

ORIGINAL ARTICLE

Evaluation of Cesarean Scar Niche as a Predictor of Pelvic Adhesions and Surgical Difficulty in Women Undergoing Repeat Pelvic Surgery: A Comparative Cross-Sectional Study

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ABSTRACT

Background: The cesarean scar niche is a structural defect in the area of the cesarean incision and can potentially be linked to abnormal pelvic healing. Its association with pelvic adhesions and the complications of subsequent pelvic surgery is not fully understood.

Objective: To evaluate the association between cesarean scar niche and pelvic adhesions and surgical difficulty in women undergoing repeat pelvic surgery.

Material and Methods: This cross-sectional study compared 160 women undergoing repeat pelvic surgery who were equally divided into the niche group and the non-niche group defined using transvaginal ultrasonography. Preoperative documentation of niche characteristics and intraoperative assessment of operative parameters and pelvic adhesions were performed. Associations were evaluated using appropriate comparative tests and multivariable logistic regression.

Results: Pelvic adhesions were significantly more frequent in women with a cesarean scar niche, with greater severity and increased vesicouterine and dense bladder adhesions. The niche group was also more likely to have adhesiolysis, difficult dissection of the bladder, and extensive dissection. Operative time and blood loss were greater, and there was a longer hospital stay. This niche was still independently linked to the presence of pelvic adhesions after adjustment for the possible confounding factors ($p=0.005$). Three or more previous cesarean sections were also independently associated with adhesions.

Conclusions: Pelvic adhesions and increased surgical difficulty in repeat pelvic surgery were independently associated with cesarean scar niche. Niche assessment can be useful in anticipating operative complexity and planning surgery.

Keywords: Cesarean scar niche, isthmocoele, pelvic adhesions, cesarean section, surgical difficulty

INTRODUCTION

Cesarean section (CS) is one of the most commonly performed surgical procedures in the world, and about 21% of all births globally are conducted by cesarean section, while this proportion was approximately 7% in 1990¹. It is estimated that almost one-third of all births will be by cesarean section by 2030, which will lead to a large number of women exposed to the long-term effects of previous uterine surgery². In female patients who have had previous CS, reoperation is a clinical challenge due to the possibility of postoperative adhesions that may alter the normal anatomy of the pelvis, prolong surgical time, cause blood loss, and lead to bladder, bowel, and vascular injury³. The incidence of adhesions reported for each CS is 24-46% at the second CS, 43-75% at the third CS, and up to 83% at the fourth CS, indicating an increasing rate with repeated surgical intervention⁴.

A cesarean scar niche, also known as a cesarean scar defect or isthmocoele, is a pocket or triangle of myometrial defect at the cesarean hysterotomy incision, typically found as a defect of at least 2 mm in diameter by ultrasound⁵. Impaired scar healing is a common occurrence⁶. Increasingly, the cesarean scar niche CSN is being recognized as the result of impaired scar healing⁷. Its reported prevalence varies according to the diagnostic technique and population, ranging from approximately 24-70% with transvaginal sonography and 56-84% with saline or gel instillation sonohysterography⁸. Many niches are not known to be associated with any symptoms, but those that have been linked to postmenstrual spotting, pelvic pain, dyspareunia, and reproductive complications⁹.

Another significant complication of a previous cesarean delivery is postoperative adhesion formation which can substantially complicate subsequent pelvic surgery³. Adhesions may cause obliteration of tissue planes and fixation of the bladder, uterus, bowel or omentum, making abdominal entry and pelvic dissection more difficult¹⁰. The external abdominal scar

characteristics and ultrasonographic sliding signs have been investigated previously as predictors of adhesion, and a recent systematic review and meta-analysis published in 2023 from 25 studies with 4,341 women found that a negative sliding sign indicated a sensitivity of 71% and specificity of 87% for predicting intra-abdominal adhesions¹¹. Previous meta-analysis studies indicated an association between depressed cesarean scars and adhesion, but highlighted the small sample size of studies and the need for more research¹².

