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ORIGINAL PAPER

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Outcomes and Complications After Repeat Cesarean Sections Among King Abdulaziz University Hospital Patients

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ABSTRACT

Introduction: Cesarean section (CS) is a surgical procedure that often saves the lives of both the mother and the baby, while a previous CS is one of the main indications for cesarean delivery in current pregnancy. **Aim:** Our aim was to determine the surgical and obstetrical outcomes and complication for the mother and the neonate after 4 or more CSs and compare it with mothers who had less than 4 previous CSs. **Methods:** This case-control study was conducted by reviewing the records of all women who underwent multiple CSs from 2013 to 2018. Our study group comprised of 394 women who had 4 or more CSs, and our control group comprised of similar number of women who had previous history of two or three CSs. **Results:** A total of 788 patients were enrolled in our study. We found that adhesions were the most common complications in our study group with a considerable increase in number of both moderate and severe adhesions in the study group compared to the controls with p-value of <0.001. **Conclusion:** Increasing number of CSs leads to an increase of the complications risk. Among the complications, adhesions were the most common in our study group, followed by intraoperative bleeding.

Keywords: multiple Cesarean sections, outcome, complication, adhesions.

sia, hemolysis, elevated liver enzyme levels, low platelet levels syndrome, and others (2,3). Locally, in Saudi Arabia (SA), where families are encouraged socially and culturally to have many children, it is common to see pregnant women preparing to have the sixth or seventh CS (4).

The CS rate has increased substantially over the past few years due to older maternal age, defensive obstetric practice, maternal request for a CS, and medico-legal concerns (5). According to the American Center for Disease Control and Prevention, the cesarean delivery rate was 20.7% in 1995 in the United States (US) which substantially increased to 31.9% in 2016 (6). In addition, there was a study conducted at the King Chulalongkorn Memorial Hospital, Thailand showing that the number of CSs performed has dramatically increased in several countries over the past ten years, they reported that the CS rate has increased from 34.4% in 2003 to 46.5% in 2011 (7). According to the Turkish Demographic and Health Survey, the CS rate in 1993 was 8% and later increased to 37% in 2008, as reported by other studies (8). Meanwhile, in SA, various statistics reports described an 80% rise in overall CS rate from 1997 to 2006 (9).

Several previous studies tried to determine if there was a rise in the complication rate for patients who underwent multiple previous CSs. A systematic review in 2010 aimed to study the relation between the increasing number of cesarean deliveries and maternal morbidity. The review found that the numbers of surgical injuries, rate of blood transfusions, and adhesion formation, all increased with the growing number of CSs. Additionally, the number of hysterectomies was found to be rising with the

1. INTRODUCTION

Cesarean section (CS) is a surgical procedure that often saves the lives of both the mother and the baby (1). A previous CS is one of the main indications for cesarean delivery in the current pregnancy. Other indications include cephalopelvic disproportion, placenta previa, eclamp-

repeated CSs in all studies (10). A cohort study in the US published in 2006, with a sample size of 30,132, compared the maternal outcome and surgical complications of patients who had more than one CS with a control group who had only one CS and they found an association between the increased number of CSs and complications (11). Conversely, in Finland in 2004, the results of a case-control study of a sample size of 64 respondents concluded that there was no difference in the incidence of pregnancy-associated complications, such as gestational diabetes, antepartum fetal distress, pre-eclampsia, preterm delivery, and intrahepatic cholestasis of pregnancy between the CS group and the control group (2). Another retrospective review in 2017 in Turkey compared the obstetric outcomes in 1318 women, between a group of 244 women with four or more previous CSs and a group of 1074 women with two or three previous CSs; adhesion incidence, number of blood transfusions, surgery duration, and the duration of hospital stay were significantly higher in women with two or three previous CSs. Conversely, there was no difference in the rates of cesarean hysterectomy, placenta previa, abnormal placental invasion, uterine rupture, bladder, and bowel injury (5). Two similar studies were conducted in SA; the first one was performed in Riyadh in 1996 with a study group consisting of 395 patients who had two or more previous CSs prior to the current pregnancy, and who were being managed at King Khalid University Hospital over the study period 1989–1993. It showed that undergoing four or more previous CSs was significantly associated with dense adhesions (12). The second study was performed in Jeddah in 2004 where patients were assigned to groups based on the number of CSs they had undergone. It showed that the third CS does not define a threshold for increased risk to the mother. Instead, overall morbidity rises continually with each successive CS (13).

Although CSs have many indications and benefits, multiple CSs can lead to serious complications (14). However, according to the literature, little is known about the exact complications from having multiple CSs in our region.

