SMJ- Sohag Medical Journal, Vol. 29 No (2) 2025

Print ISSN1687-8353 Online ISSN2682-4159

Original Article

Single Layer versus Double Layer Closure as Risk Factor for Niche

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Abstract

Background: The number of women suffering from cesarean delivery-associated issues is increased worldwide. The appearance of the uterine scar, specifically a niche in the caesarean scar, is a surrogate marker of some long-term maternal symptoms related to cesarean delivery. This study aimed to compare single-layer and double-layer uterine closure as risk factors for niche.

Methods: This prospective cohort study was conducted on 350 pregnant women between 18 to 45 years old who were admitted for caesarean section (CS) either elective or selective, at the Department of Gynaecology and Obstetrics, Sohag University Hospital, Sohag, Egypt. All participating women were asked to answer a questionnaire on symptoms and possible complaints, which had arisen since the CS. Participants were invited to a medical examination 6 months postoperatively, in which a 3D transvaginal ultrasonography (3D-TVUS) was performed to assess scar position and integrity after their CSs.

Results: There was a significant association between niche formation and uterine closure technique ($P<0.001$). The logistic regression analysis showed that uterine closure techniques were found to be significant predictors for niche presence among the studied participants. Women who had single uterine closure showed more than triple risk for developing niche compared to those with double-layer non-locked.

Conclusions: One of the most common long-term complications is the uterine niche, which had a prevalence of 67.4% in our study. Of the primary risk factors identified include the use of single-layer closure during surgery

Keywords: Single Layer; Double Layer; Closure; Risk Factor; Niche; Cesarian Delivery

DOI : 10.21608/SMJ.2025.366587.1548 **Received:** March 09 , 2025 **Accepted:** Abril 10 , 2025

Published: May 01, 2025

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Citation: **Abdelrhamn Faisal Wasel . et al., Single Layer versus Double Layer Closure as Risk Factor for Niche SMJ,**2025 Vol. 29 No (2) 2025. 49- 56

Introduction

With the rising worldwide prevalence of cesarean deliveries (CD), the number of women suffering from CD-associated issues increases. Bleeding and infection are among the short-term side effects of Cesarean sections (CSs), other signify-cant long-term complications include abnormal placental adhesion, malformative CD scars, uterine rupture, dehiscence, and pregnancies with cesarean delivery scars. [1,2] Some long-term maternal symptoms are related to the appearance of the uterine scar, especially to a niche in the cesarean scar as a surrogate marker. [3]

According to Jordans et al., [4] a niche is depression at the site of the CS scar in the myometrium of at least 2 mm in depth that can be visualized by transvaginal ultrasound (TVUS), preferably with contrast. It is associated with gynecologic signs including abnormal uterine bleeding, dysmenorrhea, chronic pelvic pain, and fertility problems, besides complications in subsequent gestations, including uterine rupture and placenta accreta spectrum (PAS) disorders. [5, 6]

The main aetiology involved in niche development remains unidentified. Multiple CSs and thinning in the lower uterine segment during labour, as well as surgery-related factors, including the level of hysterotomy, are among the contributing factors . [7]

Surgery-related risk factors include the uterine closure technique after a CD, there is no universally accepted standard recommending single- or double-layer closure of the uterine incision. The double-layer closure technique is associated with a lower prevalence of large niches and thicker residual myometrium, but clinical outcomes are lacking. [8, 9]

The outcomes after single-layer vs double-layer closure were reported in previous studies, but most of which used the less optimal locking sutures that are related to higher niche incidences, and primarily focused on short-term outcomes. [10]

This work aimed to assess the effect of two uterine closure techniques, the single layer (SL) vs double-layer (DL) uterine closure technique concerning the possibility of niche development after CSs.

Patients and Methods

350 of pregnant women (18 to 45 years old) who were admitted for CS either elective or selective, at the Department of Gynaecology and Obstetrics, Sohag University Hospital, Sohag, Egypt, between October 2019 and June 2021. A written consent was obtained from each participant, as well as an approval from the Ethics Committee of the Faculty of Medicine, (ID: EA2/069/19) was obtained.

The exclusion criteria included women having menstrual disorders, previous uterine surgery such as myomectomy, and metroplasty, known uterine anomalies, placenta increta or percreta during the current gestation, pregnant with three or more fetuses in the current pregnancy, and uterine rupture or perforation.

The demographics and delivery data of participants, in particular cervical dilatation (0 cm to 10 cm) determined by vaginal examination at the time of the CS were documented. A questionnaire on symptoms and possible complaints which had arisen since the CS was answered by each participant, and a 6-months postoperative medical examination using a 3D transvaginal ultrasonography (3D-TVUS) was performed to assess scar position and integrity after their CS was performed.