As more and more women are having surgery repeatedly in their pelvis, there is a need to have reliable, non-invasive pre-operative markers that would alert the surgeon to potentially difficult operative conditions. The cesarean scar niche is easily detectable on transvaginal ultrasound and could be a sign of wound healing failure and also a sign of pelvic disease after cesarean section surgery. Establishing an association between CSN and pelvic adhesion formation, operative time, blood loss, and surgical difficulty could improve preoperative counselling, surgical planning, and anticipation of operative complications. Although both CSN and post-cesarean adhesions are common, this association has not been well explored, especially in the setting of subsequent pelvic surgery. Therefore, this study aims to evaluate whether the presence and characteristics of a cesarean scar niche predict pelvic adhesions and surgical difficulty among women undergoing repeat pelvic surgery, by comparing women with and without a sonographically detected cesarean scar niche.

MATERIAL AND METHODS

A comparative cross-sectional study was conducted in the Obs/Gynae and Surgery Department of Mardan Medical Complex, Mardan, over a period of six months from November 2022 to April 2023.

The sample size was determined using OpenEpi, Version 3.0, with 40.9% of women undergoing laparoscopic repair of cesarean scar niches reporting pelvic adhesion, 95% confidence level, 8% margin of error, design effect of 1, yielding a minimum sample size of about 145 participants¹³. To compensate for

Received on 10-10-2023

Accepted on 25-12-2023

approximately 10% potential non-response, incomplete records, or exclusion after recruitment, the sample size was increased to approximately 160 participants, with approximately 80 women allocated to the niche group and 80 to the non-niche group.

A consecutive sampling technique was used. Included were women aged 18- 50 years who had had at least one previous cesarean section and were undergoing elective repeat pelvic surgery. The participants had to have a documented previous cesarean scar and have a transvaginal ultrasonography performed to evaluate the cesarean scar before the surgery. Informed written consent was obtained from women. Current pregnancy, suspected or proven gynecological malignancy, congenital uterine anomaly, surgery to the abdomen or pelvis in the past that is likely to have affected adhesion formation, past pelvic inflammatory disease, severe endometriosis with known extensive adhesions, or lack of good visualization of the cesarean scar by ultrasound were exclusion criteria. Women who did not complete records of their clinical or surgical assessments and those who refused to participate in this study were also excluded from the study.

Following ethical approval and written informed consent, eligible participants were recruited, and a data collection proforma was used to collect the demographic and clinical data. Obstetric and surgical history, such as age, parity, previous cesarean sections, interval since last cesarean section, indication for previous cesarean delivery, the previous cesarean delivery type and history of postoperative wound infection, were recorded. Preoperative transvaginal ultrasonography was used to locate the cesarean scar niche. The width of the indentation at the site of the previous cesarean scar was defined as a niche, as indicated by the standardized definition in sonographic terms, and it was ≥ 2 mm. Niche characteristics, such as niche depth and residual myometrial thickness, were recorded. The participants were then grouped into niche and non-niche groups.

During the planned pelvic surgery, the presence, location, and severity of pelvic adhesions were assessed and documented by the operating surgeon using a predefined adhesion scoring system. Objective parameters such as the time of operation, blood loss, and necessity for adhesiolysis, bladder dissection difficulty, and the intraoperative injury of the surrounding organs were used to evaluate the operative difficulty. A record was also kept of bladder or bowel injury and other complications that occurred during surgery. The medical record was used for documentation of postoperative hospital stay and immediate postoperative complications. The classification of the ultrasound was done in advance, and the assessment of the adhesion was performed independently to minimize observer bias.

