Correlation between Sonographic Caesarean Section Scar Thickness and Intraoperative Appearance of Lower Uterine Segment

Original Article

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ABSTRACT

Objective: Detection of the relation between transvaginal ultrasound measurement of cesarean scar thickness with intraoperative uterine scar grading assessed sonographically, and intraoperative integrity.

Patients and Methods: A total of 44 pregnant women with previous CS scheduled for elective caesarean delivery at term were enrolled and subjected to pre-delivery transvaginal ultrasound examination of caesarean scar thickness and correlated with intraoperative lower uterine segment grading.

Results: The best cut off value of transvaginal sonographic measurements of caesarean section scar thickness for detection of dehiscence was <3.5 mm i.e. grade III and IV with sensitivity 75%% and specificity 88.9%, positive predictive value 60% and negative predictive value 94.1%. The mean value of cesarean section scar thickness was 2.32±0.40mm for scar dehiscence group.

Conclusion: Transvaginal sonographic measurements of caesarean section scar thickness had a proper sensitivity in prediction of possibility of cesarean scar dehiscence and it give an idea about risk and benefits of performing trial of labor after cesarean section.

Key Words: Caesarean scar thickness, dehiscence, rupture uterus, ultrasound.

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INTRODUCTION

Cesarean section (CS) rates have alarmingly increased globally in recent times. A history of a prior one is the most frequent indicator of CS, accounting for around one-third of all CS cases each year. One of the most common reasons to avoid a trial of labor is the risk of uterine rupture, which can result in serious concerns to the mother and newborn , contributed to the drop of the rates of vaginal birth following cesarean section[1].

One common cesarean delivery complication that raises the risk of uterine rupture is uterine scar dehiscence. Pregnancy difficulties can be screened for, and early identification of, as well as planned for the method of delivery, thanks to antenatal care[2].

It has been discovered that estimating the thickness of LUS may have a role in forecasting scar dehiscence. Sonographically, the LUS appears as a two-layered structure in late pregnancy, consisting of the relatively hypoechoic myometrial layer and the echogenic muscularis and mucosa of the bladder wall, which includes a portion of the visceral-parietal peritoneum[3].

When deciding whether to conduct a labor trial following CS, the thickness of LUS should be considered as an auxiliary tool. The thinning of LUS has been directly linked to the possibility of scar dehiscence or rupture. On the comparison of transvaginal and trans-abdominal sonography estimates of LUS thickness, however, there is a paucity of data[4].

The study aims to detect the relation between transvaginal ultrasound measurement of cesarean scar thickness with intraoperative uterine scar grading assessed sonographically, and intraoperative integrity.

METHODOLOGY

This cross sectional analytical study that included 44 pregnant women, with previous CS undergoing elective Cesarean Section, recruited form Kasr Al-ainy maternity hospital , Cairo University , from March until August 2023.

Inclusion criteria

We included pregnant women with history of one previous CS , dating more than 38 weeks gestational age,

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singleton pregnancy, in a cephalic presentation, not in labor, with intact membranes and with inter-pregnancy period more than two years.

Exclusion criteria

Women with disorders of amniotic fluid (e.g: poly, oligo- or anhydramnios), women with placenta previa or placental abruption, history of other uterine surgery (e.g. myomectomy), medical disorders (e.g: diabetes, hypertension, …. etc), history of more than one previous cesarean section, non-cephalic presentations (e.g: breech), women with true labor pain and patients refusing to participate in the study, were ruled out.

Sample size justification

Sample size calculation was based on the correlation between pre-operative sonographically measured lower uterine thickness and intra-operative grade of lower uterine defect during Cesarean section (CS) among mothers with previous CS. Prior data indicated that the correlation coefficient between lower uterine thickness and lower uterine defect was 0.985[5]. In order to detect a correlation coefficient of 0.4 with 80% power setting type I error probability to 0.05, we therefore needed to analyze a minimum of 44 women. G*Power program 3.1.9.6 for MS Windows, Franz Faul, Kiel University, Germany, was used to calculate the sample size.

