

To Estimate The Incidence And Risk Factors For Uterine Rupture/ Scar Dehiscence In Women Contemplating Vaginal Birth After Cesarean Delivery

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Abstract:

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.

Materials and Methods: A prospective observational study of 120 women with previous cesarean sections was conducted at a tertiary care center, Department of Obstetrics and Gynecology at Katihar medical college, Katihar, Bihar from July 2023 to July 2024. Participants underwent standardized antenatal monitoring including serial ultrasonographic assessment.

Results: The 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.

Key Word: Uterine rupture, Scar dehiscence, Cesarean section, Pregnancy complications, Ultrasonography, Maternal outcomes, Neonatal outcomes

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I. Introduction

Uterine rupture is defined as complete disruption of all uterine layers during pregnancy, delivery, or immediately after delivery. It is a catastrophic situation in obstetrics, and, although rare, often results in both maternal and fetal adverse consequences [1]. Uterine rupture can be complete or partial (dehiscence). Complete rupture usually involves direct communication between the uterine cavity and the peritoneum, and is associated with high rates of perinatal mortality and morbidity [2]. Dehiscence presents when the myometrium is covered by the visceral peritoneum, often an incidental finding in caesarean deliveries, and usually described without any major medical complications [3,4]. The incidence of uterine rupture ranges between 0.5 and 5.3 per 10 thousand deliveries, [5] and mostly happens during trial of labor after a cesarian section (TOLAC) [6].

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 [7]. 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 [8]. 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) [9]. 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% [10]. 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 [11]. 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 [12]. The type of uterine closure, suture material used, and the presence of infection during healing have also been implicated in scar integrity [13].

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 [14]. Additionally, the psychological impact on mothers and the economic burden on healthcare systems underscore the broader implications of these complications [15].

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 [16]. 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.

II. Material And Methods

This prospective observational study was conducted at the Department of Obstetrics and Gynecology at a tertiary care teaching centre at Katihar medical college, Katihar, Bihar from July 2023 to July 2024. The study protocol received approval from the Institutional Ethics Committee prior to commencement. All participants provided written informed consent before enrollment.

Study Design: Prospective open label observational study

Study Location: This was a tertiary care teaching hospital based study done in Obstetrics and Gynecology at Katihar medical college, Katihar, Bihar from July 2023 to July 2024.

Study Duration: July 2023 to July 2024.

Sample size: 120 patients.

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.

Subjects & selection method: 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.

Inclusion criteria:

- All singleton pregnancy with previous Caesarean delivery

Exclusion criteria:

- Multiple pregnancy

Procedure methodology

The patients fulfilling inclusion criteria were recruited in the study after obtaining the Institutional Ethics Committee clearance. The patients were included in study after obtaining the informed consent. The patients' details including the demographic details, maternal medical history, any pregnancy complication in past and the foetal outcome etc were included in a proforma. The patients with singleton pregnancy with history of previous caesarean section willing for VBAC were included and monitored for the incidence and risk factors associated with presence of uterine rupture or dehiscence. Their fetomaternal outcome was documented.

Statistical analysis

Data was analyzed using SPSS version 20 (SPSS Inc., Chicago, IL). Student's *t*-test was used to ascertain the significance of differences between mean values of two continuous variables and confirmed by nonparametric Mann-Whitney test. In addition, paired *t*-test was used to determine the difference between baseline and 2 years after regarding biochemistry parameters, and this was confirmed by the Wilcoxon test which was a nonparametric test that compares two paired groups. Chi-square and Fisher exact tests were performed to test for differences in proportions of categorical variables between two or more groups. The level $P < 0.05$ was considered as the cutoff value or significance.

III. Result

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 ± 428 g vs 3124 ± 386 g, $p=0.028$). 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/m ²)*	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 $\pm$ SD

In our study, higher rate of scar complications were seen with shorter interpregnancy interval; 6.7% uterine rupture with interpregnancy interval between 1-2 years and 13.3% scar dehiscence with interpregnancy interval 1-2 years.

In our study, higher rate of successful VBAC was seen with lower gestational ages; 100% with gestational age between 31-34 weeks; 66.7% with gestational age between >34 -37 weeks and 81.8% with gestational age between >37 -40 weeks.

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/m ²	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

