

# Relaparotomy Post Cesarean Delivery: Characteristics and Risk Factors.

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## Research Article

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# Abstract

**Purpose:** Relaparotomy following cesarean delivery (CD) is performed at a rate of 0.2-1% of CD. The objective of the present study was to identify risk factors for relaparotomy following CD, and to examine whether there is a difference in the risk of relaparotomy between CD performed during different daytimes.

**Methods:** A retrospective study including all CD over ten years. Cases that underwent laparotomy within one week following CD were compared to those that did not. CDs for placenta accreta were excluded.

**Results:** Sixty-four patients underwent relaparotomy following CD. In univariate analysis relaparotomy was significantly higher pregnancies following assisted-reproductive technologies (39.1%vs. 16.9%), hypertensive disorders of pregnancy (18.8%vs. 7%), twin pregnancies (29.7%vs. 10%), preterm deliveries (34.4%vs. 17.6%), low birthweight (2815gr vs. 3047gr), placenta previa (7.8% vs. 1.3%) low body mass index (22.4 vs. 24.5) and urgent CD (54.7% vs. 40.8%), especially during the second stage of labor. In a multivariate regression analysis, the adjusted odds ratio for relaparotomy was 10.24 in CD due to placenta previa, and 5.28 in CD performed at the second stage of delivery.

At relaparotomy, active bleeding was found in 50 patients (78.1%), nearly half received packed cells, 12.5% developed consumptive coagulopathy, and 17.2% needed hospitalization in the intensive care unit. 6.3% underwent a second relaparotomy, mainly due to bleeding.

**Conclusion:** Hypertensive disease, placenta previa, and urgent CDs mainly those performed at the second stage of labor are risk factors for relaparotomy after CD.

## Introduction:

Relaparotomy following cesarean delivery (CD) is defined as an additional abdominal surgery for exploration within 60 days of CD including skin opening <sup>1</sup>. It is usually an urgent medical condition, complicating about 0.2-1% of CD, and is performed mainly due to abdominal bleeding, abdominal wall hematoma, uncontrolled bleeding and infections <sup>2-5</sup>. The elevated rate of CD over the years resulted in an increased complications rate including bleeding, infections and injury to adjacent organs resulting in relaparotomy <sup>6-9</sup>. Although a few studies reported association between relaparotomy and emergent CD <sup>10,11</sup>, none examined the association to the time of day.

Characterizing the patients who underwent relaparotomy may enlighten us about possible risk factors and lead to preventive measures that may be taken in order to avoid such potentially life-threatening events.

The objective of the present study was to detect all the patients that had relaparotomy following CD in a large tertiary center, to compare them to the patients who delivered by CD without this complication, and to identify risk factors for relaparotomy. We aimed to examine whether there is a difference in the risk of relaparotomy between CD performed during different daytimes.

## Material And Methods:

A retrospective study including all consecutive CD's between 03/2011 and 04/2020 at the Chaim Sheba Medical Center, a large tertiary referral center at the center of Israel with over 10,000 deliveries per year.

Inclusion criteria included all patients that underwent laparotomy within one week following a cesarean delivery.

Exclusion criteria were pregnancies with placenta accreta. Our medical center specializes in cesarean deliveries complicated by placenta accreta, therefore the rate of placenta accreta is higher than in other medical centers. Since these specific operations are prone to bleeding complications and to injuries to adjacent organs, these operations were excluded from our analysis.

We compared all relaparotomy cases to all CDs without a subsequent relaparotomy.

Elective CD was defined as a scheduled CD performed at the planned time, either in the morning at afternoon. The indications for elective CD were maternal, fetal or placental conditions posing a risk for vaginal delivery <sup>12</sup>, for example non-vertex presentation, previous CD, pregnancies with placenta previa or suspected macrosomia. Emergent CD was defined as a non-elective CD but with no immediate risk for the mother or fetus performed at any time during the day. For example, a patient planned to have an elective CD who came in labor before the scheduled CD or non-progressive labor. Urgent CD was defined as CD performed due to immediate maternal or fetal life-threatening risk, such as severe fetal bradycardia or a massive bleeding, performed at any time of the day.

Data included maternal age, maternal body mass index (BMI), gravidity, parity, mode of previous delivery, time from previous cesarean delivery, gestational or pre-gestational diabetes, hypertensive disorders of pregnancy, gestational age at delivery, number of fetuses, birthweight, cause of CD, meconium stained amniotic fluid, placenta previa, duration of cesarean delivery, time of cesarean delivery, and cause of relaparotomy. Comparison was made between different hours of the day according to the work-shifts.

