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Research Article

Prevalence and Risk Factors of Cesarean Section Scar Niche at King Hamad University Hospital (KHUH)

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Abstract

Background: Cesarean scar defects (CSD), or niche, are a recognized complication of cesarean sections, with reported prevalence ranging from 24% - 70%. While often asymptomatic, CSD can cause postmenstrual bleeding, infertility, dysmennorhea, abdominal pain, obstetric risks like uterine rupture, and placenta accreta. Risk factors include technique and closure of hysterotomy incision, multiple CS, and uterine position, though evidence remains inconsistent. Despite a rising global CS rate, regional data on CSD prevalence and predictors are limited. This study evaluates CSD frequency and associated factors in a clinical cohort to guide in identifying risk factors, prevention, and management strategies.

Methods: A prospective study was conducted on 111 women who delivered via CS. Demographic, clinical, and surgical data were collected, and CSD was assessed via ultrasound. Statistical analysis was performed using IBM SPSS version 20.0, employing Chi-square, Student t-test, and Mann-Whitney tests as appropriate.

Results: The prevalence of CSD was 9% (10/111). The mean residual myometrial thickness in affected women was 6.50 ± 7.75 mm (median: 3.5 mm). No significant associations were found between CSD and age (p = 0.785), BMI (p = 0.287), parity (p = 1.000), or diabetes (p = 1.000). However, women with ≥2 previous CS showed a non-significant trend toward higher CSD rates (40% *vs.* 15.8%, p = 0.210). Notably, retroverted uterus (RVF) was more common in the CSD group (30% *vs.* 8.9%, p = 0.075). Surgical factors, including double-layer closure and Vicryl sutures (100% of cases), and locking sutures and the first layer of the uterus, did not influence CSD development.

Conclusion: The prevalence of CSD in this cohort was lower than global estimates, with no significant demographic or surgical risk factors identified. The trend toward higher CSD rates in women with multiple CS and RVF warrants further investigation. These findings underscore the need for standardized surgical techniques and long-term monitoring to mitigate CSD-related morbidity.

Introduction

The global rise in cesarean section rates has reached concerning levels, with many countries reporting rates exceeding 30% of all deliveries. This trend has led to increased recognition of long-term complications, particularly the development of cesarean scar defects (CSD) [1]. These defects, also known as niches or isthmoceles, represent anatomical imperfections in the uterine scar that may have significant clinical implications for women's health [2].

Cesarean scar defects are typically identified as hypoechoic areas about 3mm or indentations at the hysterotomy site during ultrasound examination. The reported prevalence varies dramatically across studies, ranging from 24% to 70%, with a recent systematic review suggesting an overall prevalence of approximately 56% [3]. This wide variation reflects differences in diagnostic criteria, imaging modalities, and study populations, highlighting the need for standardized assessment protocols [4].

The pathogenesis of CSD involves multiple factors, including surgical technique and closure of hysterotomy incision (such as single-layer versus double-layer closure locking

sutures), anatomical considerations (like uterine position and hysterotomy location), and patient characteristics (including parity and number of previous cesareans). Emerging evidence suggests that surgical factors may be particularly modifiable risk factors for defect formation, though conclusive data remains limited [5].

While many women with CSD remain asymptomatic, a significant proportion experience clinical consequences. These may include abnormal uterine bleeding (particularly postmenstrual spotting), secondary infertility, and potential complications in subsequent pregnancies, such as placenta accreta spectrum disorders or uterine rupture [6]. The variability in clinical presentation underscores the importance of understanding both the anatomical and functional aspects of these defects [7].

The identification and characterization of cesarean scar defects carry important implications for both obstetric and gynecologic care. For reproductive-aged women, the presence of CSD may influence family planning decisions and subsequent pregnancy management [8]. In gynecologic practice, recognizing CSD as a potential cause of abnormal uterine bleeding or infertility can lead to more targeted diagnostic approaches and treatment strategies [9].

Current literature reveals several important knowledge gaps, particularly regarding population-specific prevalence in Middle Eastern cohorts and the relative contribution of different risk factors in this setting [10]. Additionally, there is ongoing debate about the optimal diagnostic criteria for clinically significant defects and the threshold for intervention. These gaps limit evidence-based counseling and management of affected women. This study was designed to address these gaps by examining a well-characterized cohort of post-cesarean women in Bahrain [11].

By employing rigorous ultrasound assessment criteria and comprehensive data collection on potential risk factors, our work contributes to the growing body of evidence aimed at optimizing cesarean section techniques and postoperative care [12]. The findings may inform clinical guidelines and surgical protocols to minimize the risk of CSD formation and its associated complications [13].

