Ultrasonographic Diagnosis of Cesarean Section Niche in Correlation with Clinical Symptoms in Non-Pregnant Women

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Abstract

Background: Cesarean section (CS) scars can develop into niches, which are triangular anechoic areas at the site of the CS incision indicating defective tissue healing and usually associated with various gynecological symptoms. However, the prevalence and clinical significance of niches remain debated.

Objectives: This study aimed to investigate the prevalence of niches in women with previous CS, and to correlate their presence with the clinical symptoms.

Methods: A cross-sectional study was conducted on 100 women with previous one or two CS evaluated within 6 months after delivery. Trans-vaginal ultrasound (TVUS) was used to identify the niche and to measure its length, depth, width in addition to the residual myometrial thickness (RMT). Patients were then classified as symptomatic or asymptomatic based on the niche related gynecological symptoms.

Results: From women attending the Ob&Gyn clinic within 6 months post CS uterine niche was detected in 100 women during routine TVUS examination. 68 women (68%) were symptomatic and 32(32%)were asymptomatic. Symptoms included menstrual irregularity (35.0%), Dysmenorrhea (36%) Chronic pelvic pain (27%). The most common symptom was Postmenstrual spotting reported in in all symptomatic group (68%) followed by dyspareunia that was reported only in (52.0%) of the patients. Comparing the symptomatic and asymptomatic groups showed that: Age and BMI were significantly higher in symptomatic group (P value is 0.002 and 0.016) respectively. The depth and the width of the niche were significantly higher in symptomatic group (P value 0.027 and <0.001) respectively while Residual myometrium was significantly lower in symptomatic patients (p value <0.001) The number of patients with rectangular niche was significantly higher in symptomatic group (P value 0.003).The number of patients was intra-niche fluid was significantly higher in symptomatic group compared to asymptomatic one (P value <0.001). A significant correlation was found between niche size and symptom severity (p value <0.01).

Conclusions: Uterine niche is a reported complication following CS, with significant clinical implications. Uterine niche is presented in variable sizes and shapes with positive correlation to the severity of the niche related symptoms. Accurate diagnosis with imaging techniques is essential.

Keywords: Uterine Niche, Cesarean Section, Trans-vaginal Ultrasound, Postmenstrual Spotting.

1-Introduction

In recent decades, cesarean section (CS) deliveries have significantly increased in developed countries, raising concerns about long-term complications such as uterine rupture, CS scar pregnancy, and pathologically adherent placenta in future pregnancies [1]. Recently, several studies have identified a niche at the CS scar site resulting from defective tissue healing, defined as a triangular anechoic area observed via ultrasound (US). This myometrial indentation is characterized by a specific depth, but a universally accepted definition of a niche remains debated. Alternative terms describing this pathology include cesarean scar defect, deficient cesarean scar, diverticulum, pouch, and isthmocele [2].Interest in the clinical significance of a niche at CS scars has surged in recent years, leading to an increasing number of published studies. Various methods for detecting and measuring a niche have been described, primarily utilizing trans-vaginal 2D and 3D sonography, as well as contrast-enhanced sonohysterography. Fewer studies have employed hysteroscopy or hysterosalpingography; however, none of these diagnostic methods is currently regarded as the gold standard [3].Currently, there is no consensus on the gold standard for detecting and measuring a niche at CS scars. Since not all women with a history of cesarean delivery develop a niche, identifying risk factors for its occurrence is crucial. Additionally, there is increasing interest in the potential associations between a niche and

various gynecological symptoms, as well as the underlying mechanisms contributing to these symptoms [4]. The presence of a niche is linked to multiple symptoms, including abnormal uterine bleeding such as prolonged menstruation and postmenstrual spotting in approximately 30% of affected women. Other reported symptoms include dysmenorrhea, chronic pelvic pain, and dyspareunia. Furthermore, the retention of blood, mucus, and fluid within the niche, cervix, and uterus may contribute to secondary subfertility, potentially hindering sperm penetration or embryo implantation [5].Various therapies such as laparoscopic and hysteroscopic niche resection have proven effective in reducing postmenstrual spotting and improving patient satisfaction. Although niche-related symptoms after CS are not life-threatening, they can lead to long-term morbidity, impacting quality of life [6]. In addition to these symptoms, uterine niches are increasingly recognized for their potential role in future obstetric complications, such as abnormal placentation and increased risk of emergency CSs in women attempting vaginal birth after cesarean [7]. Accurate, non-invasive diagnosis is crucial for effective management.