A lower-segment CS was performed in all women by the attending obstetrician, with laparotomy via a transverse Pfannenstiel incision and hysterotomy via a transverse Monroe Kerr incision. According to the surgeon's preference, a locked or non-locked technique was used for uterine closure.

Women underwent a CS with standard mode of uterotomy and correct approximation of the cutting edges. A double-layer closure of the uterine incision using unlocked continuous

Multifilament sutures for both layers, a large portion of the myometrium and the endometrium was involved in the first layer, while a continuous running suture that imbricated the first layer, including serosal and myometrial tissue was performed in the second layer. Each participating surgeon received an online mandatory instruction video before the operation. Unlocked continuous multifilament sutures were used to perform a single-layer closure of the uterine incision.

3D-TVUS:

After CSs, a sonographic uterine scar was evaluated using TVUS in all participants. Niche development was detected and measured accor-

ding to the guidelines endorsed by European experts, 7 Sonographers to standardise the evaluation of the uterine scar. The first ultrasound in each hospital was validated by the senior investigator. When no niche was visible using the 3D-TVUS, patients can choose whether a contrast-enhanced ultrasound, either with saline or gel, was performed, sonohysterography is the gold standard for niche detection. [11] This approach was chosen to diminish the costs and participant discomfort.

The niche was reported if an anechoic space without fluid or gel at the site where the previous CS scar was formed. The niche was measured in the midsagittal plane to identify its position, length, width, and the double thickness of the endometrium. Also, it was screened for the presence of a niche branch, the extent of the adjacent myometrial thickness and the residual myometrial thickness (RMT) in front of the niche, the distance between the upper border of the defect, and the insertion of the urinary bladder were determined.

The surgery-related risk factors were investigated, including those related to the closure technique, e.g. the full-thickness suture including the endometrial layer, split thickness suture with the endometrial layer excluded, single-layer myometrium closure with or without endometrial suture, number of cases with one-layer and those with two-layer closure, operation time, and suture material.

Statistical analysis:

Data analysis was performed using the Statistical Package for the Social Science (SPSS) version 26 program. Descriptive tests were used to sum-arize quantitative parameters including mean±standard deviation (SD), median and range (minimum-maximum). Qualitative data was presented as numbers and percentage. Tests of normality like Kolmogorov-Smirnov were conducted and the data was not normally distributed. Chi-square test was used to illustrate association between niche detection and quantitative data. A multivariate logistic regression analysis was conducted to evaluate predictors of presence of niche among the studied cases, only statistically significant factors in the univariate analysis were introduced in the multivariate model (P value <0.05).

Results

This study included 350 pregnant women with a mean age of 27.1 ± 6.3, a mean gravidity number of 2.1 ± 1.5, and mean number of CS of 1.5 ± 1.3. More than a fifth of the studied women were diabetics (23.7%) and hypertensives (26%). **Table1**

Table 1: Obstetric history of the studied pregnant women

Parameter	n = 350
Age*	28.3 ± 6.7
Gravida*	2.2 ± 1.6
Abortions*	0.7 ± 1.4
Number of previous C.S*	1.5 ± 1.3
Diabetes [n(%)]	87 (24.85%)
Hypertension [n(%)]	97 (27.71%)
PROM [n(%)]	70 (20%)
Gestational age [n(%)]	35.7 ± 3.9
Preterm labor [n(%)]	168 (48%)

*mean ± SD; n: number; frequency (%); PROM: premature rupture of membranes

Regarding indications of CS, the majority of the participants had CS due to repeated previous CS (37.1%). The mean CS gestational age was 35.1 ± 3.8 and the mean cervical dilatation was 2.4 ± 1.7. The majority of the participants (40.6%) underwent a double layer non locked, 25.7% had a single layer locked, and 19.1% had a single layer non locked uterine closure techniques. Most of the studied participants reported absence of dysmenorrhea (81.1%), absence of dyspareunia (77.1%), absence of premenstrual spotting (78%) and presence of regular menstrual cycles (70.6%). **Table 2**

