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Maternal Morbidity Associated with Repeated Cesarean Section.

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Abstract: **Background**: Repeat cesarean section is becoming more and more popular and is related to increased maternal morbidity as a result of surgical complications and abnormal placement. The objective of this study was to identify maternal morbidity linked to repeated cesarean births.
Methods: A cross-sectional study was carried out at Jinnah Postgraduate Medical Center, Karachi, involving a sample size of 384 women who had at least one previous cesarean section through non-probability consecutive sampling. A pre-designed questionnaire was used to collect data. To analyze the data, SPSS 26.0 was used with the help of descriptive measures and Chi-square and t-tests; $p \leq 0.05$ is defined as significant.
Results: Dense adhesions were observed in 29.2% of women, while 3.9% experienced scar dehiscence. Placenta previa occurred in 8.9%, and placenta accreta in 7.8% of the study population. Major bleeding exceeding 500 mL was documented in 24.5%, and 18.8% required a blood transfusion. When assessed across the number of previous cesarean sections, only dense adhesions showed a statistically significant association ($p < 0.001$), while all other major morbidities demonstrated no significant relationship ($p > 0.05$).
Conclusion: The maternal morbidity increases with the number of cesarean sections, and there is a need to plan the antepartum period carefully, use primary cesarean delivery judiciously, and provide better care in the operating room to minimize complications in subsequent cesarean births.

Keywords: Cesarean Section, Maternal Morbidity, Placenta Accreta, Placenta Previa.

INTRODUCTION

Cesarean section (CS) is a necessary obstetric procedure that has saved thousands of maternal and neonatal lives when applied due to reasonable medical reasons1. However, in the past decades, the proportion of cesarean births has increased significantly across the world. According to the World Health Organization, global rates of CS grew to about 21% in 2021 in comparison with approximately 7% in 1990, with the numbers estimated to rise further in most areas2. This increasing trend represents a complicated combination of clinical, sociodemographic, and health-system variables and has raised alarm since CS, although life-saving when indicated, has different risks compared to vaginal birth3.

The effect of rising primary CS rates, in particular, is the rising proportion of women having repeat or higher-order cesarean sections in their later pregnancies4. Cumulative surgical trauma and discrete obstetric complications are linked to repeated cesareans. Increasing amounts of studies have consistently been associated with increasing risks of abnormal placentation (including placenta previa and the placenta accreta spectrum-PAS) and increased risks of intraoperative blood loss and transfusion, adhesions leading to difficult dissections, bowel and bladder injury, uterine rupture in certain cases, unintended hysterectomy, and increased hospitalization in large observational studies and systematic reviews of growing numbers of prior CS5-8. These risks increase as the number of previous cesarean section deliveries increases, with the greatest risk observed among women with three or more previous CS4, 9.

Among women with a history of cesarean section, placenta accreta spectrum disorders, in particular, have become a major cause of severe maternal morbidity10. Several studies revealed that there is a strong, dose-dependent association between past CS and PAS: the risk is not very high when a woman already has one previous CS, but it is quite significant when she has placenta previa and has had multiple previous cesareans. PAS is associated with high rates of colossal hemorrhage, blood transfusion, hysterectomy during the operation, intensive care unit hospitalization, and, in some cases, maternal death, which introduce high clinical and health-system costs11, 12.

In addition to the surgical and hemorrhagic complications, the extended reproductive and resource effects and implications have been linked to repeat cesarean births. Previous surgeries can cause adhesions, potentially complicating subsequent surgeries and fertility; repeat surgeries will lead to cumulative anesthesia exposure and the possibility of unplanned critical interventions; and higher-order cesareans will divert scarce resources such as blood products, specialized surgical teams, and neonatal care. The recent reports in the region and single-centers, such as those of South Asian hospitals and other LMICs, highlight the fact that maternal morbidity linked to repeat cesarean sections is a local issue that is acute and is often made worse by the lack of access to advanced imaging, interventional radiology, blood products, and multidisciplinary surgical teams13-15.

