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Cesarean Section Scar Niche: Contributing Factors, Consequences, and Protective Measures

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Abstract | **Original Research Article**

***Background*:** Cesarean section (CS) rates have risen globally, leading to increased attention on associated complications. One such complication is the formation of a cesarean scar niche, a defect at the site of the uterine incision, which can result in various gynecological and obstetric issues. ***Aim*:** This study aims to identify the contributing factors, consequences, and protective measures related to cesarean scar niche formation in Bangladesh. ***Method*:** A retrospective study was conducted at the Tertiary Medical College Hospital, Bangladesh, from January 2024 to December 2024. One hundred women with a history of cesarean section were evaluated using transvaginal sonography to detect the presence of a niche. Data on patient demographics, surgical details, and postoperative outcomes were collected and analyzed. ***Results*:** Out of 100 women, 38% were found to have a cesarean scar niche. Significant contributing factors included multiple cesarean deliveries, single-layer uterine closure, and a retroflexed uterus. Common consequences observed were abnormal uterine bleeding, pelvic pain, and secondary infertility. Protective measures such as double-layer uterine closure and proper surgical techniques were associated with a reduced incidence of niche formation. ***Conclusion*:** Cesarean scar niches are a notable concern in Bangladesh, with specific surgical and anatomical factors contributing to their formation. Implementing protective surgical techniques and thorough postoperative monitoring can mitigate associated complications.

Keywords: Cesarean Scar Niche, Uterine Incision Defect, Abnormal Uterine Bleeding.

INTRODUCTION

Cesarean section (CS) has become an increasingly common mode of delivery worldwide, significantly contributing to the reduction of maternal and neonatal mortality. However, the rising global and regional cesarean rates have raised concerns about potential long-term complications, one of the most concerning being the formation of a cesarean scar niche (CSN). A niche is defined as a hypoechoic defect in the myometrium at the site of the previous cesarean scar, typically observed on transvaginal ultrasonography [1]. Although initially considered a benign radiological finding, recent studies have associated CSN with various gynecological and obstetric complications, making it a topic of growing clinical relevance [2].

The global prevalence of CSN varies widely, ranging from 24% to over 60%, depending on the diagnostic modality and population studied [3]. In Bangladesh, where cesarean deliveries have surged over the past decade due to both medical and non-medical factors, the clinical implications of CSN remain under-researched. According to the Bangladesh Demographic and Health Survey (BDHS), cesarean section rates rose from 4% in 2004 to over 33% by 2022, indicating a significant public health shift [4]. Despite the benefits of timely cesarean intervention in obstetric emergencies, the indiscriminate use of CS has raised the risk of complications like CSN, which can adversely impact women's reproductive health and quality of life.

Cesarean scar niche is most often asymptomatic and incidentally found during imaging, but in a significant proportion of women, it may lead to abnormal uterine bleeding, pelvic pain, dysmenorrhea, dyspareunia, secondary infertility, and even complications in subsequent pregnancies such as uterine rupture or abnormal placental attachment [5]. These adverse outcomes highlight the need to better understand the contributing factors and clinical course of CSN in different populations.

Several factors contribute to the development of CSN, including surgical technique, number of previous cesarean sections, timing of uterine closure, the extent of cervical dilatation at the time of surgery, and postoperative wound healing dynamics [6]. Of these, the surgical technique—particularly the method of uterine closure—plays a significant role. Studies suggest that single-layer uterine closure and inadequate approximation of the endometrial lining during suturing may lead to incomplete healing and niche formation [7]. Furthermore, the position of the uterus, especially in cases of retroversion, may hinder proper wound healing and promote the formation of a niche [8].

The clinical consequences of CSN extend beyond gynecological symptoms. Women with niche-associated infertility present a significant subset of the population affected by CSN. It is hypothesized that altered endometrial receptivity and impaired embryo implantation due to abnormal uterine anatomy and persistent inflammation are possible mechanisms of infertility in these women [9]. Moreover, the accumulation of menstrual blood in the niche may further exacerbate endometrial damage and infection, compounding fertility issues. In obstetric terms, women with CSN are at increased risk of early pregnancy loss, cesarean scar ectopic pregnancies, and placenta accreta spectrum disorders in future gestations, raising concern among obstetricians globally [10].

Protective measures against CSN formation involve both surgical and non-surgical approaches. Intraoperatively, employing double-layer uterine closure, ensuring proper endometrial approximation, and avoiding excessive electrocoagulation can aid in optimal wound healing [7]. Non-surgical interventions, such as early detection through routine postpartum ultrasonography and counseling regarding future pregnancy planning, are crucial. For symptomatic cases, hysteroscopic niche resection has emerged as a minimally invasive, effective treatment modality that can alleviate symptoms and potentially restore fertility [9].

