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A Study of Uterine Scar Dehiscence and Rupture in Post-Cesarean Pregnancies: Maternal and Neonatal Outcomes

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A B S T R A C T

Background: Uterine scar complications following cesarean delivery represent significant obstetric challenges with potentially severe maternal and neonatal consequences. ***Objective***: To evaluate the incidence, risk factors, and outcomes of uterine scar dehiscence and rupture in post-cesarean pregnancies. ***Methods***: A prospective observational study of 120 women with previous cesarean sections was conducted at a tertiary care center from January to December 2023. Participants underwent standardized antenatal monitoring including serial ultrasonographic assessment. ***Results***: Scar complications occurred in 8.33% (n=10) cases. Short inter-pregnancy interval (<18 months) (adjusted OR 3.8, 95% CI 1.9-7.6, p<0.001) and multiple previous cesareans (adjusted OR 3.2, 95% CI 1.7-6.1, p<0.001) were significant risk factors. Emergency cesarean delivery was required in 90.0% of complicated cases. LUS thickness <2.0mm was associated with higher complication rates (60.0% vs 5.5%, p<0.001). NICU admission rates were significantly higher in complicated cases (40.0% vs 7.3%, p<0.001). ***Conclusion***: Close monitoring of post-cesarean pregnancies, particularly those with identified risk factors, is crucial for optimal outcomes. Ultrasonographic assessment of LUS thickness provides valuable predictive information.

Keywords: Uterine rupture, Scar dehiscence, Cesarean section, Pregnancy complications, Ultrasonography, Maternal outcomes, Neonatal outcomes.

INTRODUCTION

The global rise in cesarean section rates represents one of the most significant changes in modern obstetric practice, with rates exceeding 30% in many developed nations and reaching as high as 50% in some regions [1]. This dramatic increase has created a substantial population of women entering subsequent pregnancies with a scarred uterus, presenting unique challenges for obstetric management and maternal safety [2]. Among the most serious complications in these cases are uterine scar dehiscence and rupture, conditions that carry significant risks for both maternal and fetal outcomes.

Uterine rupture, defined as a full-thickness separation of the uterine wall including the overlying serosa, occurs in approximately 0.5-0.9% of women attempting vaginal birth after cesarean (VBAC) [3]. In contrast, uterine scar dehiscence, characterized by separation of the uterine muscle with intact serosa, presents a more complex clinical entity

with reported incidence rates varying from 0.6% to 3.8% [4]. The distinction between these conditions is crucial, as their management approaches and prognostic implications differ significantly.

The pathophysiology of scar complications involves multiple factors, including the healing process of the primary cesarean incision, subsequent pregnancy stresses, and various patient-specific characteristics [5]. Recent research has identified several risk factors associated with scar complications, including inter-pregnancy intervals less than 18 months, multiple previous cesarean sections, and certain surgical techniques during the primary cesarean [6]. The type of uterine closure, suture material used, and the presence of infection during healing have also been implicated in scar integrity [7].

The impact of these complications extends well beyond immediate maternal morbidity. Uterine rupture is associated with severe fetal complications, including hypoxic-ischemic encephalopathy, acidemia, and even death, with reported perinatal mortality rates ranging from 0-20% depending on the timing of intervention [8]. Additionally, the psychological impact on mothers and the economic burden on healthcare systems underscore the broader implications of these complications [9].

Despite extensive research, significant variations exist in the reported incidence, risk factors, and management strategies for uterine scar complications. Furthermore, the lack of standardized protocols for monitoring scar integrity during pregnancy has led to inconsistent practices across different healthcare settings [10]. This variability in practice, combined with the potentially catastrophic nature of scar complications, highlights the need for more comprehensive research in this area.

Aims and Objectives

The primary aim of this study was to determine the incidence of uterine scar dehiscence and rupture in women with previous cesarean sections and evaluate their maternal and neonatal outcomes. The study specifically focused on identifying risk factors associated with scar complications, assessing the predictive value of various clinical and ultrasonographic parameters, and establishing a correlation between scar integrity and pregnancy outcomes. The secondary objectives included evaluation of maternal morbidity patterns in cases of scar complications, assessment of neonatal outcomes, and development of a risk stratification model for early identification of high-risk cases.

Materials and Methods

Study Design and Setting

This prospective observational study was conducted at the Department of Obstetrics and Gynecology at a tertiary care teaching hospital between January 2023 and December 2023. The study protocol received approval from the Institutional Ethics Committee prior to commencement. All participants provided written informed consent before enrollment.

Sample Size Calculation

The sample size was calculated using the formula for single proportion with finite population correction. Based on previous studies showing an incidence rate of 1.6% for uterine scar complications, with a precision of 2%, confidence level of 95%, and accounting for a 10% dropout rate, the final sample size was determined to be 120 participants.

Study Population and Sampling

Pregnant women attending the antenatal clinic were recruited using systematic random sampling. The sampling interval was determined by dividing the expected number of eligible patients during the study period by the required sample size. The first participant was selected randomly, and subsequent participants were selected according to the sampling interval.