Our study aims to diagnose the presence of niche in patients with previous CS by trans-vaginal ultrasound (TVUS) either symptomatic or asymptomatic with correlation to niche related gynecological symptoms.

2-Patients and methods

This comparative cross-sectional study was carried out at Obstetrics and Gynecology Clinic, Faculty of Medicine, Benha University on 100 Patients during the period from January 2023 to March 2024. An approval from Benha Research Ethics Committee of Faculty of Medicine Benha University was obtained. An informed written consent was also obtained from patients before enrollment. The study included women with history of one or two CS with no serious postoperative complication within 6 months after delivery. Women with any pelvic pathology or using intrauterine devices as contraception excluded from the study. In this study, all selected patients underwent a comprehensive evaluation, including detailed history taking, clinical examination [Abdominal examination of CS scar and incisional hernia, Local examination: vaginal bleeding, vaginal discharge, local tenderness or cervical motion tenderness], and review of prior investigations.TVUS was performed for detecting and measuring a CS niche, including its length, depth, width, and residual myometrial thickness (RMT), during the postmenstrual or mid-follicular period using Mindray DC-70 Exp TVUS with a semi-filled bladder. After diagnosis of the uterine niche patients were classified into symptomatic and asymptomatic with correlation of niche-related gynecological symptoms. When evaluating a uterine niche, five key rules were followed [8]: in women with a previous CS undergoing US for gynecological symptoms or infertility, saline or gel contrast sonohysterography (SCSH or GIS) was recommended if no niche was detected without intrauterine fluid. Niche measurements excluded the endometrium, with length, depth, and width measured in the plane where the niche appeared largest, which might not always be mid-sagittal or mid-transverse. RMT was measured in its thinnest part, and the transverse plane was used only for width and branch identification.

A four-step roadmap was proposed for evaluating and measuring uterine niches. First, it is crucial to optimize ultrasound machine settings by adjusting the sector angle for a clear view of the entire uterus. The depth should be set to visualize the uterus fully, with focal depth focused on the niche. Scanning is performed in two directions, the sagittal plane from right to left and the transverse plane from the cervix to the fundus, to ensure an optimal view and rule out any uterine pathology before making measurements.

Statistical methods

Data analysis was performed by SPSS software, version 25 (SPSS Inc., PASW statistics for windows version 25. Chicago: SPSS Inc.). Qualitative data were described using number and percentage. Quantitative data were described using median (minimum and maximum) for non-normally distributed data and mean± Standard deviation for normally distributed data after testing normality using Kolmogrov-Smirnov test. Significance of the obtained results was judged at the (≤0.05) level. Chi-Square, Fisher exact test, Monte Carlo tests were used to compare qualitative data between groups as appropriate

3-Results

The age of patients with a uterine niche ranged from 18 to 41 years, with a mean of 30.8 ± 4.59 years. Among them, 57 patients (57.0%) had one previous CS, while 43 patients (43.0%) had two. The body mass index (BMI) varied from 19 to 36 kg/m², averaging 26.37 ± 3.54 kg/m². Regarding niche related gynecological symptoms 68 women were symptomatic (68%) while 32 were asymptomatic (32%). In terms of menstrual regularity, 65 patients (65.0%) experienced regular cycles, while 35 (35.0%) reported irregular cycles, with menstruation occurring every 15 to 31 days (mean: 24.46 ± 3.2 days) and lasting 4 to 10 days (mean: 5.38 ± 1.43 days). Symptomatically, 68% of patients had postmenstrual spotting, 52% experienced dyspareunia, and 33% reported deep pelvic pain. **(Table 1)**

(Table 1): Demographic data, and symptoms history

		Niche patients(n =100)
Age (year)	Mean ± SD	30.8 ± 4.59
	Range	18 - 41
Number of previous CS	1	57 (57.0%)
	2	43 (43.0%)
BMI (kg/m²)	Mean ± SD	26.37 ± 3.54
	Range	19 - 36
Symptomatic		68 (68%)
Asymptomatic		32 (32%)
Time between menstruations (days)	Mean ± SD	24.46 ± 3.2
	Range	15 - 31
Duration (days)	Mean ± SD	5.38 ± 1.43
	Range	4 - 10
Postmenstrual spotting	Yes	68 (68%)
	No	32 (32%)
Dysmenorrhea	Yes	36 (36%)
	No	64 (64%)
Chronic pelvic pain	Yes	27 (27%)
	No	73 (73%)
Dyspareunia	Yes	52 (52.0%)
	No	48 (48.0%)
Deep pelvic pain	Yes	33 (33.0%)
	No	67 (67.0%)

CS: caesarean section, SD: Standard deviation; BMI: Body mass index.