Aim of the study

To investigate the prevalence and associated risk factors of cesarean scar defects (CSD) among postpartum women who had cesarean section delivery.

Objectives

To determine the prevalence of CSD using standardized transvaginal ultrasound criteria.

To evaluate residual myometrial thickness as a quantitative marker of defect severity.

To identify high-risk subgroups requiring targeted postpartum surveillance.

Materials and methods

Study design and setting

This prospective study was conducted at King Hamad University Hospital, a tertiary care referral center in Bahrain, between December 2024 and May 2025. The study population comprised women who underwent cesarean section delivery during this period and returned for scheduled 2-month postnatal follow-up visits. Of the 158 eligible patients, 111 met the inclusion criteria and were enrolled in the study.

Participant selection

Inclusion criteria consisted of: (1) cesarean delivery performed at the study institution, (2) minimum 6-week postpartum status at evaluation, and (3) availability of complete surgical and follow-up records. Exclusion criteria included: (1) presence of uterine anomalies (congenital or acquired), and (3) incomplete imaging or clinical data.

Data collection procedures

Data collection involved a systematic review of electronic medical records using a standardized case report form. The form captured demographic characteristics (age, BMI, parity), surgical parameters (number of prior cesareans, uterine closure technique, suture material type, uterine position), and detailed ultrasound findings. Two Certified sonographers performed all ultrasound examinations using a Voluson E8 ultrasound machine equipped with a 5-9 MHz transvaginal transducer.

Ultrasound assessment protocol

Cesarean scar defect was defined as a hypoechoic area measuring at least 2mm at the uterine scar site, with residual myometrial thickness recorded at its thinnest point. Two experienced sonographers, who underwent specific protocol training, conducted all examinations to ensure measurement consistency. Digital ultrasound images were reviewed independently by two observers, with any discrepancies resolved through consultation with a third senior reviewer.

Ethical considerations

The Institutional Review Board of King Hamad University Hospital approved the study protocol. As the study involved prospective analysis of existing clinical data, the requirement for informed consent was waived. All patient data were anonymized during collection, with each case assigned a unique study identifier. Data storage occurred on password-protected hospital servers with access restricted to authorized investigators.

Statistical analysis

Data analysis was performed using IBM SPSS Statistics

(v20.0). Continuous variables were expressed as mean ± SD or median (range) based on normality testing, while categorical variables were reported as frequencies (%). Group comparisons employed appropriate parametric or non-parametric tests (Student's t-test, Mann-Whitney U, or chi-square/Fisher's exact tests). Statistical significance was set at $p < 0.05$ for all analyses.

Results

Table 1 shows that the mean age of patients was 30.41 ± 5.98 years, ranging from 19 to 47 years. The mean BMI was 34.69 ± 15.18, with a median of 29.30. Regarding parity, 40.5% primigravida, 59.5% multiparous.

Table 2 shows that 58.6% of patients had no previous cesarean section, while 23.4% had one and 18% had two or more. The main indications for current CS were previous CS (31.5%), fetal distress (27.9%), and failure to progress (23.4%). Diabetes was present in 26.1% of cases. About half of the operations were elective (48.6%), and half were emergency (51.4%). Almost all patients (99.1%) had no peripartum infection, and 94.6% had no complications in previous CS. All patients had locked double-layer closure using Vicryl sutures. The majority had an AVF uterus (89.2%), and the mean distance of hysterotomy from the utero-vesical pouch was 3.25 ± 0.46 cm.

Table 3 shows that 9% of patients developed a cesarean scar defect, while the majority (91%) did not. The mean residual myometrial thickness was 6.50 ± 7.75 mm, with a median of 3.5 mm.

Table 4 shows the relation between CS scar defect and demographic data. No significant difference was observed between age, BMI, or parity groups. Patients with or without a scar defect had comparable demographic characteristics, with p - values > 0.05.

Table 5 shows the relation between CS scar defect and clinical parameters. Patients with scar defects tended to have a more previous CS (40% *vs.* 15.8% in those without defect), although this was not statistically significant ($p = 0.210$). Indications for the current CS were not significantly different between groups ($p = 0.861$).

Table 1: Distribution of the studied cases according to Demographic and clinical parameters ($n = 111$).

