with MRCDs. Conversely, studies by Macones et al. (23) and Cahill et al. (24) found no significant association between an increased number

of prior CDs and the incidence of uterine scar rupture, underscoring the variability of outcomes among different study populations.

Group 2 had poorer neonatal outcomes, as evidenced by a lower gestational age at delivery and a higher NICU admission rate compared to Group 1. Similarly, Oben et al. reported an increased rate of neonatal morbidity associated with preterm birth in women with MRCDs (25). In contrast, Uygur et al. (18) and Rashid et al. (19) reported no statistically significant differences in Apgar scores or NICU admission rates among neonates born to mothers with varying numbers of prior CDs. The earlier gestational age in Group 2 may be due to the higher incidence of PP and PA, which often require planned preterm delivery to prevent catastrophic hemorrhage.

Our study has certain limitations that should be acknowledged. Firstly, its retrospective nature limits the possibility of establishing cause-effect and may introduce information and selection bias. Secondly, being conducted at a single tertiary care facility, the results may not be applicable to a wide range of settings with varying patient demographics, clinical practices, or healthcare infrastructures. Thirdly, despite the fact that comprehensive data were retrieved from the hospital's digital medical database, we cannot exclude possibility that some variables were not fully documented. Consequently, detailed operative notes, adhesion grading, and estimated blood loss relied on subjective surgical descriptions, limiting their objective assessment in this retrospective analysis. Despite the aforementioned limitations, the extensive sample size and the study's focus on objective clinical outcomes support the reliability and relevance of the results.

CONCLUSION

This study demonstrates that MRCDs are significantly associated with increased maternal and offspring morbidity, particularly in women with four or more previous CDs. These findings highlight the importance of individualized care planning, multidisciplinary surgical preparedness, and comprehensive patient counseling. Efforts to reduce primary CD rates and promote trial of labor after CD, where clinically appropriate, are essential to reduce the long-term risks associated with MRCD.

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