The depth of the niche ranged from 1 to 19 mm (mean: 7.57 ± 4.44 mm), the width from 1 to 14 mm (mean: 4.85 ± 3.24 mm), and the residual myometrium from 1 to 7 mm (mean: 3.19 ± 1.37 mm). The uterine position was anteverted-flexed (AVF) in 83 patients (83.0%) and retroverted-flexed (RVF) in 17 (17.0%). The most common niche shape was triangular (53.0%), followed by rectangular (21.0%) and oval (20.0%), with semicircular being the least common (6.0%). Intra-niche fluid was present in 43 patients (43.0%). **(Table 2)**

(**Table 2**): Niche description regarding trans-vaginal ultrasonography data

Depth of Niche (mm)	Mean ± SD	7.57 ± 4.44
	Range	1 - 19
Width of Niche (mm)	Mean ± SD	4.85 ± 3.24
	Range	1 - 14
Residual myometrial thickness (mm)	Mean ± SD	3.19 ± 1.37
	Range	1 - 7
Position of uterus	AVF	83 (83.0%)
	RVF	17 (17.0%)
Shape of niche	Oval	20 (20.0%)
	Rectangular	21 (21.0%)
	Semi circular	6 (6.0%)
	Triangular	53 (53.0%)
Intra-niche fluid	Yes	43 (43.0%)
	No	57 (57.0%)

AVF: Anteverted flexed; RVF: Retroverted flexed, SD: Standard deviation

Comparing symptomatic and asymptomatic groups, the study found that age and BMI were significantly higher in the symptomatic group compared to the asymptomatic one. However, there was no significant difference in the number of previous CS between the two groups. Notably, the number of patients with regular menstruation was significantly lower in the symptomatic group (p < 0.001), while the number of patients experiencing dyspareunia was significantly higher. Additionally, there were no significant differences in the timing between menstruations or the duration of each menstruation between the groups (**Table 3**)

(**Table 3**): Comparison of the Baseline characteristics, Menstrual and symptoms history in the studied groups

		Symptomatic (n =68)	Asymptomatic (n =32)	P value
Age (year)	Mean ± SD	32.51 ± 3.49	27.16 ± 4.55	**0.002***
	Range	25 - 41	18 - 36	
Number of previous CS	1	37 (54.4%)	20 (62.5%)	0.519
	2	31 (45.6%)	12 (37.5%)	
BMI (kg/m^2)	Mean ± SD	27.13 ± 3.72	24.75 ± 2.5	**0.016***
	Range	19 - 36	20 - 33	
Regularity	Regular	33 (48.5%)	32 (100.0%)	**<0.001***
	Irregular	35 (51.5%)	0 (0.0%)	
Time between menstruations(days)	Mean ± SD	24.15 ± 3.27	25.13 ± 2.97	0.379
	Range	17 - 31	15 - 29	
Duration (days)	Mean ± SD	5.57 ± 1.6	4.97 ± 0.86	0.722
	Range	4 - 10	4 - 7	
Dyspareunia	Yes	52 (76.5%)	0 (0.0%)	**<0.001***
	No	16 (23.5%)	32 (100.0%)	

BMI: Body mass index SD: Standard deviation; *statistically significant as p value <0.05

The depth and width of the niche were significantly greater in symptomatic patients, while the residual myometrium was significantly lower. Furthermore, the symptomatic group had a higher prevalence of rectangular-shaped niches, whereas the prevalence of triangular-shaped niches was significantly lower. The occurrence of intra-niche fluid was also significantly higher in symptomatic patients compared to asymptomatic ones. **(Table 4)**

Table 4: Comparison of the Trans-vaginal ultrasonography data of both groups

		Symptomatic (n =68)	Asymptomatic (n =32)	P value
Depth of Niche (mm)	Mean ± SD	8.84 ± 4.55	4.88 ± 2.7	**0.027***
	Range	2 - 19	1 - 10	
Width of Niche (mm)	Mean ± SD	6.03 ± 3.23	2.34 ± 1.23	**<0.001***
	Range	1 - 14	1 - 5	
Residual myometrium(mm)	Mean ± SD	2.87 ± 1.23	3.88 ± 1.41	**<0.001***
	Range	1 - 7	1 - 7	
Position of uterus	AVF	54 (79.4%)	29 (90.6%)	0.254
	RVF	14 (20.6%)	3 (9.4%)	
Shape of niche	Oval	13 (19.1%)	7 (21.9%)	0.792
	Rectangular	20 (29.4%)	1 (3.1%)	**0.003***
	Semi circular	4 (5.9%)	2 (6.3%)	1.000
	Triangular	31 (45.6%)	22 (68.8%)	**0.034***
Intra-niche fluid	Yes	43 (63.2%)	0 (0.0%)	**<0.001***
	No	25 (36.8%)	32 (100.0%)	