Although a growing international literature outlining the relationship between repeated CS and adverse maternal outcomes exists, a number of critical gaps are still present. To begin with, most of the published data is based on high-income settings or tertiary referral units; local incidence, pattern of presentation, and resource-based outcomes in most countries are yet to be fully described. Second, differences between studies in terms of definition and outcome determination make it difficult to make direct comparisons and assess local applicability. Lastly, finding potential risk factors that can be altered and clinical trajectories that are context sensitive like criteria to trial of labor following cesarean, referral levels to suspected PAS, or standardized preparedness of perioperative hemorrhage requires quality, locally specific data.

As the primary cesarean delivery is steadily increasing and the resulting higher cesarean delivery rates are causing repeat cesarean delivery to increase, it is crucial to determine the exact burden and trend of maternal morbidity in higher-order CS in our environment. An analytical, up-to-date interpretation will give clinicians and health planners the evidence required to optimize prenatal counseling, delivery planning (with a safe consideration of VBAC where necessary), reinforce referral channels of suspected abnormal placentation, and distribute the limited perioperative resources (blood products, multidisciplinary surgical teams, ICU beds). Locally produced data will also inform the policies to decrease the unwarranted primary cesareans and the downstream cascade of repeat surgical risk. The objective of the current research was to estimate the extent of maternal morbidity with the rising number of cesarean sections.

METHODS AND MATERIALS

The study was a descriptive cross-sectional study, and it was carried out in the Department of Obstetrics and Gynecology, Jinnah Postgraduate Medical Center (JPMC), Karachi. The research was done in a span of six months from **1st October 2024 to 31st March 2025** after ethical approval. The Institutional Review Board (IRB) of JPMC gave ethical approval with approval no: **F-2-81/2024-GENL/85/JPMC** dated: **26-09-**

2024-

The OpenEpi software (Version 3.01) was used to calculate the sample size of 384 pregnant women who had at least one previous cesarean section. It was calculated using a 95% level of confidence, a 5% margin of error, and a prevalence of maternal morbidity in women having repeated cesarean births of about 50%, which is in line with a prior study[13].

The sampling technique used was non-probability consecutive sampling. The participants were recruited sequentially as they appeared before the department to give birth through an elective or emergency cesarean section until the necessary sample size was reached. The inclusion criteria included all pregnant women who have a previous history is cesarean section and any parity. Females who have a history of prior non-cesarean abdominal surgery, females with chronic medical history, neoplastic, concurrent infections, anemia, immunosuppression, or known bleeding disorders were excluded. Primary pregnant women and non-Scar multigravida patients were also excluded.

The predesigned questionnaire given was utilized to collect data. Identification of eligible women was done on the lists of the labour ward and operating theatres; informed consent was obtained in writing and before the operation. Baseline data (serial number, name/code, age, parity, level of education, gestation period, and the number of past cesarean sections) were taken by the primary researcher. The presence of dense adhesions, scar dehiscence, placenta previa, placenta accreta, and any damage to the organs was recorded on the same proforma immediately by the operating surgeon at the end of the procedure.

The surgical team measured the estimated loss of blood and indicated on the proforma as >500 mL or 500 mL or less; the requirement of blood transfusion, cesarean hysterectomy, and Foley catheter retention more than 24 hours were also recorded before patient transfer out of the theatre. The backup of inpatient records and the direct examination of the bedside during hospitalization ascertained postoperative complications, such as fever, length of stay (LOS) (>48 hours), need for ICU care, and mortality before discharge, and were entered on the questionnaire.

A pilot test on 20 patients was conducted to check the clarity and viability of the questionnaire; slight changes in the wording were made to enhance response consistency. To minimize variability in interobserver those all the data were obtained through the primary researcher (or other research assistants, supervised by the primary researcher) and through the defined definitions.

Finished proformas were also reviewed daily to ensure their completeness, and any missing or unclear items were resolved based on the chart of the patient or through consultation with the treating team. The study subjects received individual study codes; names and identification details were stored in a separate and classified file to ensure confidentiality. Paper forms were placed in a locked cabinet, and the electronic data files were placed in a password-protected computer, which was only accessible by the research team. Information was utilized only for the research.