## Statistical analysis:18/2

Continuous variables were described as mean  $\pm$  standard deviation or median (IQR). Comparison of continuous variables between the two groups was conducted using Mann–Whitney U test. Chi-square or Fisher exact test were used for comparison of categorical variables as appropriate. Significance was accepted at  $p < 0.05$ . Statistical analyses were conducted using the IBM Statistical Package for the Social Sciences (IBM SPSS v.20; IBM Corporation Inc, Armonk, NY, USA).

## Results:

During the study period there were overall 93,626 deliveries at our medical center, 24,239 by cesarean delivery (comprising 25.9%). Sixty-four patients underwent relaparotomy during the first week following

delivery, comprising 0.26% of all cesarean deliveries. There were 348 CDs performed due to placenta accrete, 14 of them (4%) underwent relaparotomy. These patients were excluded from the study population.

In an univariate analysis relaparotomy was associated with the following (Table 1): Lower pre-pregnancy BMI, pregnancies following assisted reproductive technologies, hypertensive disorders of pregnancy, twins, preterm births, smaller birthweight, placenta previa, or urgent CD, and those operated during the second stage of labor. Previous delivery by cesarean delivery did not increase the risk of relaparotomy, nor the interval from the last cesarean delivery. The incidence of relaparotomy did not differ among CDs performed at different hours in the day.

Table 1  
Characteristics of study population:

Characteristic	Relaparotomy n = 64	Normal postpartum n = 24,239	CI 95%	P value
Maternal age, years	35 ± 6.4	34 ± 5.5		0.141
Immigrant	14 (21.9%)	4,225 (17.4%)		0.349
Prepregnancy BMI	22.4 ± 3.5	24.5 ± 5.1		<b>&lt; 0.001</b>
Underweight (BMI < 18)	4 (6.3%)	1,083 (4.5%)		0.535
Overweight BMI > 25	13 (20.3%)	6,708 (27.7%)		0.189
Predelivery BMI	28.7 ± 4.3	29.5 ± 5.0		0.221
Weight gain, kg	15 ± 6	13 ± 6		0.062
Smoking	1 (1.6%)	1,355 (5.6%)		0.267
Gravidity	2 ± 1.8	3 ± 1.9		0.150
Parity	1 ± 1.3	1 ± 1.3		0.200
Cesarean deliveries	0 ± 0.9	1 ± 0.9		0.161
Previous cesarean delivery	20 (31.3%)	10,202 (42.1%)		0.079
Years from last cesarean	5 ± 3	4 ± 3		0.164
ART conception	25 (39.1%)	4,092 (16.9%)	3.15 (1.90–5.22)	<b>&lt; 0.001</b>
Ovulation induction / IUI	2 (3.1%)	1,203 (5.0%)		0.771
Twins	19 (29.7%)	2,432 (10.0%)	3.78 (2.21–6.48)	<b>&lt; 0.001</b>
Fasting glucose	81 ± 7	84 ± 14		0.341
GCT	111 ± 25	116 ± 30		0.244
Diabetic disorder	9 (14.1%)	3,654 (15.1%)		0.821
Hypertensive disorder of pregnancy	12 (18.8%)	1,704 (7.0%)	3.05 (1.62–5.72)	<b>&lt; 0.001</b>
Aspirin / LMWH	5 (7.8%)	1,801 (7.4%)		0.811
Coagulopathy	1 (1.6%)	497 (2.1%)		1.0
Male fetus	28 (43.8%)	12,778 (52.7%)		0.151