SD: Standard deviation; *statistically significant as p value <0.05

4-Discussion

Cesarean section (CS) scar may develop into uterine niche, which are triangular anechoic areas detected by TVUS at the site of the CS incision indicating defective tissue healing [2].Uterine niche is usually associated with various gynecological symptoms including but not limited to menstrual irregularity ,postmenstrual spotting or dyspareunia[3] . Interest in the clinical significance of a niche at CS scars has surged in recent years, leading to an increasing number of published studies; however, the prevalence and clinical significance of niches remain debated [4,5] . This study aimed to investigate the prevalence of uterine niche in women with previous CS, correlate its presence with clinical symptoms.100 women attending the Obs&Gyn clinic within 6 months post CS for routine follow up were included in this work. TVUS was performed to diagnose the presence uterine niche, dividing them into symptomatic and asymptomatic groups with correlation to the niche related gynecological symptoms.

In the current study, the age of the niche patients ranged from 18 to 41 years with a mean value of 30.8 ± 4.59 years. The BMI of niche patients ranged from 19 to 36 kg/m2 with a mean value of 26.37 ± 3.54 kg/m2. The number of previous CS was 1 in 57 (57.0%) patients and 2 in 43 (43.0%). In agreement with our findings, a prospective observational study was conducted by (**Naji et al,2013**) to examine the CS scar of 284 consecutive pregnant women at 11-13, 19-21 and 32-34 weeks' gestation and reported that the median (IQR) of age was 33 (29–36) years. The median (IQR) of BMI was 26 (24–31) kg/m2. The median (IQR) of previous CS number was 207 (72.9) for 1 previous CS, 72 (25.3) for 2 previous CSs, and 5 (1.8) for ≥3 previous CSs [9].

In line with our results, an observational prospective cohort study was performed by (**Alassi et al ,2022**) on 200 women to assess post caesarean section scar defect (PCSD) by trans-vaginal US and evaluation of its related complications in non-pregnant women and reported that the age of the niche patients ranged from 24 to 42 years with a mean value of 31.74 ± 4.14 years [10].

Regarding menstrual regularity in our study, 65 (65.0%) patients had regular menstruation, and 35 (35.0%) patients had irregular menstruation. Menstruation was reported to occur every 15 to 31 days with an average of 24.46 ± 3.2 days. Of the niche patients, 68 (68%) patients had postmenstrual spotting and 52 (52.0%) patients suffered from dyspareunia. Supporting our findings, a prospective study in 2022 was done by (**Wang,et al** 2022) to generate a definition for a large niche in non-pregnant women based on the presence of postmenstrual spotting including 727 women who had a CS > 1 year earlier underwent trans-vaginal sonography (TVS) examination, of whom 263 were diagnosed with a niche (prevalence of 36.2%). The participants were classified into two groups asymptomatic (n=103) or symptomatic with postmenstrual spotting (n=160). All women in the symptomatic group had a history of 2–12 days of postmenstrual bleeding, starting after their last Cesarean delivery. The average menstruation duration in the asymptomatic group was 6.1 vs 9.5 days in the symptomatic group (P < 0.0001) [11].

In the current study, the depth of niche ranged from 1 to 19 mm with a mean value of 7.57 ± 4.44 mm, the width of niche ranged from 1 to 14 mm with a mean value of 4.85 ± 3.24 mm, the residual myometrial thickness ranged from 1 to 7 mm with a mean value of 3.19 ± 1.37 mm. The position of uterus was AVF in 83 (83.0%) patients and RVF in 17 (17.0%) patients. Viewing the niche in RVF uterus was more challenging but still can be detected. Regarding the position of the uterus , (**Naji et al,2013**) found that, in 36 cases of their study population , a CS scar was not visible to operators when the uterus was retroverted [9]. On Contrary to these findings, (**Ofili-Yebovi 2008**) suggested that the CS scar niche is often seen in the retroverted uterus and concluded that the risk of scar deficiency is increased in women with a retroflexed uterus and in those who have undergone multiple CS. This could be explained by larger sample size [12].