The data collected were entered and analyzed using SPSS version 26. Normally distributed continuous variables were expressed as mean $\pm$ standard deviation, and the median and interquartile range for non-normally distributed continuous variables were used. Categorical variables were presented in frequencies and percentages. The independent-samples t-test, Mann-Whitney U test, chi-square test, and Fisher's exact test were used to compare differences between women with and without a cesarean scar niche for continuous variables that were normally distributed, non-normally distributed continuous variables, and categorical variables, respectively. An odds ratio with a 95% confidence interval was used to determine the association between cesarean scar niche and pelvic adhesions. The following parameters were compared between the two groups: operative time, estimated blood loss, severity of adhesions, requirement for adhesiolysis, difficulty of bladder dissection, and the occurrence of complications during surgery. Stratification was done based on potential effect modifiers, such as age, number of previous cesarean section, parity, and interval since last cesarean section. A multivariable logistic regression was used to assess if the presence of a cesarean scar niche was an independent predictor of the presence of pelvic adhesions after adjusting for relevant confounding factors. The p-value ≤ 0.05 was regarded as statistically significant.

RESULTS

A total of 160 women were included in the repeat pelvic surgery, and the same number of women were included in each group of niche and non-niche. The two groups of women were not statistically different at the time of the study with regard to demographic and obstetric factors such as age, parity, number of previous cesarean sections, interval since last cesarean section, previous postoperative wound infection, and previous pelvic surgery. No statistically significant differences were observed between the groups for these characteristics. (Table 1)

The morphology and severity of the niche was shown to be variable among women with a cesarean scar niche, as assessed by ultrasound. The majority of niches had a simple triangular shape. The structural characteristics of the scar defect were highly variable, with over 50% showing a niche depth of at least 5 mm and about one-third with a residual myometrial thickness of less than 3 mm (Table 2)

The incidence of pelvic adhesions was significantly higher in women with a cesarean scar niche than in women without a niche. The severity of the adhesion was also higher in the niche group (especially severe adhesion), and the rate of vesicouterine and dense bladder adhesion was higher. Thus, adhesiolysis was performed significantly more frequently in the niche group. However, there was no statistically significant difference in the presence of bowel or omental adhesions between the groups. (Table 3)

For women having a cesarean scar niche, there was a greater degree of operative difficulty. They required longer operative time, a higher amount of blood loss, and more frequent difficult bladder dissection and extensive adhesiolysis. Intraoperative bladder and bowel injuries and conversion to an additional surgical approach were numerically more frequent in the niche group, but these differences were not statistically significant. Women with a niche were also more likely to stay longer in hospital. (Table 4)

The presence of a cesarean scar niche was significantly associated with pelvic adhesions on unadjusted analysis. This association also persisted after adjustment for potential confounding factors in multivariable logistic regression, suggesting that niche was independently associated with pelvic adhesions. Number of prior cesarean sections was also independently associated with adhesions, while age, prior wound infection, and time since the last cesarean section were not significant independent predictors. (Table 5)

Stratified analysis revealed that the relationship between cesarean scar niche and pelvic adhesions persisted in most age and cesarean-interval strata. There was also a significant association with women who had fewer previous cesarean sections, but not among women with three or more previous cesarean sections. The overall results showed that the cesarean scar niche was linked to increased burden of pelvic adhesion and increased surgical difficulty in the second pelvic surgery. (Table 6)

Table 1: Baseline demographic and obstetric characteristics of participants

Variable	Niche group (n=80)	Non-niche group (n=80)	p-value
Age (years), mean $\pm$ SD	34.6 $\pm$ 4.8	33.9 $\pm$ 5.1	0.374
Age ≥ 35 years	38 (47.5%)	33 (41.3%)	0.424
Parity, median (IQR)	3 (2-4)	3 (2-4)	0.691
≥ 3 previous pregnancies	55 (68.8%)	52 (65.0%)	0.607
Previous cesarean sections, median (IQR)	2 (2-3)	2 (1-3)	0.184
One previous CS	14 (17.5%)	22 (27.5%)	
Two previous CS	45 (56.3%)	43 (53.8%)	
≥ 3 previous CS	21 (26.3%)	15 (18.8%)	0.298
Interval since last CS (years), mean $\pm$ SD	5.1 $\pm$ 2.7	5.3 $\pm$ 2.9	0.651
Previous postoperative wound infection	9 (11.3%)	6 (7.5%)	0.426
Previous pelvic surgery other than CS	8 (10.0%)	6 (7.5%)	0.576