Characteristic	Relaparotomy n = 64	Normal postpartum n = 24,239	CI 95%	P value
Amniotic fluid index	142 ± 58	151 ± 59		0.440
Oligohydramnios	3 (4.7%)	548 (2.3%)		0.177
Polyhydramnios	2 (3.1%)	1,395 (5.8%)		0.587
Meconium stained amniotic fluid	7 (10.9%)	2,447 (10.1%)		0.823
Placenta previa	5 (7.8%)	316 (1.3%)	6.41 (2.55–16.09)	< 0.001
Gestational age, weeks	37 <sup>3/7</sup> ± 2 <sup>6/7</sup>	38 <sup>1/7</sup> ± 2 <sup>1/7</sup>	2.44 (1.46–4.10)	0.025
< 37 <sup>0/7</sup>	22 (34.4%)	4,271 (17.6%)	4.08 (2.12–7.83)	< 0.001
< 34 <sup>0/7</sup>	11 (17.2%)	1,173 (4.8%)		< 0.001
< 32 <sup>0/7</sup>	5 (7.8%)	574 (2.4%)	3.49 (1.39–8.73)	0.018
Prelabor cesarean delivery	42 (65.6%)	17,468 (72.1%)		0.252
Second stage cesarean	9/22 (40.9%)	1,368/6,771 (20.2%)	2.73 (1.16–6.41)	0.015
Second stage duration, min.	140 ± 97	184 ± 143		0.387
Induction of labor	9/22 (40.9%)	2,958/6,771 (43.7%)		0.791
Vertex	47 (73.4%)	18,376 (75.8%)		0.654
Nature of cesarean	26 (40.6%)	13,338 (55.0%)	0.55 (0.33–0.92)	0.055
Elective	3 (4.7%)	1,002 (4.1%)	1.14 (0.35–3.64)	0.022
Emergent	35 (54.7%)	9,899 (40.8%)		0.809
Urgent			1.74 (1.06–2.86)	0.026
Cesarean duration, minutes	46 ± 29	42 ± 20		0.313
Time of cesarean delivery	10 (15.6%)	3,615 (14.9%)		0.988
Night (23 – 7)	28 (43.8%)	11,140 (46.0%)		
Morning (7–15)	26 (40.6%)	9,484 (39.1%)		
Evening (15–23)				
Birthweight	2,815 ± 787	3,047 ± 651		0.021

Characteristic	Relaparotomy n = 64	Normal postpartum n = 24,239	CI 95%	P value
Maximal birthweight	3,059 ± 755	3,298 ± 612		0.028
Minimal birthweight	2,717 ± 645	2,991 ± 677		0.022
Intrapartum fever	0 (0%)	589 (2.4%)		0.410
Pre-delivery Hb	11.7 ± 1.1	11.8 ± 1.1		0.484
Pre-delivery PLT	195 ± 52	204 ± 60		0.231
Pre-delivery Fibrinogen	412 ± 89	454 ± 92		<b>0.029</b>
DIC	0 (0%)	11 (0.01%)		1.0
Transfusion	7 (10.9%)	651 (2.7%)	4.45 (2.02– 9.79)	<b>&lt; 0.001</b>
Uterine rupture	0 (0%)	181 (0.7%)		1.0
CI: confidence interval				
BMI: body mass index				
ART: assisted reproductive treatment				
IUI: in utero insemination				
GCT: glucose challenge test				
LMWH: low molecular weight heparin				
Hb: hemoglobin				
PLT: platelets				
DIC: disseminated intravascular coagulation				

Multivariate analysis of the risk factors associated with relaparotomy following cesarean is presented in Table 2. Placenta previa (OR 10.24, 95%CI 2.96–35.66) and cesarean deliveries performed at the second stage of delivery (OR 5.28, 95%CI 2.45–11.35) were found to be independent risk factors for relaparotomy.

Table 2  
Multivariate analysis of factors associated with relaparotomy (rate = 0.3%)

Variable	Prevalence of risk factor	Relaparotomy rate	aOR (95% CI)	P value
Prepregnancy BMI			0.90 (0.83–0.97)	0.010
Weight gain			1.01 (0.96–1.06)	0.658
Assisted reproduction	16.9%	0.6%	1.83 (0.94–3.59)	0.074
Twins	10.1%	0.8%	4.30 (1.88–9.83)	0.001
Hypertensive disorders	7.1%	0.7%	2.45 (1.06–5.68)	0.036
Gestational age			1.02 (0.88–1.18)	0.772
Placenta previa	1.3%	1.6%	10.24 (2.96–35.66)	< 0.001
Second stage cesarean	5.7%	0.7%	5.28 (2.45–11.35)	< 0.001
CI: confidence interval				
BMI: body mass index				

Table 3 presents the characteristics of the relaparotomy surgery. In 78% of the patients active bleeding was found, and nearly half received blood products, 12.5% developed consumptive coagulopathy, and 17% needed intensive care. There were no cases of maternal death.