Patient information and informed consent

The patient gave her assent to participate in the clinical study prior to enrollment after being given a clear explanation of its purpose, scope, and possible adverse consequences.

Study interventions and procedures

According to inclusion and exclusion criteria, participants were subjected to history taking, full examination including general and abdominal obstetric examination was conducted for all participants.

Transvaginal (TVS) ultrasound examination was done using (Mindray DC-N3) machine equipped with micro-convex transvaginal (V10-4B) transducer with frequency of 5-8 MHz.. All ultrasound examinations were done by the same sonographer . The lower uterine segment must be clearly defined by a partially full bladder. An excessively distended bladder will extend the cervix, stretch the LUS, and impair measurement accuracy. For this reason, the ultrasound tests were performed with the bladder pleasantly full. The patient was lying supine with their knees slightly bent and their hips slightly raised with a pillow when the vaginal probe was placed into the posterior vaginal fornix. In order to confirm that the view is midline one and prevent obliquity, a clear image of the LUS was obtained in the mid-sagittal plane while seeing the cervical canal. Upon transvaginal examination, the uterovesical fold, the decasualized endometrium, and the chorioamniotic membranes were found to represent the hyperechoic line and the muscle layer of the LUS, respectively. To guarantee reliable measurements, the scar region was enlarged until it accounted for at least 75% of the image. Using a measuring caliber positioned at the interface between the myometrium and the bladder wall as well as the interface between the myometrial and chorioamniotic membrane, the thickness of the muscular layer of LUS was obtained. The LUS was measured three times, with the lowest measurement being recorded[6].

Intraoperative: The scar was then scored according to Qureshi scoring system: Intra operatively; the LUS scar was identified by the same surgeon grading) which classified as four grades: A LUS in Grade 1 is well-formed. There is no visible uterine contents in Grade 2, but there is a thin uterine scar. Grade 3 is visible uterine content and scar dehiscence. Grade 4 refers to a burst scar that does not indicate the link between the abdominal and uterine cavities[7].

Study outcomes

Primary outcomes

Relation between TVS sonographic measuring of cesarean section scar thickness related with the intraoperative LUS grading. A cutoff measurement of sonographic cesarean section scar thickness at which TOLAC can be allowed.

Secondary outcomes

- Thickness of dehiscent scar.
- Relation between scar appearance (grading) and operative outcomes.

Statistical Analysis

While qualitative (categorical) data was described statistically in terms of frequencies (number of cases) and percentage, quantitative data was described in terms of mean ± standard deviation (± SD). The Student t test for independent samples when comparing normally distributed data and the Mann Whitney U test for independent samples when the data are not normally distributed were used to compare the numerical variables between the research groups. The Chi-square test was used to compare categorical data.

For linear relationships between normally distributed variables, the Pearson moment correlation equation was

used, and for non-normal variables or non-linear monotonic relations, the Spearman rank correlation equation. In statistics, a probability value (*p value*) of less than 0.05 is deemed significant. IBM SPSS (Statistical Package for the Social Science; IBM Corp, Armonk, NY, USA) version 22 for Microsoft Windows and Microsoft Excel 2019 (Microsoft Corporation, NY, and USA) were used for all statistical analyses.

RESULTS

This cross-sectional study includes 44 women who were seen at Cairo University's Kasr Al-Ainy Obstetrics and Gynecology Hospital. Women who had previously completed CS and who satisfied the identical inclusion and exclusion requirements were all recruited.

The results of the present study are demonstrated in the following tables and figures

In (Table 1) the mean age was (31.82±6.41). There were 15 patients (34.1%) were ">35 years". As regards BMI ranged 18-40 with mean 27.82±6.23, there was 12 patients (27.3%) were Normal weight, 17 patients (38.6%) were Obese, 10 patients (22.7%) were Overweight and 5 patients (11.4%) were Underweight.