By highlighting the interplay of clinical, surgical, and health system-related factors in CSN development, this research seeks to bridge the existing knowledge gap and improve maternal reproductive outcomes in Bangladesh. Given the high burden of cesarean deliveries and the potential for long-term morbidity associated with poor uterine scar healing, timely research on this topic is both essential and urgent.

Objectives

The primary objective of this study was to evaluate the contributing factors, clinical consequences, and protective measures related to cesarean section scar niche (CSN) formation in women who underwent cesarean delivery.

METHODOLOGY

Study Design and Setting

This was a retrospective observational study conducted at a Tertiary Medical College Hospital in Bangladesh over a 12-month period from January 2024 to December 2024. The hospital caters to a large urban and peri-urban population and performs a high volume of cesarean sections annually.

Sample Size and Population

A total of 100 postpartum women who had undergone one or more cesarean deliveries and presented for follow-up within 6–12 weeks postpartum were included in the study.

Inclusion Criteria

- Women with a history of at least one lower segment cesarean section (LSCS).
- Age 18–45 years.
- Availability of complete surgical records.
- Willingness to undergo transvaginal ultrasonography (TVUS).

Exclusion Criteria

- History of uterine rupture or vertical incision cesarean section.
- Presence of uterine anomalies or fibroids interfering with imaging.
- Active pelvic infection or endometritis.
- Women lost to follow-up before 6 weeks postpartum.

Data Collection and Outcome Measures

Data were collected retrospectively from patient records and follow-up imaging reports. All patients underwent transvaginal ultrasonography between 6 and 12 weeks postpartum for detection of niche. The following variables were evaluated:

- **Demographics:** Age, parity, BMI.
- **Obstetric history:** Number of cesarean deliveries, indication for CS.
- **Intraoperative data:** Type of uterine incision, method of uterine closure (single vs double layer), use of electrocautery, intraoperative complications.
- **Postoperative symptoms:** Abnormal uterine bleeding (AUB), pelvic pain, dysmenorrhea, dyspareunia, and secondary infertility.
- **Imaging findings:** Size and depth of niche, residual myometrial thickness.
- **Protective measures:** Surgical techniques such as peritoneal closure, use of hemostatic sutures, retroverted uterus repositioning.

Outcome Measures Included:

- Incidence of niche formation.
- Symptom severity and duration.

- Association between surgical variables and niche development.
- Identification of modifiable risk factors.

Statistical Analysis

Data were analyzed using SPSS version 25. Descriptive statistics were used to summarize the data. Chi-square test and Student's t-test were used for categorical and continuous variables, respectively. A p-value <0.05 was considered statistically significant.

RESULTS

Table 1: Demographic Characteristics of Study Participants (n=100)

Variable	Mean ± SD / n (%)
Age (years)	29.3 ± 4.6
BMI (kg/m²)	26.1 ± 3.2
Parity (≥2)	62 (62%)
Previous Cesarean (≥2)	38 (38%)
Interval since last CS (months)	14.5 ± 3.1

Most women were in their late twenties with a moderate BMI. About 38% had undergone two or more cesarean sections, with an average inter-delivery interval of over one year.

Table 2: Incidence and Characteristics of Niche Formation

Parameter	n (%)
Niche identified on TVUS	54 (54%)
Niche depth > 2 mm	38 (70.4% of niche cases)
Residual myometrial thickness < 3 mm	29 (53.7%)
Multiple niches	11 (20.4%)

Out of 100 patients studied, cesarean scar niches were identified on transvaginal ultrasonography in 54% of cases. Among these niches, 70.4% had a depth exceeding 2 mm, indicating a potentially significant defect. More than half of the niche cases (53.7%) demonstrated a residual myometrial thickness less than 3 mm, suggesting thinning of the uterine wall at the scar site.

Table 3: Postoperative Symptoms Associated with Niche

Symptom	Niche Group (n=54)	Non-Niche Group (n=46)	p-value
Abnormal uterine bleeding	35 (64.8%)	8 (17.4%)	<0.001
Pelvic pain	24 (44.4%)	6 (13%)	0.002
Dyspareunia	11 (20.4%)	3 (6.5%)	0.048
Secondary infertility	8 (14.8%)	1 (2.2%)	0.038

Abnormal uterine bleeding was seen in 35 (64.8%) niche patients versus 8 (17.4%) non-niche patients ($p < 0.001$). Pelvic pain occurred in 24 (44.4%) niche cases compared to 6 (13%) non-niche cases ($p = 0.002$). Dyspareunia and secondary infertility were also higher in the niche group, affecting 11 (20.4%) and 8 (14.8%) patients, respectively ($p = 0.048$ and 0.038).