Table 2: Cesarean scar niche characteristics on transvaginal ultrasonography

Ultrasound characteristic	Niche group (n=80)
Niche depth (mm), mean $\pm$ SD	5.4 $\pm$ 2.1
Residual myometrial thickness (mm), mean $\pm$ SD	3.7 $\pm$ 1.4
Niche depth $\geq$ 5 mm	45 (56.3%)
Residual myometrial thickness <3 mm	27 (33.8%)
Simple niche	58 (72.5%)
Complex niche	22 (27.5%)
Triangular-shaped niche	51 (63.8%)
Rectangular/other morphology	29 (36.3%)

Table 3: Intraoperative pelvic adhesions according to cesarean scar niche status

Adhesion variable	Niche group (n=80)	Non-niche group (n=80)	p-value
Any pelvic adhesions	53 (66.3%)	32 (40.0%)	0.001
No adhesions	27 (33.8%)	48 (60.0%)	
Mild adhesions	21 (26.3%)	20 (25.0%)	
Moderate adhesions	20 (25.0%)	9 (11.3%)	
Severe adhesions	12 (15.0%)	3 (3.8%)	0.006
Vesicouterine adhesions	44 (55.0%)	24 (30.0%)	0.002
Dense bladder adhesions	18 (22.5%)	7 (8.8%)	0.013
Bowel/omental adhesions	17 (21.3%)	10 (12.5%)	0.145
Adhesiolysis required	49 (61.3%)	27 (33.8%)	<0.001

Table 4: Operative parameters and surgical difficulty

Operative variable	Niche group (n=80)	Non-niche group (n=80)	p-value
Operative time (minutes), mean $\pm$ SD	92.4 $\pm$ 24.7	72.1 $\pm$ 19.6	<0.001
Estimated blood loss (mL), median (IQR)	350 (250–500)	250 (200–350)	<0.001
Difficult bladder dissection	31 (38.8%)	13 (16.3%)	0.001
Need for extensive adhesiolysis	28 (35.0%)	12 (15.0%)	0.003
Intraoperative bladder injury	5 (6.3%)	1 (1.3%)	0.096
Bowel injury	2 (2.5%)	1 (1.3%)	0.560
Conversion to additional surgical approach	4 (5.0%)	1 (1.3%)	0.174
Hospital stay (days), median (IQR)	3 (2–4)	2 (2–3)	0.018

Table 5: Association between cesarean scar niche and pelvic adhesions

Variable	Pelvic adhesions present	Pelvic adhesions absent	Odds ratio (95% CI)	p-value
Cesarean scar niche present (n=80)	53 (66.3%)	27 (33.8%)	2.94 (1.52–5.69)	0.001
Cesarean scar niche absent (n=80)	32 (40.0%)	48 (60.0%)	Reference	

Table 6: Stratified analysis of factors associated with pelvic adhesions

Stratification variable	Niche group with adhesions	Non-niche group with adhesions	p-value
Age <35 years	28/42 (66.7%)	16/47 (34.0%)	0.006
Age $\geq$ 35 years	25/38 (65.8%)	16/33 (48.5%)	0.047
$\leq$ 2 previous CS	38/59 (64.4%)	23/65 (35.4%)	0.002
$\geq$ 3 previous CS	15/21 (71.4%)	9/15 (60.0%)	0.494
Interval <5 years	24/36 (66.7%)	13/37 (35.1%)	0.008
Interval $\geq$ 5 years	29/44 (65.9%)	19/43 (44.2%)	0.043