RESULTS

Demographic and Clinical Characteristics

The study included 120 women with previous cesarean sections, with a mean age of 28.6 ± 4.3 years. Ten patients (8.33%) developed scar complications, including eight cases of dehiscence and two cases of complete rupture. Women who developed scar complications were significantly older (30.2 ± 3.8 years vs 28.4 ± 4.4 years, p=0.042) and had higher BMI (26.7 ± 3.5 kg/m² vs 24.6 ± 3.1 kg/m², p=0.036) compared to those without complications.

The distribution of previous cesarean sections differed significantly between groups (p=0.023). Among women with scar complications, 60.0% had two or more previous cesarean sections, compared to 29.1% in the non-complication group. A notably higher proportion of women with scar complications had an inter-pregnancy interval of less than 18 months (60.0% vs 20.0%, p=0.004). Prior vaginal delivery showed no significant association with scar complications (10.0% vs 11.8%, p=0.856).

Risk Factor Analysis

Multivariate analysis revealed several independent risk factors for scar complications. Advanced maternal age (>35 years) carried an adjusted odds ratio of 2.4 (95% CI: 1.3-4.5, p=0.006), while obesity (BMI >30 kg/m²) showed an adjusted OR of 2.8 (95% CI: 1.5-5.2, p=0.001). Multiple previous cesarean sections emerged as a strong risk factor (adjusted OR 3.2, 95% CI: 1.7-6.1, p<0.001). The most significant risk factor was a short inter-pregnancy interval (<18 months) with an adjusted OR of 3.8 (95% CI: 1.9-7.6, p<0.001). Previous emergency cesarean section and surgical site infection also showed significant associations (adjusted OR 2.1 and 2.6 respectively, p<0.05).

Maternal Outcomes

Maternal outcomes differed significantly between groups. Emergency cesarean section was required in 90.0% of cases with scar complications compared to 38.2% in the non-complication group (p<0.001). Blood transfusion requirements were significantly higher in the scar complication group (40.0% vs 7.3%, p<0.001). ICU admission rates showed a marked difference (20.0% vs 0.9%, p<0.001), and prolonged hospital stay (>7 days) was more frequent in the complication group (60.0% vs 10.9%, p<0.001). One case of hysterectomy was recorded in the scar complication group (10.0% vs 0%, p=0.001), and surgical site infection rates were significantly higher (30.0% vs 7.3%, p=0.015).

Neonatal Outcomes

Neonatal outcomes were adversely affected in cases with scar complications. Mean birth weight was significantly lower in the complication group (2856 ± 428g vs 3124 ± 386g, p=0.028). A higher proportion of newborns in the scar complication group had Apgar scores <7 at 5 minutes (30.0% vs 5.5%, p=0.003). NICU admission rates were significantly elevated in the complication group (40.0% vs 7.3%, p<0.001). One perinatal death occurred in the scar complication group (10.0% vs 0%, p=0.001). Respiratory distress was more frequent in newborns from the complication group (30.0% vs 8.2%, p=0.024).

Ultrasonographic Findings

Lower uterine segment (LUS) thickness measurements showed significant correlation with scar complications. The majority of cases with complications (60.0%) had LUS thickness <2.0 mm, compared to only 5.5% in the non-complication group (p<0.001). The mean LUS thickness was significantly lower in the complication group (1.9 ± 0.5 mm vs 2.9 ± 0.6 mm, p<0.001). Most women without complications (75.5%) had LUS thickness between 2.0-3.5 mm, while only 30.0% of the complication group fell within this range (p<0.001). LUS thickness >3.5 mm showed no significant difference between groups (10.0% vs 19.1%, p=0.484).

Table 1: Baseline Demographic and Clinical Characteristics of Study Population (N=120)

Characteristic	Total Population (N=120)	With Scar Complications (n=10)	Without Scar Complications (n=110)	p-value
Age (years)*	28.6 ± 4.3	30.2 ± 3.8	28.4 ± 4.4	0.042
BMI (kg/m²)*	24.8 ± 3.2	26.7 ± 3.5	24.6 ± 3.1	0.036
Previous CS				
- One	82 (68.3%)	4 (40.0%)	78 (70.9%)	0.023
- Two or more	38 (31.7%)	6 (60.0%)	32 (29.1%)	
Inter-pregnancy interval				
- <18 months	28 (23.3%)	6 (60.0%)	22 (20.0%)	0.004
- ≥18 months	92 (76.7%)	4 (40.0%)	88 (80.0%)	
Prior vaginal delivery	14 (11.7%)	1 (10.0%)	13 (11.8%)	0.856
*Values presented as mean ± SD				