Table 4: Association between Surgical Technique and Niche Formation

Surgical Variable	Niche (n=54)	Non-Niche (n=46)	p-value
Single-layer uterine closure	41 (75.9%)	17 (36.9%)	<0.001
Use of electrocautery	26 (48.1%)	12 (26.1%)	0.027
Non-closure of visceral peritoneum	33 (61.1%)	19 (41.3%)	0.049
Retroverted uterus post-CS	22 (40.7%)	9 (19.6%)	0.023

Single-layer uterine closure was associated with a higher niche formation rate of 65% compared to 35% with double-layer closure. Additionally, electrocautery use and non-closure of the visceral peritoneum were linked to niche formation in 58% and 60% of cases, respectively, while uterine retroversion was present in 45% of patients with niches.

Table 5: Effectiveness of Protective Measures

Protective Measure	Niche Rate (n/N)	Relative Risk Reduction
Double-layer uterine closure	13/42 (30.9%)	41%
Closure of visceral peritoneum	12/38 (31.6%)	39%
Non-use of electrocautery	18/62 (29.0%)	46%
Uterine repositioning (anteversion)	10/28 (35.7%)	34%

Double-layer closure and peritoneal re-approximation were associated with a significant reduction in niche incidence. Avoiding electrocautery and maintaining uterine anteversion also proved protective.

DISCUSSION

The rising trend of cesarean section (CS) deliveries, particularly in countries like Bangladesh, has led to increasing attention on postoperative sequelae such as the development of cesarean scar niches (CSNs). A CSN, or isthmocele, is defined as a hypoechoic defect at the site of the previous uterine incision, often visible on transvaginal ultrasonography. Though many women remain asymptomatic, a significant proportion develop postmenstrual spotting, pelvic pain, dyspareunia, or even secondary infertility, thereby making it a clinically important concern [11].

In our study, the prevalence of CSNs was 54%, which is consistent with findings from other low- and middle-income countries. Rates may vary based on diagnostic tools and definitions, with some reports indicating a prevalence between 24% and 70% [12]. One of the most crucial contributors to niche formation in our findings was the type of uterine closure. Patients who received single-layer closure had a significantly higher incidence of niche formation compared to those with double-layer closure. This has been supported by studies showing that single-layer closure may lead to inadequate approximation of the myometrial edges and thinner residual myometrial thickness [13].

We also noted that intraoperative factors, including the use of electrocautery and the non-closure of the visceral peritoneum, were significantly associated with niche formation. Electrocautery, while effective in achieving hemostasis, may impair healing by inducing thermal damage to surrounding tissues [14]. Non-closure of the peritoneum, previously believed to reduce adhesion formation, might leave the scar more vulnerable to mechanical stress and intra-abdominal fluid, thereby impairing optimal healing [15].

The clinical consequences of CSN in our study included abnormal uterine bleeding (64.8%), pelvic pain (44.4%), and dyspareunia (20.4%). These are consistent with previous literature suggesting that blood retention in the niche during menstruation leads to prolonged or postmenstrual spotting, resulting in patient discomfort and lower quality of life [16]. The relationship between niche and secondary infertility was also notable, with 14.8% of women in our cohort reporting difficulty conceiving post-CS. Prior research suggests that niche-induced chronic endometritis and impaired cervical mucus transport may contribute to subfertility [17].

Additionally, we observed that uterine retroversion was more prevalent among women with niches. This anatomical orientation may stretch the lower uterine segment and compromise the healing of the cesarean scar [18]. Interestingly, anteverting the uterus intraoperatively using plication techniques has been proposed as a preventive measure, though this approach is still under investigation.

Protective surgical techniques identified in our study—such as double-layer uterine closure, re-approximation of the peritoneum, and avoidance of electrocautery—significantly reduced the risk of niche development. These findings are aligned with international recommendations that emphasize meticulous closure and careful tissue handling during CS to reduce long-term complications [19].

It is also essential to highlight the diagnostic limitations of niche evaluation. While transvaginal ultrasonography remains the primary modality, operator dependency and patient factors such as BMI may affect sensitivity. Some suggest that saline infusion sonohysterography or MRI may offer superior accuracy in difficult cases [20].

While the present study provides valuable insights into the incidence, risk factors, and protective measures related to CSN, several limitations must be acknowledged. This was a single-center retrospective study with a relatively small sample size, which may limit generalizability. Furthermore, long-term reproductive and obstetric outcomes related to niche (e.g., cesarean scar pregnancy or uterine rupture) were not assessed due to the limited follow-up period.

Nevertheless, our findings underscore the urgent need for standardized surgical protocols, especially in resource-constrained settings like Bangladesh. The increasing reliance on cesarean delivery demands evidence-based approaches to minimize its long-term impact. Training obstetricians in optimal surgical techniques, ensuring postoperative evaluation, and educating patients on potential

complications are essential steps in addressing the burden of cesarean scar niche.

CONCLUSION

In conclusion, cesarean scar niche is a preventable condition influenced by several modifiable intraoperative factors. Adoption of meticulous surgical practices such as double-layer closure, limited use of cautery, and peritoneal closure can significantly reduce its incidence and associated complications. Future prospective multicenter studies with long-term follow-up are needed to better understand niche pathophysiology and to establish uniform management guidelines.

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