Table 3  
Characteristics of relaparotomies following cesarean deliveries:

Characteristic	Relaparotomy n = 64
	Median [IQR] Average
Maternal age, years	34 [30–39] (35)
Prepregnancy BMI	21.5 [19.5–25.4] (22.4)
Predelivery BMI	28.3 [24.3–31.2] (28.7)
Weight gain, kg	15 [10–20] (15)
Gravidity	2 [1–3] (2)
Parity	0 [0–1] (1)
Cesarean deliveries	0 [0–1] (0)
Gestational age, weeks	38 <sup>0/7</sup> [35 <sup>4/7</sup> -39 <sup>6/7</sup> ] (37 <sup>3/7</sup> )
Cesarean duration, minutes	40 [26–55] (46)
Transfusion during cesarean delivery	5 (8.0%)
Birthweight	2,821 [2,303-3,485] (2,815)
Second stage duration, min.	133 [57–240] (140)
Hb	11.6 [11.2–12.4] (11.7)
PLT	196 [155–227] (195)
Fibrinogen	418 [370–457] (412)
Hours to laparotomy	14 [9–27] (37)

Characteristic	Relaparotomy n = 64
	Median [IQR] Average
Cesarean events	25 (39.1%)
Any	9 (14.1%)
Hysterotomy extension	9 (14.1%)
Marked adhesions	3 (4.7%)
Difficult fetus extraction	1 (1.6%)
Classical incision	2 (3.1%)
T incision	3 (4.7%)
Myomectomy	1 (1.6%)
Broad ligament hematoma	1 (1.6%)
Atony	1 (1.6%)
Rectus muscle incision	

Four patients (6.3%) underwent a second relaparotomy, mainly due to bleeding complications.

## Discussion:

The present study showed an increased risk of relaparotomy following CD in twin gestations, pregnancies complicated by hypertensive disease or placenta previa and following urgent CS, and following CD in the second stage of delivery. There was no difference in the rate of relaparotomy between different hours of the day.

We excluded surgeries with placenta accreta because these operations are prone to bleeding complications and relaparotomy, and our goal was to analyze the more common CD's. The rate of 0.26% of laparotomy following delivery reported in our study resembles the incidence of 0.2–1.04% relaparotomies, previously reported<sup>2–5,10–16</sup>.

As described in previous studies, pregnancies with placenta previa are scheduled for operations earlier than other elective CD, which may explain the significantly lower birthweight and lower gestational age in the relaparotomy group for this indication<sup>4,5</sup>. Pregnancies with placenta previa are prone to bleeding from the placental bed, and difficulties to control bleeding from the isthmus and upper cervical part<sup>17,18</sup>, leading to the significant risk for relaparotomy found in our study. In this study, multiple pregnancies were associated with increased risk of relaparotomy. The difficulty to adequately control bleeding in over-distended uterus may explain the increased risk of uterine atony and bleeding<sup>3,19</sup>. Late preterm delivery of multiple pregnancy is common and this explains the earlier gestational age and the lower birthweight

found in the relaparotomy group following twins CD<sup>19</sup>. Since ART may result in higher rates of multiple pregnancies, this may explain the statistically significant association between ART and relaparotomy found in the univariate analysis.

Although obesity is associated with technically difficult CD, along with postpartum complications such as wound rupture<sup>20</sup>, we did not find a significant risk for relaparotomy in overweight patients. Furthermore, BMI was significantly lower in the relaparotomy group.

Several studies reported an association between fetal gender and different complications of pregnancy<sup>21</sup>, including increased risk of relaparotomy in pregnancies with female fetuses<sup>2</sup>. Nevertheless, we did not find any correlation between relaparotomy and fetal gender.

Similar to previous studies<sup>1,5</sup>, we found that hypertensive diseases of pregnancy were associated with a significant risk of relaparotomy. Ahmed et al found that the most common comorbidity in patients with relaparotomy was hypertensive disorders<sup>22</sup>. It has been suggested that the main reason for this association is the coagulation disorders that may complicate severe hypertensive disorders<sup>23-25</sup>.

There are controversial reports regarding the association between previous CD to elevated risk of relaparotomy. Several studies reported an association between a history of previous CD and relaparotomy following a repeat CD<sup>1,5</sup> while others did not find such an association<sup>3</sup>. We did not find such an association, nor between the interval between the CD's and relaparotomy.

Previous studies reported that increased operative time increases the risk of relaparotomy<sup>2,3</sup>. Contrary to that, we did not find such an association. Indeed, Rottenstreich et al reported that in repeated CD, prolonged operative time (defined as longer than the 90th percentile for each specific surgeon) is associated with adverse maternal complications such as post-operative blood transfusion, prolonged hospitalization, infections, and readmission, but they did not describe an association to relaparotomy<sup>26</sup>.