2. AIM

Our aim was to determine the surgical and obstetric outcomes and complication for the mother and the neonate after 4 or more CSs and compare it with mothers who have less than 4 previous CSs.

3. METHODS

3.1 Study Design and Setting

This retrospective case-control study was conducted by reviewing the records of all women who underwent multiple CSs from June 2013 to June 2018 at KAUH, Jeddah, in the western region of SA. KAUH is a tertiary referral hospital and employs a teams of professionals with distinct medical qualifications, such as consultants, physicians, and technicians in many specialties with international expertise. Additionally, it has 845 beds with 157 beds dedicated to intensive care.

3.2 Participants

In this study, we aimed to compare the complications between the study group (n=394), who had 4 or more CSs, and the control group (n=394), which was formed by select-

ing the next women who had delivery by CS, with a history of fewer than four CSs, after each one from the study group. Those women with a history of a single CS were excluded from our control group, as they represent a unique subgroup with respect to maternal and neonatal complications.

Inclusion and exclusion criteria

All women who met the criteria of the study group (having 4 or more CSs) were included in our study. For the control group all women who had delivery by CS, with a history of fewer than four CSs, after each one from the study group were included in our study without any exclusion.

3.3 Data Collection

The data was collected from the electronic documentation system used at KAUH (phoenix system), and it was categorized into four sections: (1) demographic data (maternal age, body height [cm], body weight [kg], parity, gravidity, and nationality); (2) clinical features (previous abortion, gestational diabetes mellitus (GDM), placenta previa, pre-eclampsia, intrauterine fetal death (IUFD), twin pregnancy, neonate large for gestational age, neonate small for gestational age, oligohydramnios, polyhydramnios, placenta abruption, ectopic pregnancy, premature rupture of membranes, puerperal pyrexia [fever], vasa previa); (3) surgery details (gestational age [GA] at delivery, the total duration of the surgery [in min], mode of CS, type of anesthesia and the type of incision); (4) intraoperative and post-operative complications (adhesion, neonatal intensive care unit (NICU) admission, fetal deaths, blood loss during surgery (> 1000 mL), blood transfusion, uterine scar dehiscence, placenta accreta, cesarean hysterectomy, maternal ICU admission, maternal deaths, complete or incomplete rupture of scar, bladder injury, post-partum hemorrhage, uterine rupture, bowel injury, wound infection, urinary tract infection, and chest infection).

3.4 Confidentiality and ethical approval

Ethical approval was obtained from the Institutional Review Board of KAUH. Access to data was available only to the principal investigator. To ensure the privacy and confidentiality of participants, all identifying variables have been removed.

3.5 Data Analysis

Regarding data analysis, data were coded, checked, and entered into the Statistical Package for the Social Sciences version 22 (IBM Corp., Armonk, NY). Categorical variables, including nationality, clinical features, mode of CS, type of anesthesia, type of incision, and complications were described using frequencies. Continuous variables, including maternal age, body height, body weight, parity, gravidity, GA at delivery (in weeks), and the total duration of the surgery (in min) were described using mean and standard deviation (SD). Chi-Square and independent t-tests were used to assess the association between the variables of the study and control groups. For all statistical tests, p-values ≤ 0.05 were considered significant.

4. RESULTS

At KAUH hospital, 9094 women gave birth from June 2013 to June 2018. Out of those, 3312 (36.42%) deliveries were completed by CS. Of all the women who gave birth

by CS, 394 (11.90%) had 4 or more CSs and were chosen to be our study group. Women who had 4 CSs comprised the majority of the patients in our study group (250 - 63.45%), while mothers with larger number of CSs had 5,6,7 and 8 CSs (28.16%, 6,1% 1.52% and 0.76% respectively). We also selected 394 patients, who had 2 or 3 CSs as a control group, making the total sample size of patients enrolled in our study 788.

The demographic data of our sample showed that the mean age of the study group was 36 ± 4.57 (SD) years, which was significantly higher, compared to the age of the controls, which was 34 ± 4.89 years; the mean body height of the respondents in study group was 165.38 ± 7.41 cm and for the controls it was 156.13 ± 7.01 cm; the mean body weight of the respondents in the study group was 80.60 ± 16.71 kg and the body weight of the controls was 77.46 ± 17.05 kg. Most of the patients in the study and control groups were Saudis with 282 (71.6%) and non-Saudi 265 (67.3%), respectively. Other demographic data are presented in Table 1.

Comparing the history of the clinical courses between the study group and the control group, the rates of placenta previa, IUFD, and GDM were significantly higher in the study group with a p-value of <0.001 , <0.001 , and 0.029, respectively. No other significant differences were observed between the two groups. Other clinical features are presented in Table 1.