Table 1: Baseline characteristics among study population

Baseline characteristics (n=44)	
Age (years) Mean±SD	31.82±6.41
BMI) (Kg\m2) Mean±SD	27.82±6.23
Gravidity Mean±SDh	2.66 ±0.86
Gestational age (wks.) Mean±SD	38.73±0.79
Fetal weight (gm) Mean±SD	3157.50±440.02
Previous CS Post-Partum Hemorrhage	3 (6.8%)
Previous CS Pelvic pain	5 (11.4%)
Previous CS Wound infection	8 (18.2%)

In (Table 2) : A statistically significant higher mean estimated blood loss was detected among cases with CS scar dehiscence than no dehiscence (643.89 versus 751.25ml). It also revealed a statistically higher incidence of downward or lateral extension of cesarean scar among cases with dehiscence than no dehiscence (50% versus 2.8%, respectively).

Table 2: Intraoperative findings in cases with and without dehiscence

	No dehiscence n=36	Dehiscence n=8	*p value*
Estimated blood loss(ml)	643.89±47.84	751.25±51.62	<0.001*
extension of Cesarean scar	1(2.8%)	4(50%)	<0.001*
Cesarean section scar thickness (mm) by T.V.S	4.34±0.61	2.32±0.40	<0.001**
Need of plication Of L. U.S	2 (5.5%)	6(75%)	0.001*
Bladder injury	0 (0%)	1(12.5%)	0.077
Difficulty of bladder dissection	2 (5.5%)	4 (50%)	0.021*
Operation time(min) Mean±SD	46.2±2.8	58.7±4.3	0.234

(Table 3) shows highly statistically significant higher frequency of thickness level 1.6 to 3.5 in intraoperative grades Grade III and IV for LUS, while, there was a higher frequency of thickness level 3.5-4.5 and >4.5mm in intraoperative grades Grade I for LUS, with p- value (p<0.001).

Table 3: Association between caesarean section scar thickness by TVS and intraoperative appearance of lower uterine segment among study group

TVS LUS thickness (mm)	Intraoperative appearance of lower uterine segment								Total	
	Grade I		Grade II		Grade III		Grade IV			
	No.=20	%	No.=16	%	No.=6	%	No.=2	%	No.	%
1.6-2.5 (mm)	0	0.0%	0	0.0%	4	66.7%	2	100.0%	6	13.6%
2.6-3.5 (mm)	0	0.0%	4	25.0%	2	33.3%	0	0.0%	6	13.6%
3.6-4.5 (mm)	6	30.0%	12	75.0%	0	0.0%	0	0.0%	18	40.9%
>4.5 (mm)	14	70.0%	0	0.0%	0	0.0%	0	0.0%	14	31.8%
Chi-square test	59.644									
p-value	<0.001**									

Table 4: ROC analysis of best cut-off value , sensitivity , specificity , PPV and NPV of ultrasound estimation of LUS thickness

Cut-off	Sen.	Spe.	PPV	NPV	AUC (C.I.95%)	*p-value*
<3.5	75%	88.9%	60%	94.1%	0.910 (0.784-0.975)	<0.001

DISCUSSION

Due to the relative safety and benefits of cesarean sections over vaginal delivery in complicated pregnancies, the procedure has become more common in recent decades. However, there is a higher risk of maternal death and morbidity, including uterine rupture and placenta previa-accrete[8].

Following one or more prior cesarean sections, uterine rupture is frequently linked to labor trials[9].

Findings from research indicate a clear correlation between the likelihood of a ruptured uterus and the existence of scar abnormalities in the lower uterus. It is still unknown how useful sonography is for measuring LUS thickness in the treatment of VBAC. The bladder, comprising its muscularis and mucosa (the outer layer) and the somewhat hypo-echoic myometrial layer, is located inside of the echogenic visceral-parietal reflection and makes up the LUS, which appears as a two-layered structure on ultrasonography[10].

Consequently, this cross sectional analytic study was conducted and aimed to detect the relation between TVS measurement of CS scar thickness with intraoperative uterine scar grading . Intra-operative assessment of LUS of study population revealed that we had two groups, 36 non dehiscence cases and 8 dehiscence cases.