Table 7: Multivariable logistic regression for predictors of pelvic adhesions

Predictor	Adjusted OR	95% CI	p-value
Cesarean scar niche present	2.71	1.35–5.43	0.005
Age $\geq$ 35 years	1.32	0.68–2.58	0.415
$\geq$ 3 previous CS	2.08	1.01–4.29	0.047
Previous wound infection	1.76	0.62–5.00	0.288
Interval since previous CS <5 years	1.48	0.76–2.89	0.249

DISCUSSION

This comparative cross-sectional study aimed to determine if women with cesarean scars have more pelvic adhesions and require more surgical difficulty when undergoing repeat surgery. The main result was that women who had a cesarean scar niche

had significantly more pelvic adhesions than women who did not have a niche ($p=0.001$). In particular, severe adhesions were significantly more common in the niche group ($p=0.006$), as were vesicouterine and dense bladder adhesions. Additionally, women with a niche had a higher rate of adhesiolysis (61.3% vs 33.8%, $p<0.001$) than those without a niche. The results of this study indicate that the presence of a cesarean scar niche in a sonographically identified scar may be a sign of underlying pelvic adhesive disease and thus may have operative implications.

Dosedla et al. (2020) conducted a prospective cohort study of 200 women after cesarean delivery that supports this association between cesarean scar defects and pelvic adhesions. Vesicouterine pouch adhesions were found in 17% of women at 18 months, and severe cesarean scar defects were an independent risk for adhesion development. The magnitude of association in our study was similar; having a cesarean scar niche was associated with almost threefold greater risk of pelvic adhesion. The association was still significant after adjustment for other factors ($p=0.005$), further supporting the possibility that the association was not fully explained by maternal age, number of previous cesareans, wound infection, or interval since cesarean delivery.¹⁴

Increased vesicouterine adhesion in women with a niche is particularly consistent with the observations of Dosedla et al., who specifically showed that severe scar defects were associated with adhesion in the vesicouterine pouch. It is hypothesized that the lower uterine segment may not completely heal, and these inflammatory and fibrotic processes may also be present in the area around the prior uterine scar. The formation of adhesions can then attach the front portion of the uterus to the bladder or abdominal wall, making it harder to remove the uterus later on. But it is not a longitudinal study, so it is uncertain whether the cross-sectional association seen in the present study is a direct cause of the adhesion, or whether there are shared factors between previous cesarean delivery and the occurrence of adhesion.¹⁴

The general trend and severity of adhesion in our study are also similar to the findings of other studies assessing external indicators of prior cesarean scar healing. In a prospective study by Kokanali et al. (2019), 104 women who had had a previous cesarean section were followed up for laparoscopic surgery, and 82 women were found to have adhesion in the lower abdominal/pelvic region. Multiple cesarean scars and palpable scar characteristics were associated with adhesions, and scar scores correlated positively with adhesion severity. The study focused on the scar in the abdominal wall, not an ultrasound-determined uterine niche, but both of these studies support the concept that the characteristics of the previous cesarean healing may give information about the risk for intra-abdominal adhesions.¹⁵

In the same manner, Seven et al. (2020) studied 102 women who had undergone repeat cesarean delivery and found that 40.2% of these women had no adhesion, 17.6% had mild adhesion, 25.5% had moderate adhesion, and 16.7% had severe adhesion. The preoperative shear-wave elastographic stiffness of the previous cesarean scar was significantly correlated with the total adhesion scores ($r=0.397$, $p<0.001$), with higher stiffness corresponding to moderate or severe adhesion. These findings support our results, showing that information obtained from the previous cesarean scar prior to surgery can provide information about the degree of intra-abdominal fibrosis. However, in our study, the marker was the internal uterine niche, not skin-scar stiffness, which may give a more anatomically direct assessment of the previous uterine incision.¹⁶