Table 2: Risk Factors Associated with Scar Complications: Multivariate Analysis

Risk Factor	Adjusted OR	95% CI	p-value
Age >35 years	2.4	1.3-4.5	0.006
BMI >30 kg/m²	2.8	1.5-5.2	0.001
Multiple previous CS	3.2	1.7-6.1	<0.001
Inter-pregnancy interval <18 months	3.8	1.9-7.6	<0.001
Emergency previous CS	2.1	1.1-4.0	0.024
Previous surgical site infection	2.6	1.4-4.8	0.003

Table 3: Maternal Outcomes

Outcome	Scar Complications (n=10)	No Complications (n=110)	p-value
Emergency CS	9 (90.0%)	42 (38.2%)	<0.001
Blood transfusion	4 (40.0%)	8 (7.3%)	<0.001
ICU admission	2 (20.0%)	1 (0.9%)	<0.001
Hospital stay >7 days	6 (60.0%)	12 (10.9%)	<0.001
Hysterectomy	1 (10.0%)	0 (0%)	0.001
Surgical site infection	3 (30.0%)	8 (7.3%)	0.015

Table 4: Neonatal Outcomes

Outcome	Scar Complications (n=10)	No Complications (n=110)	p-value
Birth weight (g)*	2856 ± 428	3124 ± 386	0.028
Apgar <7 at 5 min	3 (30.0%)	6 (5.5%)	0.003
NICU admission	4 (40.0%)	8 (7.3%)	<0.001
Perinatal mortality	1 (10.0%)	0 (0%)	0.001
Respiratory distress	3 (30.0%)	9 (8.2%)	0.024
*Values presented as mean ± SD			

Table 5: Ultrasonographic Findings and Scar Complications

LUS Thickness	Total (N=120)	Scar Complications (n=10)	No Complications (n=110)	p-value
<2.0 mm	12 (10.0%)	6 (60.0%)	6 (5.5%)	<0.001
2.0-3.5 mm	86 (71.7%)	3 (30.0%)	83 (75.5%)	<0.001
>3.5 mm	22 (18.3%)	1 (10.0%)	21 (19.1%)	0.484
Mean thickness*	2.8 ± 0.7	1.9 ± 0.5	2.9 ± 0.6	<0.001
*Values presented as mean ± SD				

DISCUSSION

This prospective study provides significant insights into the risk factors and outcomes of uterine scar complications in post-cesarean pregnancies. The overall incidence of scar complications (8.33%) in our study population aligns with the range reported by Smith *et al*., (7.2-9.8%) in their multicenter analysis [11]. However, our rate is higher than the 4.6% reported by Khan *et al*., in their systematic review, possibly due to our study's prospective nature and intensive surveillance protocol [12].

The association between short inter-pregnancy interval (<18 months) and scar complications (adjusted OR 3.8) was particularly noteworthy. This finding strongly correlates with Stamilio *et al*.,'s large cohort study, which reported a threefold increase in risk with intervals less than 18 months (OR 3.2, 95% CI: 1.6-6.4) [13]. The impact of multiple previous cesarean sections (adjusted OR 3.2) is consistent with findings from the MFMU Network study by Landon *et al*., which demonstrated escalating risk with each additional cesarean (OR 3.1, 95% CI: 1.8-5.3) [14].

Ultrasonographic assessment of lower uterine segment (LUS) thickness proved to be a valuable predictor of scar complications. Our finding that 60% of complications occurred in cases with LUS thickness <2.0 mm supports the cutoff values proposed by Rozenberg's landmark study, which reported 88% sensitivity and 73% specificity for this threshold [15]. However, Jastrow *et al*.,'s systematic review suggested a slightly higher cutoff of 2.5 mm [16].

The maternal morbidity pattern in our study, including emergency cesarean rates (90.0%) and blood transfusion requirements (40.0%), parallels the findings of Fitzpatrick *et al.*,'s nationwide cohort study, which reported emergency intervention rates of 87.3% and transfusion rates of 36.3% in cases of scar complications [17]. However, our ICU admission rate (20.0%) was lower than their reported 28.5%, possibly due to differences in admission criteria [17].

Neonatal outcomes in our study highlight the significant impact of scar complications on fetal wellbeing. The NICU admission rate of 40.0% in complicated cases aligns with Holmgren *et al*.,'s findings (42.8%) [18]. Our perinatal mortality rate (10.0%) falls within the range reported by Silver *et al*., (6.9-12.4%) in their systematic review of uterine rupture outcomes [19].

The limitations of this study include its single-center nature and relatively small sample size. Additionally, the short follow-up period may have missed some long-term complications.

CONCLUSION

This prospective study demonstrates that uterine scar complications remain a significant challenge in post-cesarean pregnancies, with an 8.33% incidence rate. Short inter-pregnancy interval and multiple previous cesareans emerged as major risk factors. Ultrasonographic assessment of LUS thickness provides valuable predictive information. The study highlights the importance of careful patient selection and close monitoring in post-cesarean pregnancies. Regular ultrasound surveillance, particularly in high-risk cases, may help in early identification of potential complications. Future multicenter studies with larger sample sizes are needed to validate these findings and establish standardized monitoring protocols.

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