Surgery details were compared between the two groups; the mean GA of delivery was significantly lower in the study group compared to the control group with a p-value of <0.001 . There was an increase in the total duration of the surgery in the study group compared with the controls with a p-value of <0.001 . There was a difference in the type of anesthesia used within the study group; more general anesthesia was used compared to the controls with a p-value of 0.010. Details of the surgeries are shown in Table 2.

Regarding intraoperative and post-operative complications, we found a considerable rise in both moderate and severe adhesions in the study group compared to the controls with both of them having a p-value of <0.001 . Additionally, comparison between the cases and the controls showed an increase in both blood loss during surgery (>1000 mL) and blood transfusion in the case group. In addition, placenta accreta and cesarean hysterectomy as obstetric complications, and maternal ICU and NICU admissions were all significantly increased in the study group. No differences were observed between the study and control groups with respect to bowel injury, wound infection, and incomplete rupture of the scar. Other intraoperative and post-operative complications are presented in Table 3.

5. DISCUSSION

CS, in general, is considered to be a safe procedure (12), but the risk of complications should not be overlooked and must be reviewed with caution, especially for patients who have had multiple CSs. This retrospective case-control study aimed to identify the risk of complications with multiple CSs. Our results demonstrated a significant increase in severe adhesions, bleeding during the surgery, GDM, placenta previa, placenta accreta, and cesarean hysterectomy in the study group.

Variable	study group (n=394)	Control group (n=394)	P-value
Maternal age (years)	36 ± 4.57	34 ± 4.89	<0.001
Body height (cm)	165.38 ± 7.41	156.13 ± 7.01	.631
Body weight (kg)	80.60 ± 16.71	77.46 ± 17.05	.009
Gravida	5.68 ± 1.81	4.60 ± 2.27	<0.001
Para	4.81 ± 1.15	3.62 ± 1.67	<0.001
Nationality			
Saudi	282 (71.6%)	265 (67.3%)	.216
Non-Saudi	112 (28.4%)	129 (32.7%)	
Clinical Features			
Abortion	161 (40.9%)	150 (38.1%)	.466
GDM	106 (26.9%)	79 (20.1%)	.029
Placenta previa	40 (10.2%)	14 (3.6%)	<0.001
Pre-eclampsia	31 (7.9%)	32 (8.1%)	1.000
Intrauterine fetal death (IUFD)	26 (6.6%)	5 (1.3%)	<0.001
Twin	20 (5.1%)	20 (5.1%)	1.000
Baby large for GA	15 (3.8%)	22 (5.6%)	.312
Baby small for GA	15 (3.8%)	13 (3.3%)	.847
Oligohydramnios	10 (2.5%)	15 (3.8%)	.416
Polyhydramnios	9 (2.3%)	9 (2.3%)	1.000
Abruptio placenta	8 (2.0%)	7 (1.8%)	1.000
Ectopic pregnancy	8 (2.0%)	6 (1.5%)	.787
PROM	7 (1.8%)	10 (2.5%)	.624
Puerperal pyrexia (fever)	2 (0.5%)	2 (0.5%)	1.000
Vasa previa	1 (0.3%)	0 (0.0%)	1.000

Table 1. Demographic Characteristics of the Study and Control Groups (n=788). Values are presented as mean \pm SD or n (%)

The demographic data of our sample, as expected, showed an increase in maternal age, with the increase in number of cesarean deliveries. The mean maternal age of our study group was considerably higher when compared to other studies. A study that was done by Biler in Turkey found the mean maternal age of 32 ± 4.60 years (5) and a retrospective study conducted at King Khalid University, Abha, SA found the mean maternal age of the study group of 31.8 ± 4.7 years (4). However, a study conducted by Rashid at the Security Forces Hospital in Riyadh showed that the mean maternal age was 35 ± 4 years, which was very similar to our study group (15). In addition, the mean body height and weight of the study group were 165.38 ± 7.41 cm and 80.60 ± 16.71 kg, respectively, which were both higher than the mean body height 152 ± 18 and weight 78 ± 15.0 in Rashid's study (15). The mean number of parity of the study group was significantly higher than among the controls with a p-value < 0.001 .