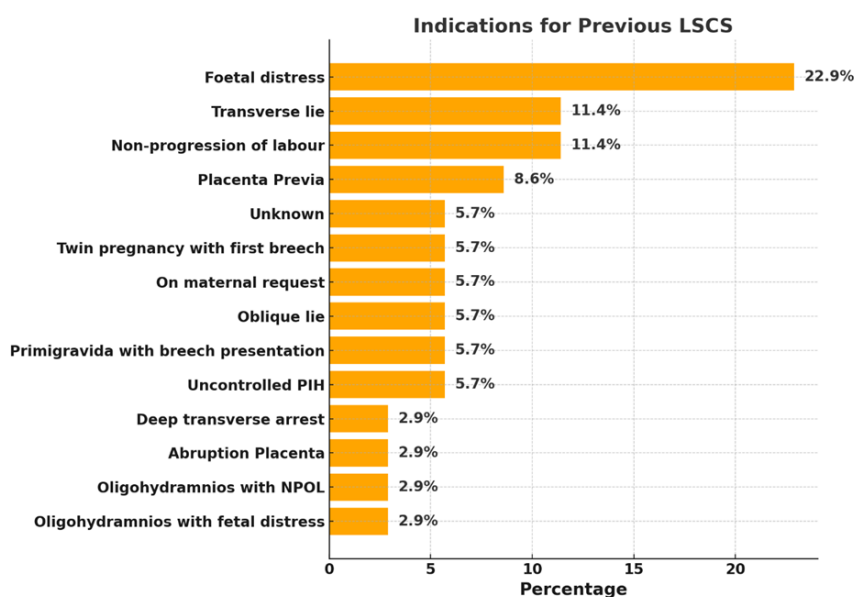


Figure 1: Distribution of Indication of previous LSCS

In our study, most common indication of previous LSCS was foetal distress (22.9%), followed by non-progression of labor and transverse lie (11.4% each).

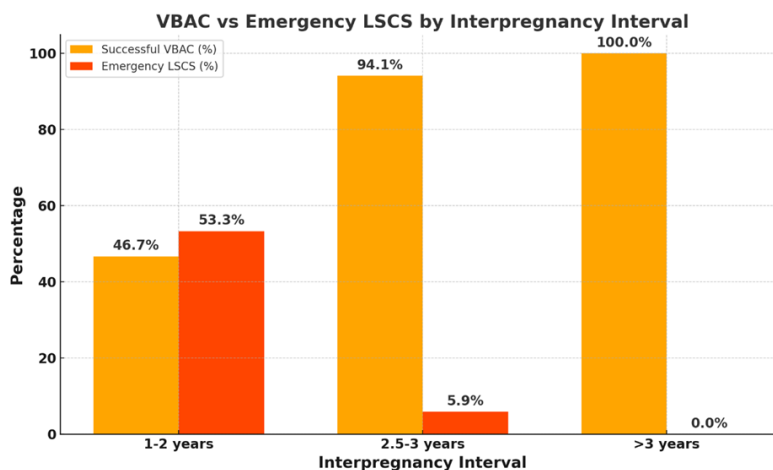


Figure 2: Interpregnancy interval and pregnancy outcome

The mean interpregnancy interval of the patients was 2.3571 ± 0.6921 years. Higher rate of successful VBAC was seen with higher interpregnancy interval, 100% with interpregnancy interval > 3 years, 94.1% with interpregnancy interval between 2.5-3 years and 46.7% with interpregnancy interval between 1-2 years.

In our study, higher successful VBAC rates were seen with cervical dilatation of more than 3cm; 100% with cervical dilatation between 3-4cm at time of admission and 47.1% with cervical dilatation between 1-2cm at time of admission.

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

In our study, use of oxytocin was found associated with higher incidence of scar complications; 9.09% uterine rupture with oxytocin use and 18.18% scar dehiscence with oxytocin use.

Table 4: Neonatal Outcomes

Outcome	Scar Complications (n=10)	No Complications (n=110)	p-value
Birth weight (g)*	2856 $\pm$ 428	3124 $\pm$ 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 $\pm$ 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 $\pm$ 0.7	1.9 $\pm$ 0.5	2.9 $\pm$ 0.6	<0.001

*Values presented as mean $\pm$ SD

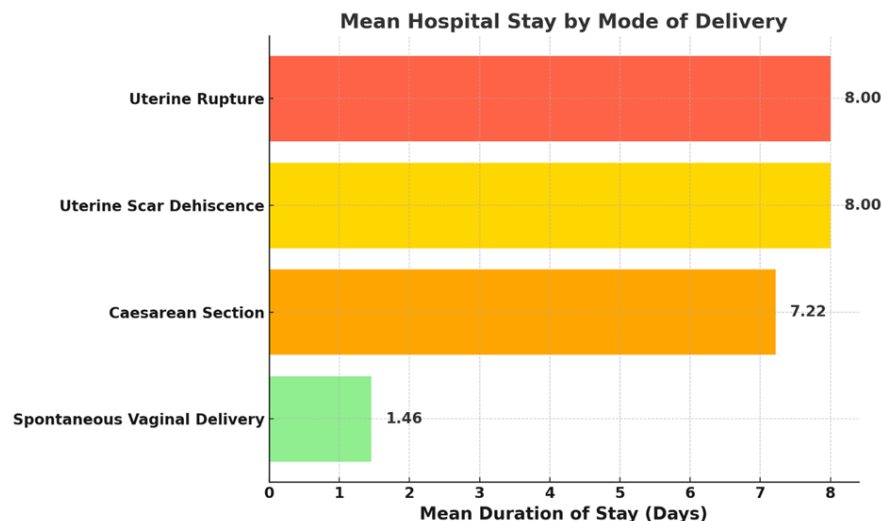


Figure 3: Distribution of mean hospital stay (in days)

In our study, the mean duration of hospital stay was more in patients with caesarean section and patients with scar complications.

IV. 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 [17]. 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 [18].

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) [19]. 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) [20].

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 [21]. However, Jastrow *et al.*, 's systematic review suggested a slightly higher cutoff of 2.5 mm [22].

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 [23]. However, our ICU admission rate (20.0%) was lower than their reported 28.5%, possibly due to differences in admission criteria [24].

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%) [25]. 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 [26].

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.

V. 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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