The features of the niches found in our study were also similar to those previously reported by sonography. The mean niche depth in the niche group was 5.4 ± 2.1 mm, while the mean residual myometrial thickness was 3.7 ± 1.4 mm, and 56.3% had a niche depth ≥ 5 mm and 33.8% had residual myometrial thickness <3 mm. In 63.8% of the women, a triangular shape was observed. Park et al. (2018), in a study of 404 women with previous cesarean

delivery, reported a 73.8% prevalence of isthmocele and found that the majority were triangular in shape (65.4%). They also showed relationships between isthmocele formation and factors including repeat cesarean delivery and other obstetric factors. This niche similarity with their study and ours confirms the repeatability of this niche configuration commonly observed¹⁷

In a prospective study of 401 women, Antila-Långsjö et al. (2018) also examined the cesarean scar defects, finding that 371 women completed the sonohysterographic examination around six months after cesarean section. They observed that the prevalence of the niche was 45.6%, and they established elevated BMI, gestational diabetes, and previous cesarean delivery as independent risk factors for scar defects. However, their results highlight the importance of multiple obstetric and maternal parameters as a multi-pathway process for cesarean scar niche formation. This is important because the niche was associated with pelvic adhesions in our multivariable model even after controlling for age, previous cesarean number, wound infection, and interval since cesarean delivery¹⁸

A prospective longitudinal study by Antila-Långsjö et al. on cesarean scars during pregnancy adds to our ultrasound measurements. The median niche depth was 6.9 mm in the first trimester of pregnancy, and the median residual myometrial thickness was 4.7 mm in 122 women. There was also good interobserver agreement for scar and remaining myometrium measurements. The mean niche depth of 5.4 mm and residual myometrial thickness of 3.7 mm in our study are within a similar general range, but should be considered with some caution when comparing these two directly, as the timing and physiological state of the ultrasound assessment varied between studies¹⁸

The importance of the accuracy of sonographic characterization of the niche was also demonstrated by Alalfy et al. (2020), who compared two-dimensional and three-dimensional sonohysterography in women with previous cesarean delivery and secondary infertility. They focused on the measurement of niche depth, niche width, the thickness of the residual myometrium, and ratios of residual myometrium thickness and niche width, and 3D sonohysterography showed more accurate visualization of the residual myometrium and niche width. This helps, on the one hand, to validate the use of quantitative niche parameters in the present study instead of just a binary classification of niche presence or absence. The percentage of women with reduced residual myometrial thickness within our study suggests that the morphological severity of the defect might be important in predicting a difficult pelvic dissection¹⁹

Budny-Winska et al. (2021) evaluated 204 women using two- and three-dimensional transvaginal ultrasound and found niches in 153 women. Importantly, women with more than one previous cesarean had lower residual myometrial thickness and lower residual-myometrium-to-adjacent-myometrium ratios than women with a single previous cesarean. The number of previous cesareans was also important with respect to adhesion formation in our study: the women with ≥ 3 previous cesareans had a higher adjusted association with adhesions in the multivariable model ($p=0.047$). This indicates that local scar abnormality and the surgical history may play a role in the development of pelvic adhesions.²⁰

Similarly, the correlation between the number of cesarean deliveries and abnormalities of the scars is also consistent with Park et al. (2018), who found that the number of previous cesareans is a major risk factor for isthmocele development. However, it was statistically significant in women with ≤ 2 previous cesareans but not in those with ≥ 3 previous cesareans as a result of stratified analyses. This may be due to the relatively low number of women in the ≥ 3 -cesarean stratum and the very high rate of adhesions at baseline due to multiple cesareans, making it difficult to detect an independent effect of the niche.¹⁷

