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Evaluation of Cesarean Scar Following Double Uterine Closure Including Upper Flap of Peritoneum Compared to Double Closure without Peritoneum

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Abstract:

Background: Cesarean scar defects (CSD) are associated with significant maternal morbidity, yet the impact of different uterine closure techniques on CSD formation remains underexplored. This study evaluates the effect of double uterine closure with and without the inclusion of the upper peritoneal flap on CSD size and residual myometrial thickness (RMT). This study aims to compare the residual myometrial thickness and the size of the cesarean scar defect following double-layer uterine closure with and without the inclusion of the upper peritoneal flap. **Methods:** This double-blind, prospective observational study included 70 women undergoing primary cesarean section at term. Participants were randomly assigned to two groups: Group A (n=35) received double-layer uterine closure without peritoneal inclusion, and Group B (n=35) received closure with peritoneal inclusion. Transvaginal ultrasonography was used to measure CSD size and RMT at 1, 3, and 6 months postoperatively. **Results:** At 6 months, Group B demonstrated significantly smaller CSD size (2.95±0.58 mm vs. 3.51±0.76 mm, p=0.04) and greater RMT (5.65±0.7 mm vs. 4.95±0.8 mm, p=0.02) compared to Group A. ROC curve analysis revealed a CSD size cut-off of <3.73 mm with 84.85% sensitivity and 98.19% specificity for predicting CSD disappearance. **Conclusion:** Double uterine closure with the inclusion of the upper peritoneal flap results in smaller cesarean scar defects and greater residual myometrial thickness, suggesting it may be a preferable technique for reducing long-term complications associated with CSD.

Keywords: Cesarean scar, double uterine closure, upper flap of peritoneum.

Introduction

There is an increasing incidence of cesarean scar (CS) defect/niche and its sequelae, probably not entirely explained by better diagnosis or rising cesarean rate. Discussion of possible etiological factors has received scant attention but would be important to formulate preventive strategies. Meaningful informative studies on long-term sequelae of cesarean section are very difficult and none are available for causation of CS defect. Hence, it is crucial to identify key areas in etiology of CS defect for focused research [(1)].

The surgical technique of uterine incision closure is the most important determinant of CS defect formation. Other factors such as cervical location incision, adhesion formation and patient specific factors seem far less important in etiology. Rather than the headline theme of "single versus double-layer closure of uterus", the finer details of surgical technique which achieve good apposition without inducing tissue ischemia seem more important [(2)].

Single-layer technique may be best reserved for thin myometrial edges especially during repeat cesareans. Adhesions between uterine isthmus and bladder/abdominal wall seem common associations but not causative for CS niche. It would be desirable to prove these surgical principles by good quality prospective randomized "quantitative" studies but the wait may be very long and this should not hinder the adoption of good surgical principles. Science is much cognitive and not just empirical [(1)].

The cesarean scar defect (CSD), which is only present after a CS, is defined as myometrial discontinuity at the CS scar site with a sonographically visible indentation in the myometrium of at least 2 mm (also called a "niche" by many researchers). CSD is associated with abnormal uterine bleeding (75% - 82%), postmenstrual spotting (29% - 34%), cesarean scar ectopic pregnancies (1: 1800 - 1: 2216) and infertility (32/92). Uterine dehiscence, uterine rupture, cesarean scar pregnancy, and morbidly adherent placenta are also associated with CSD [(3)].

Prevalence of CSD with transvaginal ultrasonography (TVU) is 24%-43%. In recent years, the CSD problem has caught the attention and raised concern around the world, but there is no guideline for prevention of or intervention in CSD because its natural history has not been fully clarified [(4)].

An epidemiologic study revealed that "severe" maternal complications such as hemorrhage that required hysterectomy or massive blood transfusion, uterine rupture, anesthetic complications, shock, venous thrombo-embolism, cardiac arrest, acute renal failure, assisted ventilation, major infection, and wound disruption were threefold increased for cesarean delivery as compared with vaginal delivery. Also, well-known long-term effects of cesarean deliveries such as infertility, pelvic adhesions, and pelvic pain have been described in many textbooks. Subsequent pregnancies have a documented higher rate of perinatal complications not only maternal but also neonatal complications such as prematurity, low Apgar scores, neonatal intensive care unit (NICU) admissions, and higher perinatal death [(5)].