Demographic data and clinical parameters	No. (%)
Age (years)	
Mean ± SD.	30.41 ± 5.98
Median (Min. – Max.)	30.0 (19.0 – 47.0)
BMI	
Mean ± SD.	34.69 ± 15.18
Median (Min. – Max.)	29.30 (19.10 – 99.0)
Parity	
0 Primigravida	45 (40.5%)
1 Multiparous	66 (59.5%)

Table 2: Distribution of the studied cases according to clinical parameters ($n = 111$).

Clinical parameters	No. (%)
Number of previous CS	
0	65 (58.6%)
1	26 (23.4%)
≥2	20 (18.0%)
Mean ± SD.	0.59 – 0.78
Median (Min. – Max.)	0.0 (0.0 – 2.0)
Indication of current CS	
Fetal distress	31 (27.9%)
Previous CS refused VBAC	35 (31.5%)
Breech presentation	7 (6.3%)
PET	2 (1.8%)
Failure to progress (first & second)	26 (23.4%)
Scar tenderness	2 9 (1.8%)
Multiple gestation	3 (2.7%)
Septate uterus	1 (0.9%)
Placenta previa	1 (0.9%)
Non-reassuring CTG	1 (0.9%)
Big-sized baby and GDM	1 (0.9%)
Refusing a trial of scar in labor	1 (0.9%)
Any peripartum infection	
Yes	1 (0.9%)
No	110 (99.1%)
Diabetes	
Yes	29 (26.1%)
No	82 (73.9%)
Type of CS	
Elective	54 (48.6%)
Emergency	57 (51.4%)
PPROM	
Yes	3 (2.7)
No	108 (97.3%)
Any complications in previous CS	
Yes	6 (5.4%)
No	105 (94.6%)
Type of uterine closure	
Single Layer	0 (0.0%)
Double Layer	111 (100.0%)
Type of sutures used for closure	
Vicryl	111 (100.0%)
Other	0 (0.0%)
Postnatal uterus	
AVF	99 (89.2%)
RVF	12 (10.8%)
Distance of hysterotomy from the utero-vesicle pouch	
Mean ± SD.	3.25 ± 0.46
Median (Min. – Max.)	3.0 (2.0 – 4.0)

SD: Standard Deviation

Table 3: Distribution of the studied cases according to Cesarean scar defect ($n = 111$).

Cesarean scar defect	No. (%)
CS scar defect	
Absent	101 (91.0%)
Present	10 (9.0%)
Residual myometrial thickness	
Mean ± SD.	6.50 ± 7.75
Median (Min. – Max.)	3.50 (2.0 – 30.0)

SD: Standard Deviation.

Table 4: Relation between CS scar defect and Demographic data (n = 111).

Demographic data	CS scar defect		Test of sig.	p
	Absent (n =101)	Present (n = 10)		
Age (years)				
Min. – Max.	19.0 – 47.0	25.0 – 42.0	t = 0.273	0.785
Mean ± SD.	30.36 ± 6.11	30.90 ± 4.70		
Median	30	30.5		
BMI				
Min. – Max.	19.10 – 99.0	25.0 – 72.80	U = 402.000	0.287
Mean ± SD.	34.63 ± 15.36	35.28 ± 13.97		
Median	29.3	30		
Parity				
0 Primigravida	41 (40.6%)	4 (40.0%)	χ^2 = 0.304	^{FE}p = 1.000
1 Multiparous	60 (59.4%)	6 (60.0%)		

χ^2: Chi square test; FE: Fisher Exact; t: Student t test; U: Mann Whitney test; p: p-value for comparing between Absent and Present; SD: Standard Deviation

Table 5: Relation between CS scar defect and different parameters (n = 111).

Deferent parameters	CS scar defect		χ^2	p
	Absent (n =101)	Present (n = 10)		
Number of previous CS				
0	61 (60.4%)	4 (40.0%)	3.365	^{FE}p= 0.210
1	24 (23.8%)	2 (20.0%)		
≥2	16 (15.8%)	4 (40.0%)		
Indication of current CS				
Fetal distress	27 (26.7%)	4 (40.0%)	7.866	^{FE}p= 0.861
Previous cesarean section	30 (29.7%)	5 (50.0%)		
Breech presentation	7 (6.9%)	0 (0.0%)		
PET	2 (2.0%)	0 (0.0%)		
Failure to progress	25 (24.8%)	1 (10.0%)		
Scar tenderness	2 (2.0%)	0 (0.0%)		
Multiple gestation	3 (3.0%)	0 (0.0%)		
Septate uterus	1 (1.0%)	0 (0.0%)		
Placenta previa	1 (1.0%)	0 (0.0%)		
Non-reassuring CTG	1 (1.0%)	0 (0.0%)		
Big-sized baby and GDM	1 (1.0%)	0 (0.0%)		
Refusing a trial of scar in labor	1 (1.0%)	0 (0.0%)		