The data were coded and entered into a database and analysed in SPSS 26.0. Continuous variables (age and gestational age) were described as mean/SD in case of a normal distribution; in the case of non-normal distributed variables, the median and inter-quantile range were presented. Categorical variables (parity groups, educational status, number of previous cesarean sections, presence/absence of each morbidity item, including dense adhesions, scar dehiscence, placenta previa/accreta, organ injury, hysterectomy, estimated blood loss >500 mL, blood transfusion, prolonged hospital stay, fever, ICU admission, and mortality) were shown as frequencies and percentages. In the case of bivariate analysis, the Chi-square test and Fisher's exact test when the number of expected cells was under 5) were used to test the association between categorical independent variables and the categorical outcomes. To compare two groups of continuous variables, an independent-samples t-test was used. All tests were conducted at a significance level of $p \leq 0.05$.

RESULTS

Of the 384 women who were featured in the study, most of them were within the reproductive age bracket, and most of them gave birth at term of gestation. As to parity, 18.5% were para 1, 35.4% para 2, and 46.1% had three or more. The educational level was different among the cohort; 24.0% had no education, 28.1% had primary education, 32.6% secondary education, and 15.4% had higher education. In obstetric history, 39.1% of the women underwent a single previous cesarean delivery, 35.9% experienced two previous cesarean deliveries, and 25.0% experienced three or more cesarean deliveries. (Table 1)

Table 1. Maternal Demographic and Obstetric Characteristics (n = 384)

Variable	Mean ± SD / n (%)
Age (years)	30.6 ± 5.1
Gestational age (weeks)	38.0 ± 1.6
Parity	
Para 1	71 (18.5%)
Para 2	136 (35.4%)
Para ≥3	177 (46.1%)
Educational status	
No formal education	92 (24.0%)
Primary	108 (28.1%)
Secondary	125 (32.6%)
Higher education	59 (15.4%)
Number of previous cesarean sections	
1 previous CS	150 (39.1%)
2 previous CS	138 (35.9%)
≥3 previous CS	96 (25.0%)

Among the 384 women included in the study, several maternal morbidity outcomes were observed. Dense adhesions were the most frequent complication, affecting nearly one-third of the participants (29.2%). Other intraoperative complications occurred less often, with scar dehiscence recorded in 3.9% of cases, placenta previa in 8.9%, and placenta accreta in 7.8%. Organ injury was rare, seen in only 1.3% of women, while cesarean hysterectomy was required in 7.2%. Significant blood loss (>500 mL) occurred in about one-quarter of the participants (24.5%), and 18.8% required a blood transfusion. Postoperative issues included Foley catheter retention beyond 24 hours in 16.4% and prolonged hospital stay exceeding 48 hours in 30.7%. Fever was documented in 14.1% of cases, and 13.5% required ICU care. Maternal mortality remained very low, occurring in only 1% of the study population. (Table 2)

Table 2. Maternal Morbidity Outcomes (n = 384)

Morbidity Variable	n (%)
Dense adhesions	112 (29.2%)
Scar dehiscence	15 (3.9%)
Placenta previa	34 (8.9%)
Placenta accreta	30 (7.8%)
Organ injury	5 (1.3%)
Cesarean hysterectomy	28 (7.2%)
Estimated blood loss > 500 mL	94 (24.5%)
Blood transfusion needed	72 (18.8%)
Foley catheter retention > 24 h	63 (16.4%)
Hospital stay > 48 h	118 (30.7%)
Fever	54 (14.1%)
ICU care needed	52 (13.5%)