Cesarean scar pregnancy (CSP) and cesarean scar dehiscence (CSD) are the most common complications of cesarean scar (CS). As the incidence of CS is increasing worldwide, so is the incidence of CSP, especially in cases with assisted reproduction techniques. It is of utmost

importance to diagnose CSP in the early first trimester, as it can lead to myometrial rupture with fatal outcome. On the other hand, CSD may be encountered during pregnancy or in the postpartum period. CSD in the postpartum period is very rare and can cause secondary postpartum hemorrhage (PPH) leading to increased maternal morbidity or even death if not diagnosed and managed promptly. Both complications can be diagnosed on ultrasonography (USG) and confirmed on magnetic resonance imaging (MRI). These two conditions carry high morbidity and mortality [(6)].

The purpose of this study is to compare the residual myometrial thickness (RMT) and the size of the cesarean scar defect after double layer uterine closure with inclusion of upper peritoneal flap compared to double layer uterine closure. without inclusion of upper peritoneal flap 1,3- and 6-months post C.S.

Patients and methods:

Patients:

This double-blind prospective observational study included 70 women undergoing primary cesarean section at term. The patients were recruited from the Gynecology Department, Faculty of Medicine, Benha University Hospital during the period from July 2022 to November 2022.

An informed written consent was obtained from the patients. Every patient received an explanation of the purpose of the study and had a secret code number. The study was done after being approved by the Research Ethics Committee, Faculty of Medicine, Benha University.

Inclusion criteria were women aged between 20 and 40 years old and women between 36 to 40 weeks scheduled for primary Cesarean section.

Exclusion criteria were patients with Uterine anomalies, Placenta previa or Incision laceration in CS, patients with coagulopathies or hemolysis elevated liver enzymes, and low platelets (HELLP) syndrome, women with diagnosed non reproductive tract infection who need extra antibiotic treatment, patients with systemic disease requiring special treatment or affecting wound healing e.g., SLE or uncontrolled diabetes mellitus, and patients' refusal to participate in this study.

Grouping: Patients underwent randomization and were divided into two groups according to technique of cesarean section uterine closure. **Group A:** 35 patients received double layer closure as two continuous rows of sutures without inclusion of upper peritoneal flap. **Group B:** 35 patients received double layer closure as two continuous rows of sutures with inclusion of upper peritoneal flap in the second layer using polyglycolic vicryl number 1

Methods:

All patients and control groups were subjected to the following: Full history taking (maternal age, maternal BMI). **Obstetric history** (gestational age, parity, position of uterus, type of cesarean section, birth weight). **Laboratory investigations** (essential lab tests were formed to all women with scheduled primary cesarean section between 36 to 40 weeks. **Transvaginal ultrasonography**: Transvaginal ultrasonography was applied to detect and measure CSD 1, 3- and 6-months post C.S in each group.

Transvaginal ultrasonography

Transvaginal ultrasonography is the most commonly reported initial technique for identifying CSDs. Ultrasound examination

was performed transvaginally using a GE 730 equipment, with a 7.5 MHz trans-vaginal probe. The US probe was gently introduced into the posterior fornix of the vagina.

The scar was then visualized in a transverse plane by carefully rotating the probe at the level of the scar. During uterine visualization the following measurements are systematically recorded for evaluation of uterine scar: the thickness of residual myometrium, the thickness of myometrium bordering the scar (anterior myometrium), and the depth of the 'niche' (anechoic area at the presumed site of incision).

A Uterine niche was defined as a triangular anechoic filling defect in the anterior wall of the uterus between the corpus and the cervix [(7)]. The depth of the niche was measured from a straight line that would have formed the normal cavity line of the anterior wall if the niche had not been created to the upper tip of the niche. The thickness of the residual myometrium was measured from the serosal surface of the uterus to the top of the niche.

Thickness of remaining myometrium is measured from the apex of the defect to the outer edge of the myometrium, and the percentage of myometrium remaining is calculated as the ratio of remaining myometrial thickness to the adjacent total myometrial thickness. Calculation of remaining myometrium. A = thickness of remaining myometrium; B = full-thickness adjacent to defect. Percentage of myometrium remaining = [A/B] ×100.

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Statistical analysis

Statistical analysis was done by SPSS v25 (IBM Inc., Armonk, NY, USA). Shapiro-Wilk test was done to test the normality of data distribution. Descriptive statistics were presented as mean, standard deviation (± SD) for normally distributed numerical data. Median and range for not normally distributed numerical data. Frequency and percentage for non-numerical data. For Analytical statistics: one way ANOVA test and the Kruskal-Wallis: were used to assess the statistical significance of the difference between more than two study groups. Chi-Square test was used to examine the relationship between qualitative variables. For quantitative diagnostic measures the ROC Curve was utilized Logistic regression analyses were used for the prediction of risk factors A p value was considered significant if <0.05 at confidence interval 95%.