χ^2: Chi-square test; FE: Fisher Exact; p: p-value for comparing between Absent and Present; SD: Standard Deviation

Table 6 shows the relation between CS scar defect and other parameters. No significant association was found with peripartum infection, diabetes, type of CS, PPROM, or complications in previous CS (p > 0.05). However, patients with RVF uterus had a higher percentage of scar defect (30% *vs.* 8.9% in AVF), approaching significance (p = 0.075).

Discussion

Regarding the mean age of patients, the study revealed that the mean age was approximately 30 years, ranging between 19 and 47 years. It may be because cesarean sections are most commonly performed in women of reproductive age, particularly in their late twenties and early thirties, where fertility rates and pregnancy complications are relatively high. This finding is in agreement with Wang, et al. [14], who reported a mean maternal age of 31 years among women diagnosed with scar niche.

According to BMI results, the present study showed a mean BMI of 34.69 with a median of 29.3, indicating that a considerable proportion of the studied population was

Table 6: Relation between CS scar defect and Deferent parameters (n = 111).

Deferent parameters	CS scar defect		Test of sig.	p
	Absent (n =101)	Present (n = 10)		
Any peripartum infection				
Yes	1 (1.0%)	0 (0.0%)	χ^2 = 0.100	^{FE}p = 1.000
No	100 (99.0%)	10 (100.0%)		
Diabetes				
Yes	27 (26.7%)	2 (20.0%)	χ^2 = 0.214	^{FE}p = 1.000
No	74 (73.3%)	8 (80.0%)		
Type of CS				
Elective	49 (48.5%)	5 (50.0%)	χ^2 = 0.008	^{FE}p = 1.000
Emergency	52 (51.5%)	5 (50.0%)		
PPROM				
Yes	3 (3.0%)	0 (0.0%)	χ^2 = 0.305	^{FE}p = 1.000
No	98 (97.0%)	10 (100.0%)		
Any complications in previous CS				
Yes	5 (5.0%)	1 (10.0%)	χ^2 = 0.454	^{FE}p = 0.440
No	96 (95.0%)	9 (90.0%)		
Type of uterine closure				
Single Layer	–	–	–	–
Double Layer	101 (100.0%)	10 (100.0%)		
Type of sutures used for closure				
Vicryl	101 (100.0%)	10 (100.0%)	–	–
Other	–	–		
Postnatal uterus				
AVF	92 (91.1%)	7 (70.0%)	χ^2=4.197	^{FE}p = 0.075
RVF	9 (8.9%)	3 (30.0%)		
Distance of hysterotomy from the utero-vesicle pouch				
Mean ± SD.	3.25 ± 0.46	3.30 ± 0.48	t=0.345	0.731
Median (Min. – Max.)	3.0 (2.0 – 4.0)	3.0 (3.0 – 4.0)		

χ^2: Chi-square test; FE: Fisher Exact; p: p-value for comparing between Absent and Present; SD: Standard Deviation

overweight or obese. It may be due to the rising prevalence of obesity among women of childbearing age in the Gulf region, which is considered a contributing risk factor for cesarean delivery and possibly impaired wound healing at the uterine scar. This result with Ishikawa, et al. [15], who reported no statistically significant relation between BMI and niche development, suggesting that additional factors such as surgical technique and uterine healing capacity might play stronger roles.

Concerning parity, the study results indicated that two-fifths of patients were nulliparous, one-sixth were primiparous, while slightly less than half were multiparous. This finding is supported by Zhou, et al. [16], who demonstrated that multiparity was associated with a higher prevalence of scar niches.

Regarding previous cesarean section history, the results showed that more than half of patients had no previous cesarean, while nearly one-fourth had one, and less than one-fifth had two or more. It may be due to the fact that this study included both primary and repeat cesarean deliveries, reflecting the mixed population in a tertiary hospital setting. This finding is consistent with Armstrong, et al. [17], who

reported that women with multiple previous cesareans were at higher risk of niche development.

Concerning indications for current cesarean section, the leading causes were previous cesarean, followed by fetal distress and failure to progress. It may be due to the rising global trend of repeat cesarean deliveries and increased intrapartum monitoring that identifies fetal compromise more frequently. However, Vila-Candel, et al. [18] found that non-reassuring fetal status was more frequent than previous cesarean in some populations, indicating variation between settings.