As regard Receiver Operating Characteristics (ROC) analysis for difference intra-operative LUS grades and their ability to discrimination between dehiscence and non-dehiscence, our study revealed that the best cut off value of transvaginal sonographic measurements of caesarean section scar thickness for detection of dehiscence was <3.5mm i.e. Grade III and IV with sensitivity 75%% and specificity 88.9%, positive predictive value 60% and negative predictive value 94.1% (Figures 1-7).

Fig. 1: Transvaginal measuring of the muscular layer of the LUS was taken in outpatient clinic - Kasr Al Ainy Hospital

Fig. 2: Transvaginal measuring of the muscular layer of the LUS was taken in outpatient clinic - Kasr Al Ainy Hospital

Fig. 3: Grade 3 is scar dehiscence/uterine content visible was taken in intraoperative field - Kasr Al Ainy Hospital

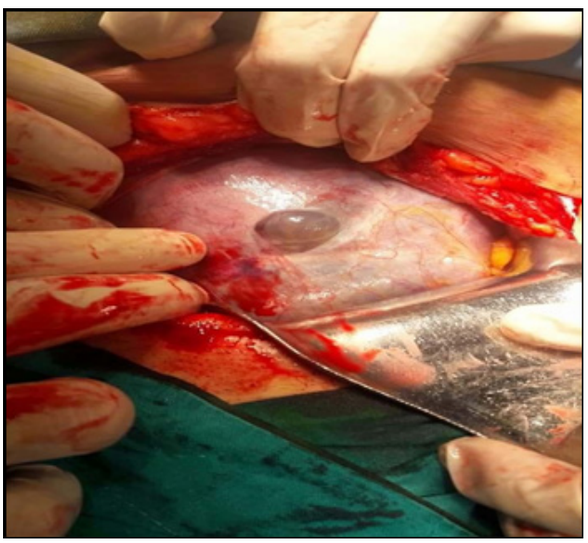

Fig. 4: Grade 4 is ruptured scar describing a connection between uterine and abdominal cavity is not showing was taken in intraoperative field - Kasr Al Ainy Hospital

Fig. 5: Grade 2 is a thin uterine scar, but no uterine contents are visible was taken in intraoperative field - Kasr Al Ainy Hospital

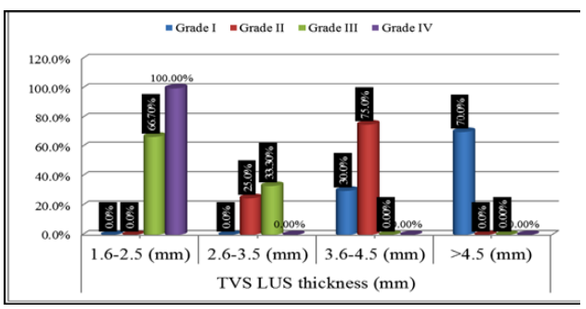

Fig. 6: Association between caesarean section scar thickness by TVS among study group

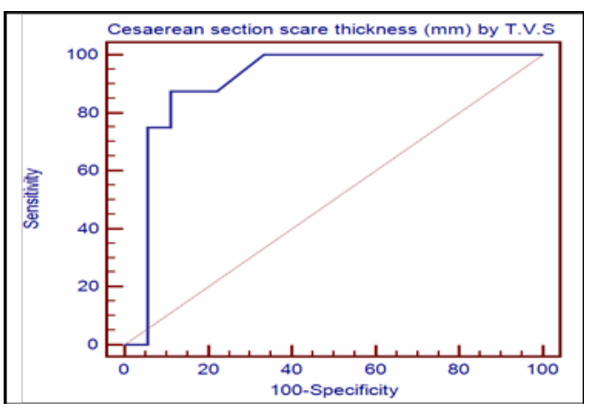

Fig. 7: Receiver Operating Characteristics (ROC) analysis for difference intra-operative LUS grades and their ability to discrimination between dehiscence and non-dehiscence

Among cases of scar dehiscence group sonographic thicknesses of caesarean section scar 1.6 to 3.5mm was statistically more frequent, while among cases of scar non-dehiscence group sonographic thicknesses of caesarean section scar 3.6-4.5 and >4.5mm were statistically more frequent.