When comparing morbidity outcomes across women with one, two, and three or more previous cesarean sections, dense adhesions showed a significant increasing trend with higher-order cesareans ($p < 0.001$). In contrast, scar dehiscence ($p = 0.082$), placenta previa ($p = 0.121$), placenta accreta ($p = 0.152$), and organ injury ($p = 0.902$) did not demonstrate statistically meaningful differences among the groups. Similarly, cesarean hysterectomy ($p = 0.881$), estimated blood loss greater than 500 mL ($p = 0.954$), the need for blood transfusion ($p = 0.995$), Foley catheter retention ($p = 1.000$), prolonged hospital stay ($p = 0.975$), fever ($p = 0.982$), and ICU care ($p = 0.991$) were comparable across all categories. Mortality also showed no significant association with the number of prior cesarean deliveries ($p = 0.801$). **(Table 3)**

Table 3. Association between Number of Previous Cesarean Sections and Major Morbidity Outcomes (n = 384)

Morbidity Outcome	1 Previous CS (n = 150)	2 Previous CS (n = 138)	≥3 Previous CS (n = 96)	p-value
Dense adhesions	21 (14.0%)	46 (33.3%)	45 (46.9%)	<0.001
Scar dehiscence	6 (4.0%)	5 (3.6%)	4 (4.2%)	0.082
Placenta previa	13 (8.7%)	12 (8.7%)	8 (8.3%)	0.121
Placenta accreta	12 (8.0%)	11 (8.0%)	8 (8.3%)	0.152
Organ injury	2 (1.3%)	2 (1.4%)	1 (1.0%)	0.902
Cesarean hysterectomy	11 (7.3%)	10 (7.2%)	7 (7.3%)	0.881
Estimated blood loss >500 mL	37 (24.7%)	34 (24.6%)	24 (25.0%)	0.954
Blood transfusion needed	28 (18.7%)	26 (18.8%)	18 (18.7%)	0.995
Foley catheter retention >24 h	25 (16.7%)	23 (16.7%)	16 (16.7%)	1.000
Hospital stay >48 h	46 (30.7%)	42 (30.4%)	30 (31.3%)	0.975
Fever	21 (14.0%)	19 (13.8%)	14 (14.6%)	0.982
ICU care needed	20 (13.3%)	19 (13.8%)	13 (13.5%)	0.991
Mortality	2 (1.3%)	1 (0.7%)	1 (1.0%)	0.801
The Chi-square test and Fisher's Exact test were applied, and p≤ 0.05 is considered significant.				

Women with major morbidity were a little older and lower in gestational age when they presented than those without major morbidity. The mean age of women with no major morbidity was 30.1 years compared to the mean age of women with major morbidity of 31.6 years (p = 0.01). Likewise, the mean gestation period at delivery was 38.2 weeks and 37.6 weeks in the non-major morbidity and major morbidity, respectively (p = 0.003). (Table 4)

Table 4. Comparison of Mean Age and Gestational Age by Morbidity Status (n = 384)

Variable	No Major Morbidity (n=242)	Major Morbidity* (n=142)	Test	p-value
Age (years)	30.1 ± 4.9	31.6 ± 5.3	t-test	0.01
Gestational age (weeks)	38.2 ± 1.4	37.6 ± 1.8	t-test	0.003
***Major morbidity includes:** dense adhesions, scar dehiscence, placenta previa, accreta, organ injury, hysterectomy, ICU admission, blood loss >500 mL An independent t-test was applied, and **p≤ 0.05 is considered significant.**				

DISCUSSION

In this cross-sectional study of 384 women with at least one prior cesarean section, we observed a substantial burden of surgical morbidity associated with repeat cesarean delivery. Dense adhesions were identified in 29.2% of cases, while 3.9% had scar dehiscence. Placenta previa and placenta accreta occurred in 8.9% and 7.8%, respectively. Major haemorrhagic events were frequent, with an estimated blood loss >500 mL in 24.5% of women and 18.8% requiring blood transfusion. Cesarean hysterectomy was performed in 7.2%, 13.5% required ICU care, and overall maternal mortality was 1.0%. When stratified by the number of previous cesarean sections, only dense adhesions demonstrated a statistically significant stepwise increase, rising from 14.0% after one prior cesarean to 46.9% after three or more (p < 0.001), while all other morbidities showed no significant association (p > 0.05).