Previous studies reported increased risk of relaparotomy following emergent CD<sup>10,11</sup>. These studies defined emergent CD as the non-elective CD. In the present study we divided the non-elective CD to emergent CD, and to urgent CD that included cases with immediate life threatening risk to the mother or the fetus. As expected, elective CD were significantly associated with lower risk of relaparotomy. However, there was no increased risk of relaparotomy following emergent CD, such as patients that were operated prior to a scheduled CD, but with no immediate risk of fetal or maternal compromise. We did find a significant increased risk in relaparotomy after urgent CD, with a 2-fold increase in the rate of relaparotomy in urgent CD performed during the second stage of labor. The duration of the second stage did not influence the risk of relaparotomy.

The median time of relaparotomies was 14 hour from delivery. Similar to that, Ashwal et al reported that the rate of relaparotomies during the first 24 h, first week and beyond it, following CD was 64.5, 22.6 and 12.9 %, respectively<sup>10</sup>. Kessous et al also reported that most women (51.2%) underwent relaparotomy

during the first 24 h after CD <sup>5</sup> and Akkurt et al described a mean interval between CD and relaparotomy of 15.7+/-3.2 hours <sup>1</sup>. Patients with risk factors for relaparotomy should be carefully monitored during the first 24 hours following CD.

The leading cause of laparotomy following delivery in our study was bleeding. Similarly, most studies reported that the leading indication for relaparotomy were postpartum hemorrhage leading to hemodynamic shock <sup>1-5,10-15,27</sup>. The etiology of hemorrhage was bleeding from uterine atony, bleeding from placental bed after operation for placenta previa, hemorrhage due to myomectomy performed during CD and hemorrhage from anterior abdominal wound dehiscence<sup>13</sup>. Other findings during relaparotomy included organ damage and foreign body, similar to cases reported before <sup>2,14</sup>

Interestingly, in 12.5% of the cases there were no intraabdominal findings during relaparotomy. A previous report has found no findings in 60.7% of the patients <sup>2</sup>.

Laparotomy following delivery increases the risk of maternal morbidity due to bleeding, coagulation disorders, requirement of blood products, infections; increases hospitalization days and creates a burden to the medical system. The most catastrophic complication is maternal death with previous reports ranging from 0 to 12% <sup>4,11-15,20,28</sup>. In our study, 12.5% developed disseminated intravascular coagulation and 17.2% of our patients were admitted to the intensive care unit. Fortunately, there were no cases of maternal mortality.

A third laparotomy was needed in 6.25% of our patients, lower than the 19.6% reported by Seal et al <sup>11</sup>. Most cases both in our study and in previous studies were due to intraabdominal hemorrhage.

We acknowledge several limitations in our study. Our medical center is a tertiary referral hospital resulting in an increased rate of high risk pregnancies. Thus our results may not represent the numbers in most delivery wards. In order to overcome part of this limitation we excluded pregnancies with placenta accrete. The large number of CDs over many years in the present study results in a more accurate perspective regarding the risk factors and the characteristics of relaparotomies following CDs.

## **Conclusions:**

Relaparotomy following CD is a rare but a significant event. Recognizing the risk factors associated with this complication may be useful for identifying women at risk for relaparotomy and thus to allow for preventive measures to be taken during the surgery, as well as during the post-surgery follow-up.

## **Declarations**

## **Ethical approval:**

The study was approved by the IRB board of the Chaim Sheba Medical center No. 7223-20-SMC.

## Funding details:

No funding was given for this study.

## Conflict of interest statement:

All of the authors have made substantial contributions to the concept, data interpretation, drafting or critical revision of the manuscript for intellectual content and have approved the final version. There are no conflicts of interest for the authors.

## Informed consent:

Due to the retrospective nature of this study the approval was given from the IRB not to receive informed consent from the patients. Patients names and ID numbers were coded.

## Authors' contribution:

Weissmann-Brenner Alina: conception, planning, carrying out, analysing and writing

Barzilay Eran: conception, planning, carrying out, analysing and writing

Meyer Raanan: carrying out, analysing

Levin Gabriel: carrying out, analysing

Harmatz Danielle: carrying out

Alakeli Amal: carrying out

Domniz Noam: carrying out

Yoles Israel: conception

## Data availability statement:

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

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