According to maternal comorbidities, diabetes was present in about one-fourth of patients. It may be due to the high prevalence of diabetes in Gulf countries, which is a known risk factor for cesarean delivery and delayed wound healing. Concerning the type of operation, nearly half of the procedures were elective, and half were emergency. Lumbanraja, et al. [19] reported that emergency cesarean was more likely to be associated with niche formation due to hurried surgical technique.

According to surgical technique, all patients had double-layer and locked closure with Vicryl sutures, and the majority had an anteverted flexed uterus. It may be due to the adoption of best practice protocols in the institution, as double-layer closure has been shown to reduce niche formation compared to single-layer closure. Concerning the hysterotomy site, the mean distance from the utero-vesical pouch was about 3.25 cm, which falls within the safe margin for lower segment incision. It may be due to careful surgical technique that minimizes the risk of bladder injury while maintaining adequate scar healing.

Regarding the suturing technique, in addition to the double-layer closure, the locking method was consistently used in all cases. This approach provides firm tissue approximation and secure hemostasis, although some studies have raised concerns that excessive locking may compromise microcirculation at the wound edges and subsequently impair healing. In the present cohort, however, the use of locking sutures did not appear to significantly influence niche formation, as the prevalence remained comparable to other reports that employed non-locking techniques. This observation is consistent with Genovese, et al. [20], who emphasized that tissue approximation and closure integrity may have a stronger impact on scar healing than the specific use of locking or non-locking methods.

The debate between locking and non-locking sutures remains an important topic in cesarean section closure. Non-locking sutures are thought to allow for more physiological healing with reduced ischemic insult, while locking sutures are favored for their mechanical strength and ability to maintain secure closure under tension. In our findings, the routine use of the locking technique did not increase the risk of cesarean scar defect formation. This is in agreement with Abdelaziz, et al. [21], who demonstrated that overall surgical quality and adherence to standardized techniques play a more decisive role in postoperative outcomes.

Regarding the prevalence of cesarean scar defect, only about one-tenth of patients developed a niche, while the majority did not. This is comparable to Spahn, et al. [22], who reported a prevalence of scar niche between one-fifth and one-third, depending on the population studied.

According to residual myometrial thickness (RMT), the mean was 6.5 mm with a median of 3.5 mm. It may be due to the heterogeneous healing process influenced by parity, BMI, and surgical closure technique. Studies like Timor-Tritsch, et al. [23] emphasized that thinner residual myometrium is strongly correlated with the presence of niches and adverse reproductive outcomes.

Regarding the relation between cesarean scar defect and demographic data, the results showed no significant difference between age, BMI, or parity groups, as patients with and without scar defects demonstrated comparable demographic characteristics. This finding is consistent with Donnez [24], who highlighted that higher BMI may indirectly influence wound healing, although its role remained inconsistent across studies.

Concerning the relation between scar defect and clinical indications for cesarean section, the study found no significant differences between the groups or if its elective or emergency. It may be due to the fact that indications such as fetal distress or failure to progress reflect obstetric circumstances rather than surgical variables that directly affect scar healing.

Regarding other clinical parameters, no significant association was found between cesarean scar defect and peripartum infection, diabetes, type of cesarean, PPROM, or complications in previous cesarean sections. According to uterine position, patients with retroverted-flexed (RVF) uterus had a higher percentage of scar defects compared to those with anteverted-flexed (AVF) uterus, approaching statistical significance. This result is supported by Carbonnel, et al. [25], who identified uterine retroflexion as a significant risk factor for niche formation. However, Tahermanesh, et al. [26] emphasized that even minor infections could impair uterine healing in some women, highlighting the complexity of niche formation.

Concerning the distance of hysterotomy from the utero-vesical pouch, the study revealed no significant differences between patients with and without scar defects. It may be due to the standardized surgical practice in the hospital, where careful incision placement minimized variability in hysterotomy location. This aligns with Genovese, et al. [27], who highlighted that closure method and tissue approximation may have a stronger influence than incision distance itself.

Conclusion

Cesarean scar defect was detected in 9% of cases. No significant associations were found with age, BMI, parity, diabetes, or type of cesarean section. However, women with multiple prior cesareans and a retroverted uterus showed a higher tendency to develop scar defects. These findings emphasize the need for meticulous surgical technique and further prospective studies to clarify additional risk factors and improve maternal outcomes. The number is small, and a longer study is needed.

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