Regarding obstetrical history, placenta previa is a critical obstetrical condition. It accounts for nearly 20% of maternal mortality due to hemorrhage (16). We found that the placenta previa prevalence was almost three-fold higher in the study group (40, 10.2%), compared to the control group

Variable	Study group (n=394)	Control group (n=394)	P-value
GA of delivery (in weeks)	37.09 ± 2.25	37.81 ± 2.10	<0.001
The total duration of the operation (in min)	75.195 ± 25.9976	68.274 ± 22.7590	<0.001
Mode of CS			
Emergence	239 (60.7%)	255 (64.7%)	.269
Elective	155 (39.3%)	139 (35.3%)	
Type of anesthesia			
Regional	300 (76.1%)	330 (83.8%)	.010
General	94 (23.9%)	64 (16.2%)	
Type of incision			
Pfannenstiel incision	383 (97.2%)	390 (99.0%)	.118
Medline vertical incision	11 (2.8%)	4 (1.0%)	

Table 2. Surgery Details of the Study and Control Groups (n=788). Values are presented as mean ± SD or n (%)

Variable	Study group (n=394)	Control group (n=394)	P-value
Adhesion	316 (80.2%)	181 (45.9%)	<0.001
Mild adhesion	105 (26.6%)	115 (29.2%)	.475
Moderate adhesion	103 (26.1%)	42 (10.7%)	<0.001
Sever adhesion	108 (27.4%)	24 (6.1%)	<0.001
Fetal NICU admission	35 (8.9%)	20 (5.1%)	.050
Blood loss during surgery (>1000 mL)	24 (6.1%)	9 (2.3%)	.013
Blood transfusion	22 (5.6%)	8 (2.0%)	.016
Uterine scar dehiscence	16 (4.1%)	23 (5.8%)	.324
Placenta accrete	15 (3.8%)	1 (0.3%)	.001
Cesarean hysterectomy	13 (3.3%)	2 (0.5%)	.004
Maternal ICU admission	10 (2.5%)	1 (0.3%)	.015
Complete rupture of scar	7 (1.8%)	15 (3.8%)	.130
Bladder injury	5 (1.3%)	2 (0.5%)	.448
Post-partum hemorrhage	4 (1.0%)	2 (0.5%)	.682
Uterine rupture	3 (0.8%)	0 (0.0%)	.247
Bowel injury	3 (0.8%)	3 (0.8%)	1.000
Wound infection	2 (0.5%)	1 (0.3%)	1.000
Incomplete rupture of scar	1 (0.3%)	0 (0.0%)	1.000

Table 3. Intra-operative and Post-operative complications of the study and control groups (n = 788).. Values are presented as n (%)

(14, 3.6%). This result correlates well with previous studies as many of them showed the relation between abnormal placentation and previous CS. In a study done over a 10-year-period in 2009, the incidence of placenta previa was found to be 1.86% after the first CS, 5.49% after the second CS, and 14.28% after the third CS (17). A systematic review in 2010 reported similar findings; previous CS was a statistically significant risk factor for placenta previa and the rate of placenta previa increased with every CS. In the review, placenta previa prevalence was 0.8–1.5% in women with one previous CS and 1.1–2.0% in women with two previous CSs, compared with women without a previous CS. Five studies in the review identified women with more than three previous CSs, and all the studies observed a statistically significant increase in the rate of placenta previa with the

increasing number of previous CSs (10). Furthermore, in our study, we found that GDM was significantly higher in our study group with a p-value of 0.029, which is contrary to the findings of a study done in Turkey and another study done in Finland (8,2), where there was no significant association between GDM and number of previous CSs. IUFD is another major complication which accounts for 27,000 stillbirths in the US (18). In our study, we found that the prevalence of IUFD was 6.6% of cases in the study group and only 3.3% of cases in the control group, which was a significant increase in the study group with a p-value ≤ 0.001. The most common previous obstetrical condition in our study and control groups was abortion, with a percentage of 40.9% and 38.1%, respectively.