Table 2: Characteristics and menstrual disorders of the studied pregnant women

Parameter		n = 350
Indications of CS	Progress failure [n (%)]	77 (22%)
	Primary C.S [n (%)]	105 (30%)
	Repeated C.S [n (%)]	130 (37.1%)
	Elective C.S [n (%)]	38 (10.9%)
Cervical dilatation (mean ± SD)		2.5 ± 1.73
Station of the fetal presenting part	0-1 [n(%)]	200 (57.14%)
	2 [n(%)]	76 (21.71%)
	3-4 [n(%)]	74(21.42%)
Surgical time: (minutes) (mean ± SD)		70.3 ± 32.9
Blood loss (mean ± SD)		492.9 ± 347.2
Uterine incision (transverse) [n (%)]		350 (100%)
Uterine closure technique	Single layer locked [n (%)]	90 (25.7%)
	Single layer non locked Double layer locked [n (%)]	67 (19.1%)
	Double layer non locked [n (%)]	51 (14.6%)
	Single layer non locked Double layer locked [n (%)]	142 (40.6%)
Uterine closure material (vicryl) [n (%)]		350 (100%)
Menstrual disorders	Dysmenorrhea [n (%)]	69 (19.42%)
	Dyspareunia [n (%)]	83 (23.71%)
	Premenstrual spotting [n (%)]	80 (22.85%)
	Cycle rhythm [n (%)]	251 (71.71%)

N: number; SD: standard deviation

Figure 1 showed that 67.4% of the studied women reported having a niche during sonographic follow up within 6 months of caesarean delivery, and a niche could not be detected in 32.6%.

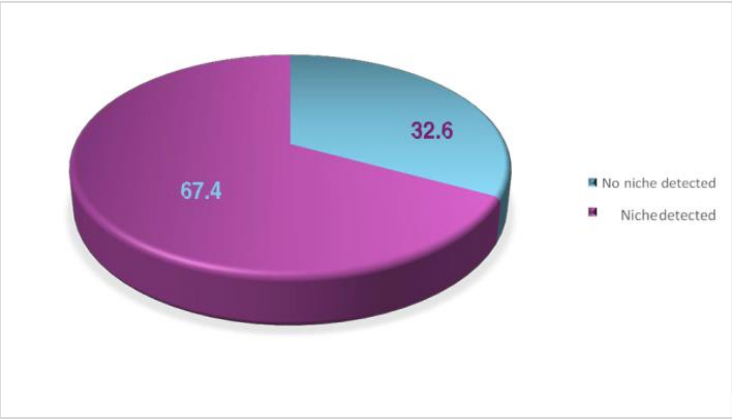

Figure 1: Niche detection of the studied pregnant women by TVS within 6 months follow-up, Sohag University Hospitals, 2024

A significant association between niche formation and uterine closure technique (P<0.001) (**Table 3)**.

Table 3: Association of niche formation with uterine closure technique of the studied pregnant women

		With niche n = 236	Without niche n = 114	P value
Uterine closure technique	Single layer locked	74 (31.4%)	16 (14%)	<0.001*‡
	Single layer non locked	53 (22.5%)	14 (12.3%)	
	Double layer locked	36 (15.3%)	15 (13.2%)	
	Double layer non locked	73 (30.8%)	69 (60.5%)	

Data are presented as frequency (%).‡Chi-squared test *significant (P value<0.05).

Data shown in **Table 4** revealed a logistic regression analysis of risk factors of characteristics of the studied pregnant women for niche formation. Uterine closure techniques were significant predictors for niche presence among the studied participants. Women who had single uterine closure showed more than triple risk for developing niche compared to those with double-layer non-locked.

Table 4: Multivariate logistic regression analysis of uterine closure technique as a risk factor of characteristics of the studied pregnant women for niche formation among, Sohag University Hospitals, 2024

Uterine closure technique	Multivariate analysis		
	Adjusted OR	95% CI	P value
Single layer locked	3.3	1.6:6.9	**0.001***
Single layer non locked	3.7	1.7:8.0	**0.001***
Double layer locked	1.1	0.5:2.6	0.74
Double layer non locked	1		

OR: odds ratio, 95% CI: 95% confidence interval, *significant difference (P value<0.05)

Discussion

Using the TVS, Niche was detected at a prevalence of 67.4%. This finding comes in the same line with those obtained by Bij De Vaate et al. [12] who reported niche at prevalences ranged from 24% to 70%, variable niche prevalences may be attributed to variations in diagnostic criteria, imaging modalities, and possible subclinical presentation of caesarean scar defect (CSD). The latter was reported to cause higher niche reporting prevalence to 56% to 84% when the presence of a CSD was assessed using TVUS and saline-infused sonohysterography (SIS), respectively, according to Bij De Vaate et al. [12]

The 3D ultrasound allows for better visualization of the niche's shape, size, and location, which can be crucial for planning any necessary treatments. This modality is particularly useful in assessing the depth and volume of the niche, which are important factors in determining the clinical significance of the defect. [13]