Comparison between dehiscence group and non-dehiscence group according to caesarean section scar thickness by TVS, we found that measuring lower uterine segment thickness with transvaginal ultrasound has a good correlation with the actual thickness.

According to a study, transvaginal ultrasound performs better than transabdominal ultrasound at measuring the thickness of the lower uterine region. In accordance to our study's findings, a lower uterine segment thickness of 3.65 mm or less is regarded as a thin scar, and a thickness of less than 2.85 mm is linked to a higher risk of uterine dehiscence. a transvaginal ultrasonography cutoff value of 3.65 mm with 65.6% specificity and 90.8% sensitivity[11].

A LUS > 3.65mm should be appropriate for a VBAC, 2-3.65mm is probably safe, and <2 mm indicates a patient at a greater likelihood for uterine rupture/dehiscence, based to a recent systematic review and meta-analysis[12].

Amer and colleagues concurred with our study , stating that mothers with a history of C.S. whose lower segment thickness was measured less than 3.6 mm were compelled to schedule a delivery at an earlier gestational age rather than to attempt a vaginal birth trial (VBAC). The LUS thickness cut-off point was determined to be less than 3.6 mm, with a 95% confidence interval, 80% sensitivity, and 51% specificity as a predictor of scar dehiscence[13].

Ginsberg *et al*.'s cross-sectional study showed that the thickness of the LUS was independently correlated with both gestational week and cesarean section; for every week that gestational week increased, the total thickness of the LUS decreased by 1.3 mm[14].

According to Tekin *et al*., LUS USG measures can be helpful in clinical decision-making for TOLAC and are useful to anticipate the intact LUS. However, given its limited positive predictive value, it is not advised for use in the prediction of exceedingly thin LUS. The correlation between TV USG full thickness and manual caliper measures was 0.443 for transvaginal US full thickness and 0.475 for myometrial measurements. For transvaginal US full-thickness, the cut-off value was 2.75 mm, while for transvaginal US thin myometrium, it was 1.35 mm[15].

According to Alalaf *et al*., there is a greater probability of uterine defects during a labor trial if the first stage of labor is characterized by a lower uterine segment thickness of 2.3mm and a myometrial thickness of 1.9mm. The body mass index, birth weight, inter-delivery interval, mother age, or gestational age at labor did not correlate with the uterine defects[16].

Ulfat *et al*. identified a substantial correlation between the LUS thinning and the short time since the last C.S. The relationship between scar dehiscence and the number of

years since the previous C.S. in our study has not been evaluated[17].

Most of studies that disagreed with our results were due to several causes as different study methodology, outcomes, sample size and different medical conditions and gestational age of studied cases at time of enrollment.

One of the study's strengths is that none of the participants were lost while it was being conducted. This was the first research carried out at Cairo University Hospitals to find a correlation between intraoperative uterine scar grading and TVS measurement of CS scar thickness. Every attempt was made to ensure that all follow-up data were recorded and that the data analysis contained only complete information. The same staff completed all clinical assessments, cesarean sections, and study evaluations of results.

It is important to note the study's limitations, which include the small sample size compared to the study's results and the small number of circumstances.

CONCLUSION AND RECOMMENDATIONS

From our study, we can conclude that transvaginal sonographic measurements of caesarean section scar thickness had a proper sensitivity in prediction of possibility of cesarean scar dehiscence and gives an idea about risk/ benefits of performing trial of labor after cesarean section.

Before advocating for routine prenatal uterine scar thickness evaluation following prior lower segment CS, particularly in low- and middle-income settings lacking appropriate prenatal care, we recommend more prospective research with greater sample size to assess our findings.

CONFLICT OF INTERESTS

There are no conflicts of interest.

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