Surgery details were compared between the two groups; the mean GA of our study group (37.09±2.25) was significantly lower than the control group (37.81±2.10) and consistent with a study in Turkey in 2010, where the mean GA of women with 4 or 5 CSs was 36.61±1.62, and for women with 2 or 3 CSs was 37.84±1.56 (14). Additionally, a study in the US in 2006 found that, with the increased number of CSs, GA significantly decreased (11). Other publications showed no difference in the GA at delivery among the women who had different numbers of CSs (5,8). Moreover, we found that the increase in total duration of the surgery duration was 75.195±25.99 minutes in the study group, which was higher than that of an Israeli study in Zerifin where the total duration of the surgery was 21.2±6.1 minutes (19). Similarly, it was considerably shorter when compared to a developing country like Nigeria, where a study reported that the total duration of the surgery was 93.97 ± 15.92 minutes (20). The primary cause for the increase in the surgery duration was difficulties experienced with dissection of the abdominal wall and separation of the bladder from the lower uterine segment due to severe adhesions that resulted from repeat CSs. Our analysis for types of incision data showed that the Pfannenstiel incision was used in the vast majority of the cases for both the study group (97.2%) and the controls (99.0%). No statistically significant difference was found between the groups regarding types of incision, similar to the observation of the cohort study conducted at the King Chulalongkorn Memorial Hospital, Bangkok, Thailand (7). In addition, we found a significant difference in the type of anesthesia that had been used between our study group and the control group. In the study group, less general anesthesia was used (23.9%) when compared to a Finnish study’s use of general anesthesia (25%) (21). Conversely, we found that the prevalence of regional anesthesia that had been used in the study group was higher (76.1%) when compared to the prevalence used in the same Finnish study (75%) (21). These differences are due to the fact that most of the patients prefer general anesthesia because they are afraid of regional anesthesia, such as spinal anesthesia.

Adhesions are fibrous, band-like structures that form intra-abdominally and are very common surgical sequelae. It is estimated that 51% of patients will develop adhesions after obstetrical and gynecological surgery (22,23). In our analysis of intraoperative and post-operative complications, adhesion formation was of statistical significance; 80% (316 cases) of the women with four or more CSs had ad-

hesions of all degrees. This finding was also demonstrated in the control group (45%, 181 cases). To further clarify, the numbers of the mild adhesions were similar in both the study and the control groups while the difference in moderate and severe adhesions was quite evident between the study and control groups. Similarly, previous studies showed statistical significance of adhesions; a Canadian retrospective cohort study described an increase in adhesion formation with each subsequent cesarean delivery in 1283 women with repeat CS. In the same Canadian study, adhesions were not observed in women with a first CS but were found in the second (24.4%), third (42.8%), and fourth (47.9%) CS (24). We assume that adhesions worsen with increasing numbers of cesarean deliveries and previous pelvic or bowel surgery, in addition to a genetic variation of being prone to developing adhesions, which plays a major role in the process.

We also found a significant increase in patients experiencing both blood loss during surgery (> 1000 mL) and blood transfusion in the study group, which were 24 (6.1%) and 22 (5.6%), respectively. That is considered low when compared to a Saudi study in Riyadh where number of patients experiencing blood loss during surgery (>1000 mL) and blood transfusion in the study group were 24 (8%) and 44 (14%), respectively (14,15). Similarly, it is still low when compared to another Saudi study in Riyadh where blood loss during surgery (>1000 mL) and blood transfusion in the study group were observed in 12 (8%) and 22 (14.6%) patients, respectively (25). We believe that these variances are associated with the ability of pregnant women to tolerate blood loss at the time of delivery and are dependent on the hemoglobin level, the blood volume, the volume of blood loss, any associated coexisting disease, and complications. Moreover, accurate estimation of blood loss at the time of CS delivery is essential in transfusion practice. Additionally, as an obstetrical complication, we found a significant increase in both placenta accreta and cesarean hysterectomy in the study group, which were 15 (3.8%) and 13 (3.3%), respectively. Abnormal placentation other than placenta previa and placental abruption is considered higher when compared to a Turkish study in Istanbul, in which it was reported as 3 (2.4%). For cesarean hysterectomy, it is lower when compared to the same Turkish study which reported it as 5 (4.09%) (14). Additionally, there was a study done in the US stating that women having 4 or more CSs had a 9 to 30 fold increased risk of placenta accreta (11). Notably, placenta accreta is the second most common indication for an emergency peripartum hysterectomy (26). Correspondingly, there is a high suspicion of placenta accreta in patients with placenta previa and after a previous CS.

Regarding ICU admissions, we found that the maternal ICU and NICU admissions rates increased with the increased CS number, which demonstrates the risk of multiple CSs on both maternal and neonatal lives. This is consistent with what has been found in some publications (11). Complications of non-statistical significance, such as bowel injury (3 cases) and bladder injury (5 cases) were present in a few cases, which was consistent with previous studies such as the case-control study done in Istanbul, Turkey in 2010 (14). We hypothesized that the decline in the numbers of

these complications was due to the development of the techniques used in cesarean delivery and the improvement in the training of the obstetricians.

6. CONCLUSION

Increasing the number of CSs leads to an increase in the risk of the intraoperative and post-operative complications. Adhesions were the most common complications in our study group followed by intraoperative bleeding. Furthermore, maternal and NICU admission risk increases with multiple CSs.

In order to determine the limited number of CSs, we recommend conducting further research aiming to identify the threshold of the number of CSs with minimal complications.

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