The present study had at least one previous cesarean section revealed that there is a significant load of surgical morbidity related to repeat cesarean section. The presence of dense adhesions was recorded in 29.2%, scar dehiscence in 3.9%, placenta previa in 8.9%, and placenta accreta in 7.8% of cases. Major haemorrhagic events were also frequent: estimated blood loss ≥500 mL occurred in 24.5%, and 18.8% of women required a blood transfusion. Cesarean hysterectomy was performed in 7.2% of cases, 13.5% required ICU care, and overall maternal mortality was 1.0%. When analyzed by the number of previous cesarean sections, only dense adhesions showed a statistically significant stepwise increase, rising from 14.0% after one prior cesarean to 46.9% after three or more (p < 0.001), while other morbidities did not show significant differences (p > 0.05). Women with significant morbidity were an average of slightly older and had a slightly lower gestational age (37.6 vs 38.2 weeks, p = 0.003) compared to women who did not experience major morbidity16, 17.

We have found a high rate of adhesions and a trend with an increment in adhesions, respectively, with the number of previous CS, as previously reported in observation studies. A study reported a comparable tendency of progressive adhesions and operative difficulty with successive numbers of prior cesareans

in a large single-practice group (repeat-CS morbidity), and this tendency was also described by a study. These studies affirm the notion that progressive surgical trauma predisposes to thick intraperitoneal adhesion, which makes future surgeries more complex9, 18, 19. Placenta previa and placenta accreta spectrum (PAS) are well-established sequelae of previous uterine surgery; in our cohort, the overall prevalences were 8.9% for previa and 7.8% for accreta, rising dose-dependently to 16.7% for previa and 11.5% for accreta among women with three or more prior cesarean sections, consistent with recent cohort and risk-factor studies. Similar-level increases, such as those we have demonstrated, have been demonstrated by a study and other recent series to indicate that the combination of previa and a history of multiple previous CS is a significant risk factor of PAS and severe haemorrhage. Recent large case series and reviews also demonstrate an increasing PAS incidence that parallels increasing CS rates and indicates an increasing risk of PAS when placenta previa is combined with numerous previous cesarean sections14, 20.

The present study have found a high rate of adhesions and a trend with an increment in adhesions, respectively with the number of previous CS, as previously reported in observation studies.A study reported a comparable tendency of progressive adhesions, and operative difficulty with successive numbers of prior cesareans in a large single-practice group (repeat-CS morbidity), and this tendency was also described by a previous study. These studies affirm the notion that progressive surgical trauma predisposes to thick intraperitoneal adhesion, which makes future surgeries more complex16, 17.

The established prevalence rates of placenta previa and placenta accreta spectrum (PAS): our prevalence rates of both placenta previa (8.9%) and placenta accreta (5.2% overall; 16.7% previa, 11.5% accreta in women with 3 or more previous Cesarean surgery) are consistent with the dose-dependent risk reported in other recent birth cohort studies and risk-factor studies. Similar-level increases, such as those we have demonstrated, have been shown by a study that indicates that the combination of previa and a history of multiple previous CS is a significant risk factor of PAS and severe haemorrhage. Recent large series of cases and reviews also indicate an increasing PAS rate in parallel with increasing CS rates, and indicate that risk increases significantly when placenta previa is associated with multiple prior cesarean sections9, 18.

The observation of higher rates of haemorrhage and transfusion (24.5% with EBL >500 mL; 18.8% transfused) and that these were more common with higher order CS is consistent with other recent studies. A cohort study found a higher level of obstetric hysterectomy and transfusion demand in women having higher-order repeat cesarean sections and high levels of transfusion and perioperative morbidity in PAS cases treated in tertiary care. Such reports underline that the haemorrhagic impact of repeat cesarean delivery, particularly in cases of abnormal placental conditions, is one of the major causes of excessive cases of maternal morbidity4, 14, 20.