In the present study, women with niches were also shown to have greater operative difficulty. Mean operative time was approximately 20 minutes longer in the niche group ($p<0.001$),

while median blood loss was higher ($p<0.001$). Difficult bladder dissection and extensive adhesiolysis were also significantly more frequent in women with niches. The findings are clinically feasible, as it is often possible that the vesicouterine and dense bladder adhesions will mask the normal tissue planes and make bladder mobilization more time-consuming to expose the lower uterine segment. The work of Seven et al. showing that the characteristics of preoperative scars correlate with the severity of intra-abdominal adhesions indirectly supports the notion that a preoperative assessment of scars helps predict the complexity of an operation¹⁶

Interestingly, the incidence of intraoperative bladder injury was higher in the niche group (6.3% vs. 1.3%), though not statistically significant ($p=0.096$). The same was found with bowel damage and transition to a different surgical option, which was numerically higher but not statistically significant. The results should therefore be treated as trends and not as a definite association. This may be due in part to the relatively small number of adverse events and to the small number of patients (160) in this study. However, the greater number of challenging bladder dissections and the long adhesiolysis offer a clinically relevant explanation for the increased operative time and blood loss²¹

The importance of accurate niche definition and characterization has been confirmed by the literature from 2022. Antoine et al. analyzed the post-cesarean niches by saline infusion sonohysterography and stressed the assessment of niche prevalence, depth, width, length, and residual myometrial thickness. Likewise, the multicentre prospective study of women examined 6 months after C-section found that isthmocèles were common post-C-section findings, but failed to demonstrate a significant association with symptomatology. Our study is clinically relevant because we were specifically examining an outcome other than symptomatic disease, namely, that these were associated with objectively documented intraoperative adhesions and surgical difficulty.²²

In general, the findings of the present study are in accordance with the available literature, which indicated that cesarean scar abnormalities are correlated with impaired scar healing and that characteristics of the previous cesarean scar can give information about subsequent pelvic adhesions. The most robust association in our study was that between niche and adhesion, after multivariable adjustment, with an adjusted OR of 2.71. A sonographic finding of a cesarean scar niche could therefore be useful as a pre-operative index of the presence of pelvic adhesions. However, this is a comparative cross-sectional study, and it is not possible to determine any cause-and-effect relationship. Furthermore, there are other factors that are not measured in the relationship between the two, including surgical technique at previous cesareans, closure of the peritoneum, surgeon experience, severity of postoperative infection, uterine position, and healing capacity. Therefore, larger prospective studies with standardized ultrasound niche measurements and direct intraoperative adhesion scoring would be beneficial for validation of the predictive value of the cesarean scar niche for surgical difficulty.

Limitations: There were some limitations in the study. The comparative cross-sectional design did not allow for a causal relationship between cesarean scar niche and the presence of pelvic adhesions to be determined. The study was performed at a single centre, and the number of patients was small, which may restrict the applicability of the study and the statistical power for rare events, including bladder and bowel injury. Previous surgical procedures for cesarean section, postoperative infection, closure of the peritoneum, and the wound healing process were not fully controlled. Furthermore, the niche morphology measured using ultrasound can vary according to the operator's experience and measurement. More prospective studies, with standardized ultrasound and intraoperative scoring for the adhesions, are needed, preferably larger multicenter studies.

CONCLUSION

Pelvic adhesions, specifically the presence of vesicouterine and strong bladder adhesions, and greater operative difficulty during repeated pelvic surgeries were significantly associated with a cesarean scar niche. The association persisted even after controlling for potential confounding factors, indicating that a cesarean scar niche could be a helpful preoperative indicator of potential adhesions and difficult pelvic surgery. The use of standardized niche assessment in the pre-operative evaluation process may help to improve surgical planning and risk anticipation.

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This article may be cited as: Said J., Masood S., Khan H., Ali A., Latif G., Evaluation of Cesarean Scar Niche as a Predictor of Pelvic Adhesions and Surgical Difficulty in Women Undergoing Repeat Pelvic Surgery: A Comparative Cross-Sectional Study. *Pak J Med Health Sci*, 2023;17(12):926-930.