In our work, the most common shape of niche was triangular in 53 (53.0%) patients, followed by oval and rectangular in 20 (20.0%) and 21 (21.0%) patients respectively. The least common shape was semicircular in 6 (6.0%) patients. Intra-niche fluid was found in 43 (43.0%) patients. Parallel with our results, a prospective observational study conducted by (**Savukyne et al, 2021**) including 122 participants to assess CS scar visibility. The CS scar was visible in 95/122 (77.9%) cases, as the uterine scar niche was found in 49/122 (40.2%). Of those with visible CS scars, half of the women had a CS niche 49/95 (51.6%). All of the CS scar niches were triangular in shape and 36/49 (73.4%) were large ones. Only two patients (1.6%) displayed a retroverted uterus at the first trimester of pregnancy, both with a non-visible uterine scar after one previous CS [13].

In the current study, 68 (68%) of niche patients were symptomatic and 32 (32%) were asymptomatic. Age and BMI were significantly higher in symptomatic group compared to asymptomatic group. There was no significant difference in the number of previous CS between both groups. In line with our findings, a research conducted by (**Alassi et al, 2022**) concluded that symptomatic niche was detected in 139 ladies, with an incidence rate of 69.5%. When dividing the included cases into asymptomatic and symptomatic groups, the mean age of the included cases was 31.62 and 31.79 years in the two groups respectively. Both age and occupation showed no significant difference between the two groups. On the other hand, parity had mean values of 2.61 and 2.83 in the two groups respectively, with a significant increase in the symptomatic group (p = 0.035) [10].

In this study, the number of patients with regular menstruation was significantly lower in symptomatic group compared to asymptomatic group, and the number of patients with dyspareunia was significantly higher in symptomatic group compared to asymptomatic group. There was no significant difference in time between menstruations and the duration of each menstruation between the studied groups. Similarly with our findings, (**Alassi et al, 2022**) reported that irregular menstrual history was reported by 54% of symptomatic cases, while it was not reported by any lady in the asymptomatic group (p < 0.001). The frequency of periods showed no significant difference between the two groups. The duration of menses was also comparable between the two groups. Postmenstrual spotting showed a significant increase in the symptomatic group [10].

In contrast with our findings, (**Wang, et al** 2022) reported that the duration of each menstruation was not significantly different between the symptomatic and asymptomatic groups. This could be explained by their larger sample size [11].

In the current study, the depth and the width of the niche were significantly higher in symptomatic patients compared to asymptomatic patients. Residual myometrium was significantly lower in symptomatic patients compared to asymptomatic patients. In line with us (**Bij et al 2011**), reported that the depth and the width of the niche were significantly higher in symptomatic patients compared to asymptomatic patients. Residual myometrium was significantly lower in symptomatic patients compared to asymptomatic patients[11].Also, a study conducted that the length, width and depth of the niche were all significantly larger in the postmenstrual-spotting group compared with the asymptomatic group [14].

In contrast with our findings, (**van et al, 2014**) conducted a prospective cohort study including 263 women to study the prevalence of niches in the caesarean scar in a random population, and the relationship with postmenstrual spotting and urinary incontinence and reported that no significant difference between patients with and without postmenstrual spotting regarding niche depth (p = 0.72), which had mean values of 5.46 and 5.15 mm in the two groups respectively. This contradicts our findings [15].

In the current study, the number of patients with rectangular shape of niche was significantly higher in symptomatic group, but the number of patients with triangular shape was significantly lower. The number of patients with intra-niche fluid was significantly higher in symptomatic group compared to asymptomatic group. The position of the uterus showed insignificant difference between symptomatic and asymptomatic groups. In agreement with our findings, (**Alassi et al, 2022**) reported that the shape of the niche was significantly different between the two groups, as rectangular defects were more encountered in symptomatic group (23% vs. 3.35 in the asymptomatic group – p = 0.015). Intra-niche fluid was detected in 64.7% of symptomatic cases, compared to no subjects in the asymptomatic group (p < 0.001) [10].

The current study had some limitations as being single center nature which might limit the generalizability of our findings. Also, absence of the long-term follow-up of the niche symptoms, with relation to the future pregnancy outcomes. Additionally, more than one diagnostic modality is needed for more truthful results.

5-Conclusions

Symptomatic niche incidence rate was 68% of women. Presence of the niche was associated with postmenstrual spotting, heaviness and irregularity of menstruation and dyspareunia which were related to the niche width and depth .Therefore, the present study encourages gynecologists to consider the niche as an important differential diagnosis for postmenstrual spotting or dyspareunia in women with a prior CS.

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