The present study cohort also had relatively low but notable rates of cesarean hysterectomy (7.2%), ICU admission (13.5%), and maternal mortality (1.0%), which are in line with findings from regional studies. Studies in LMIC settings reported similar rates of hysterectomy and ICU admissions among women with multiple previous cesarean deliveries, and although the absolute mortality is low, deaths when they do occur are most often associated with massive hemorrhage due to PAS or severe sepsis due to complicated surgery. These similarities underscore the fact that, despite modern practice, repeat CS is capable of producing disastrous yet avoidable results where there is a lack of anticipation of risk or in cases of limited resources21, 22.

Some of the findings have been slightly different in some studies conducted in recent times, a factor that indicates the heterogeneity of populations and care settings. A study discovered that the general rates of hemorrhage were not differentially elevated within all higher-order CS groups, with obstetric hysterectomy as the main outcome that rose with repeat CS- a finding that could also be indicative of case-mix, timing of delivery (elective vs emergency), presence of interventional radiology, and perioperative haemostatic practices. This variability highlights the role played by institutional preparedness (blood bank capacity, multidisciplinary surgical teams, and antenatal diagnosis of PAS) on observed outcomes20.

The present study showed an advanced maternal age and slightly earlier gestation of delivery to be associated with significant morbidity are consistent with those that have found advanced maternal age and comorbid reproductive histories (such as multiple prior uterine surgeries) to be risk factors that contribute to PAS morbidity and perioperative complications. Other recent risk analyses have highlighted maternal age and parity as predictors of abnormal placentation and poor operative outcomes, and this supports the necessity of incorporating these into antenatal risk stratification9.

Collectively, the findings of the present study is consistent with a growing literature (both single-center and multicenter studies) of the increasing risk of serious maternal morbidity with each cesarean section. Other studies have cautioned that the increase in primary CS worldwide is bound to increase the downstream burden of repeat-CS complications unless the primary CS rates are mitigated and the systems are fortified to safely handle the high-risk

repeat CS. Enhancing antenatal diagnosis of previa/PAS, concentrating care provision to anticipated PAS in centers with centralized care, providing availability to blood and multidisciplinary groups, and embracing evidence-based solutions to intentional trial of labor after cesarean are practical reactions that are backed by the literature18, 23.

Our research adds a significant local data set that confirms the trends observed in the world over the past 5 years. Our design, in contrast to some large registry studies, made intra-operative recording (adhesions, dehiscence, organ injury) possible in great detail, but, like many single-center cross-sectional studies, may not completely capture long-term maternal sequelae or be as generalizable as multicenter cohorts. The disparity between our rates and those that are reported elsewhere may be due to differences in the patterns of referral, prenatal identification of PAS, the practice of scheduling electively, and access to resources-variables reported throughout the literature16, 24.

Overall, the evidence presented in the present study supports the current evidence that repeated cesarean births are linked to significant changes in surgical morbidity, aberrant placental positioning, haemorrhage, and high-resource care. The fact that these trends are still consistent with recent literature indicates the urgency of both prevention (reducing unnecessary primary CS) and preparedness (coordinated care pathways in women with prior CS and suspected PAS) to help decrease maternal harm25.

CONCLUSION

Consecutive cesarean delivery is closely linked to a cumulative rise in maternal morbidity as women who have undergone three or more prior cesarean sections face the greatest number of complications, including dense adhesions, scar dehiscence, placenta previa, placenta accreta, major hemorrhage, and long hospital stay, and ICU admission. These results show the cumulative risk of surgery in multiple cesarean sections and the necessity of careful risk assessment in the antepartum period, specific planning of delivery, and enhanced aftercare observation. With some obvious trends of increasing morbidity with each extra cesarean section, the study supports the international movement of minimizing unnecessary primary cesarean sections and encouraging harmless options in cases where it is clinically possible. Finally, the presented evidence confirms the necessity of improved clinical guidelines and informed decision-making to achieve better maternal safety and better obstetric care outcomes.

LIST OF ABBREVIATIONS:
CS: Cesarean Section
ICU: Intensive Care Unit
LMIC: Lower Middle Income Class
PAS: Placenta Accreta Spectrum

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