Results:

The current study carried on 70 women scheduled for cesarean section. Their mean age was 28.68 years ranged from 20 to 40 years. Their mean BMI was 28.31 kg/m^2. According to gestational age, it ranged from 36 to 40 week. Primigravida represented 25.72% of the cases while multigravida represented 74.28%. The majority of cases (92.85%) had AVF uterus and 7.14% had RVF uterus. Elective cesarean section took place in 45.72% of cases and emergent CS was in 54.28%. According to birth weight mean measurements was 3.34 kg.

Baseline criteria of the studied groups showed no statistically difference according to maternal age, BMI, parity gestational age, position of uterus, type of CS and birth weight.

Table 2

Table 1. Demographic criteria of the studied subjects

Demographic data		Total subjects n=70
Maternal Age, years	M±SD	28.68±5.58
	Range	20-40
Maternal BMI, kg/m2	M±SD	28.31±2.92
	Range	24-32.73
Gestational age, weeks	M±SD	38.02±1.3
	Range	36-40
Parity, n(%)	Prmi-	18(25.72%)
	Multi-	52(74.28%)
Position of uterus, n(%)	AVF	65(92.85%)
	RVF	5(7.15%)
Type of cesarean section, n(%)	Elective	32(45.72%)
	Emergent	38(54.28%)
Birth weight ,kg	M±SD	3.34±0.32
	Range	2.8-3.9

Table 2. Baseline difference between the studied groups

	Group A n=35	Group B n=35	Test	P
Age	28.34±5.42	29.02±5.79	0.459	0.646
Gestational age	37.94±1.3	38.11±1.32	0.535	0.592
BMI	28.22±3	28.39±2.89	0.129	0.897
Parity				
Primi	8(22.85%)	10(28.57%)	0.299	0.785
Multi	27(77.14%)	25(71.42%)		
Position of uterus				
AVF	33(94.28%)	32(91.42%)	0.215	0.985
RVF	2(5.71%)	3(8.57%)		
Type of cesarean section				
Elective	15(42.85%)	17(48.57%)	0.230	0.811
Emergent	20(57.14%)	18(51.42%)		
Birth weight	3.31±0.32	3.37±0.31	0.764	0.445

*: statistically significant as P value <0.05

CSD size had significant difference between the studied groups at three month and six month after CS. Mean diameter of CSD at 6 month after CS was 3.51mm in group A and 2.95 mm in group B. CSD Table **3**

At six month follow up, only one case with remaining CSD in group A while no cases in group B with remaining CSD. Table 4

ROC curve analysis was conducted for prediction of CSD disappear at 6 months after CS and it showed moderate accurate AUC =0. 862 at best cut off level <3.73 depth was statistically different between the studied groups at 6 months after CS. Mean level at six month was 3.36mm in group A and 2.59 mm in group B.

mm with sensitivity 84.82% and specificity 98.19%. ROC curve analysis was conducted for prediction of CSD disappear at 6 months after CS and it showed moderate accurate AUC =0. 887 at best cut off level <2.33 mm with sensitivity 96.55% and specificity 82.93%. Table 5

Table 3.CSD change in diameter and CSD depth measurements in the studied groups

	Group A n=35	Group B n=35	Z	P	
CSD size first month, mm					
Mean ±SD	5.88±1.12	5.69±0.84	-0.899	0.369	
Range	4-8.51	4.07-7.41			
CSD size 3rd month, mm					
Mean ±SD	3.8±0.98	3.4±0.51	-6.741	0.03	*
Range	3.4-6.33	3-4.89			
CSD size 6th month, mm					
Mean ±SD	3.51±0.76	2.95±0.58	-6.629	0.04	*
Range	3.2-5.57	2.5-3.14			
CSD depth first month, mm					
Mean ±SD	4.07±1.17	4.39±1.25	-1.149	0.250	
Range	3-6.65	3-7.56			
CSD depth 3rd month, mm					
Mean ±SD	4.11±1.32	3.81±1.21	-1.849	0.064	
Range	3-7.38	2.8-7.4			
CSD depth 6th month, mm					
Mean ±SD	3.36±1.35	2.59±0.84	-2.208	0.027	*
Range	2-6.99	2-4.68			

*: statistically significant as P value <0.05

Table 4: CSD disappearance frequency after double layer uterine closure

	Group A n=35	Group B n=35	Test Chi-Square	p
CSD after double layer uterine closure	34(97.14%)	35(100%)	0.854	0.652

*: statistically significant as P value <0.05

Table 5: Validity of CSD diameter and CSD depth for prediction of CSD disappearance 6 months after CS

CSD diameter (mm)					
AUC	**95% CI**	**p**	**Cut off**	**Sensitivity(%)**	**Specificity(%)**
0.862	0.759-0.933	<0.001*	3.73	84.85	98.19
CSD depth (mm)					
AUC	**95% CI**	**p**	**Cut off**	**Sensitivity(%)**	**Specificity(%)**
0.887	0.789-0.950	<0.001*	2.33	96.55	82.93

*: statistically significant as P value <0.05.