The method used for uterine closure had the major influence, particularly in reducing the risk of uterine niche. Moreover, it includes variable parameters that may be changed, and don't have a well-established benchmark .[14] Currently, there is no agreement on which specific uterine closure method is most efficient in reducing the risk of uterine rupture and/or scar tissue abnormalities after CS. [15]

The current study showed that the average cervical dilation was 2.4 ± 1.7, with the fetal presenting part stations distributed as follows: Station 0-1: 119 (50.4%), Station 2: 64 (27.1%), and Stations 3-4: 53 (22.5%). Niche detection occurred in 127 cases within the single-layer group, compared to 109 cases in the double-layer group. The results demonstrated a significant predictor for niche formation, showing that there is triple the risk of developing a niche compared to those without one.

Perrone-Di Cesare-Masciullo et al. [16] and Samy et al. [17] supported our findings regarding niche detection, indicating that single-layer suturing is more effective than double-layer suturing, particularly with thicker RMT.

In contrast, Stegwee et al. [18] suggested that double-layer closure, which typically includes the endometrium, may contribute to niche development, potentially due to the different technique employed with double-layer closure. Furthermore, Hosseini et al. [19] found a higher prevalence of niches in the catgut group (p = 0.03). However, in our study, all cases were closed using Vicryl suture material, so no additional data on this aspect are available.

Stegwee et al. [91] studied the effect of single- and double-layer closure on 2290 women, symptoms were then assessed at the third month by transvaginal ultrasonography/saline infusion sonohysterography to provide long-term data. The single-layer closures were made without locking and without regard to crossing the decidua, while the double-layer closures were performed by passing through the endometrium, without locking in the first layer, and continuously without locking in the second layer. Niche formation was significantly lower among women with the single-layer closures.

In the study by Bamberg et al.[20] non-significant intergroup differences were found in niche development or residual myometrium thickness among the randomly formed 3 groups of participants, including a single-layer closure of the uterus without locking, single-layer closure with locking, and double-layer closure group, but a thicker residual myometrium thickness (RMT) was produced via double-layer closures.

On the other hand, Bennich et al. [21] revealed that unlocked double layer uterine closure didn't increase RMT compared with single layer uterine closure. Also, a randomized investigation by Hanacek et al. [22] found a higher scar defects rate of 83.2% in the single-layer closure group compared to 72.6% in the double-layer closure group. Similarly, Kalem et al. [23] claimed that a double-layer far-far near-near unlocked approach was superior to a single-layer continuous locked uterine closure in protecting against the development of isthmocele and guaranteeing enough RMT.

Also, Khamees et al. [24] revealed that the unlocked double layer uterine closure was related with higher RMT compared to the locked single layer uterine closure and better uterine scar healing. Roberge et al. [25] revealed that locked first layer and single-layer closure may be associated with lower RMT. The residual myometrium thickness was assessed in three different uterine closure techniques, including locked single-layer including the decidua, double-layer with locked first layer including the decidua, and double-layer with unlocked first layer excluding the decidua. No differences between the single- and double-layer closure techniques with locked first layers were detected. Although the double-layer closures without locking showed a thicker residual myometrium thickness compared to the locked single-layer closures. These findings indicated that the locking suture technique was hypothesized to develop ischemic tissue necrosis, leading to poorer healing due to the increased pressure, and strangulating the scar tissue.

Sevket et al. [26] demonstrated that the locked or unlocked double layer uterine closure of the caesarean incision promotes healing of the uterine scar. In contrast, Shrestha et al. [27] found that scar thickness was non-significantly varied between the single layer and double layer uterine closure. Nevertheless, many surgeons prefer locking sutures due to their better hemostasis.

Although more distinct niches were observed in cases with double-layer closures, these differences were not statistically significant, as a result of merging second-layer closures with first-layer locking increasing tissue stress while disrupting vascularization. [28]

The limitation of this study included monitoring of the participants for 6 months, which was not enough to fully evaluate the severity of symptoms and the evolution of the uterine niche. The full healing of the uterine scar, including the resolution of any niche, can take up to a year. During this time, the scar tissue continues to remodel and strengthen.

Conclusions

Uterine niche is one of the most common long-term complications of caesarean section. Niche was prevalent in 67.4% of the studied cases following the European Task Force definition. Of the primary risk factors identified include the use of single-layer closure during surgery. In terms of early complications, the rates of niche symptoms such as postmenstrual spotting and dysmenorrhea were not statistically significant.

Therefore, further research is needed that includes all risk factors for Niche formation and also more longitudinal follow-up for women after CS is required.

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