Discussion:

In our study, according to gestational age, it ranged from 36 to 40 week. Primigravida represented 25.72% of the cases while multigravida represented 74.28%. The majority of cases (92.85%) had AVF uterus and 7.14% had RVF uterus. Elective cesarean section took place in 45.72% of cases and emergent CS was in 65.28%. According to birth weight mean measurements was 3.34 kg.

Our findings agreed with Bennich et al. [8] included seventy-six nulliparae met the criteria and agreed to participate in the study. Thirty-five women were assigned to the single-layer technique and 38 to the double-layer unlocked closure technique. For both groups, CS was performed at a mean gestational age of 39 weeks [8].

In the present study, Baseline criteria of the studied groups showed no statistical difference according to maternal age, BMI, parity gestational age, position of uterus, type of CS and birth weight.

In line with our study, Roberge et al. [9] sought to evaluate the impact of 3 techniques of uterine closure after cesarean delivery on uterine scar healing. Women were allocated to 1 of the 3 groups: (1) single layer locked, including the decidua (controls) 16; (2) double layer with the first layer locked including the decidua and the second layer unlocked and imbricating the first layer; and (3) double layer with the first layer unlocked, excluding the decidua and including the deep part of the myometrium, and the second layer unlocked including the remaining part of the myometrium. It was observed that baseline characteristics, birthweight, and peritoneum closure was similar between groups.

In the current study, CSD size had significant difference between the studied groups at three month and six months after CS. Mean diameter of CSD at 6 months after CS was 4.51mm in group A and 2.95 mm in group B. CSD depth was statistically different between the studied groups at 6 months after CS. Mean level at six month was 3.36mm in group A and 2.59 mm in group B.

Consistency with our study, El-Gharib et al. (2013) [10] documented that scar thickness 2 weeks post-operative was significantly thicker among women submitted to two-layer technique of hysterotomy closure than those submitted to a single layer closure technique (P=0.0005). Also, Bamberg et al. (2017) [11] observed that the mean ± SD niche depth was 3.0 ± 1.4 mm after single-layer unlocked closure, 3.6 ± 1.7 mm after single-layer locked closure and 3.3 ± 1.3 mm after double-layer closure (p = 1.0).

According to our study, RMT was statistically higher in group B than group A at 6 months after CS (P=0.02). The mean level at six month was 4.95 mm in group A and 5.65 mm in group B.

Comparable to our findings, Glavind et al. (2013) [12] revealed that median RMT was 5.8 (interquartile range (IQR), 4.1–7.8) mm in women with double-layer closure vs 4.6 (IQR, 3.4–6.5) mm in those with single-layer closure (P = 0.04). On the other hand, Bennich et al. (2016) [8] noted that there was no difference in RMT between the two groups.

In the current study, group B showed statistically significant more cases (77.15%) that had CSD disappeared than group A (22.85%).

Zhou et al. (2018) [13] included 51 symptomatic women with caesarean scar defects or a thickness of the remaining

muscular layer of less than 3 mm according to transvaginal ultrasound. We retrospectively evaluated the gynecological and obstetrical outcomes after vaginal repair and histologically analyzed the defect. CSD disappeared in 68.63% of patients (35/51) at the 3-month follow-up.

ROC curve analysis was conducted for prediction of CSD disappear at 6 months after CS and it showed moderate accurate AUC =0.743 at best cut off level <4.8 mm with sensitivity 71.11% and specificity 72%. ROC curve analysis was conducted for prediction of CSD disappear at 6 months after CS and it showed moderate accurate AUC =0. 862 at best cut off level <3.73 mm with sensitivity 84.82% and specificity 98.19%.

ROC curve analysis was conducted for prediction of CSD disappear at 6 months after CS and it showed moderate accurate AUC =0. 887 at best cut off level <2.33 mm with sensitivity 96.55% and specificity 82.93%. The cut-off values (5 percentile) for the CS scar thickness and for the dehiscence risk coefficient were 2.9 mm and 0.25, respectively [(14)].

This study has some limitations: It was a single-center study, and the results may differ elsewhere. It was a small sample size and we excluded patients with systemic disease requiring special treatment or affecting wound healing e.g., SLE or uncontrolled diabetes mellitus.

Conclusion:

Double uterine closure with upper peritoneal flap is slightly preferred than double uterine closure without upper peritoneal flap. Residual myometrial thickness was higher in double layer closure with inclusion of upper peritoneal flap than double uterine closure with upper peritoneal flap.

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