Benha Journal of Applied Sciences (BJAS) **print: ISSN 2356–9751**
Vol. (9) Issue (10) (2024), (115 - 120) **online: ISSN 2356–976x**
http://bjas.bu.edu.eg
Medical and Health Science

Prediction of Scar Dehiscence Using Ultrasonography: Comparative Study

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Abstract
Background: There is growing worry about the effects on mothers and infants due to the increasing prevalence of cesarean sections (CS). Predicting difficulties in women with a history of cesarean section, particularly with regard to trial of labor after cesarean (TOLAC), requires a precise measurement of the thickness of the lower uterine segment (LUS). The purpose of this research is to compare the reliability of intraoperative measures with those of transvaginal and transabdominal ultrasounds in determining LUS thickness in women who have had previous CS. Methods: Included in this cohort research were 68 women, ranging in age from 18 to 40, who had a history of one prior low-transverse CS. During the 37th and 40th weeks of gestation, the lower utrine segment (LUS) thickness and myometrial thickness were measured. Elective CS was used to record intraoperative LUS thickness. The IBM SPSS Statistics software was used for the statistical analysis. The results showed that the average age of the mothers was 29.8 ± 5.9 years, and that the average gestational age was 38.4 ± 1 week. TVS recorded 4.2 ± 0.9 mm for the mean LUS thickness, while TAS recorded 6 ± 1 mm. The LUS thickness during the procedure was 3.8 ± 1 mm. The results of intraoperative measures showed a strong connection with TVS ($p < 0.001$). It should be noted that increased LUS thickness (5.14 ± 0.42 mm) was linked to longer inter-pregnancy intervals (≥ 18 months). In women who have had CS before, TVS shows more accuracy than TAS in measuring LUS thickness. Because of its precision, it can help doctors make better decisions about TOLAC, which might benefit both the mother and the baby. **Conclusions** In conclusion, our study demonstrated that transvaginal ultrasonography (TVS) showed superior precision when assessing the thickness of the lower uterine segment (LUS) in women with previous cesarean sections during term pregnancies, in comparison to transabdominal ultrasonography (TAS). TVS offers promising accuracy in clinical applications, particularly for maternal safety and mode of delivery decisions, including VBAC considerations. Its non-invasive nature makes it a valuable tool in routine antenatal care, aiding in early identification of higher scar dehiscence risk and improving pregnancy outcomes.

Keywords: Lower Uterine Segment; Transvaginal Ultrasound; Cesarean Section; Trial of Labor after Cesarean, Transabdominal Ultrasound, Ultrasonography, Scar Dehiscence

Introduction: Cesarean section rates have been steadily increasing over the last several decades. Even though the number of cesarean sections has been steadily rising, the frequency of prenatal problems such as cerebral palsy and infant death has been relatively constant (1). It is becoming more common for prior CS to be the leading indicator for CS. The risks of problems such as placenta previa, very adherent placenta, complex procedures, uterine rupture, and bladder damage are higher in women who have had several cesarean sections. Elective repeat cesarean births are associated with an increased cumulative hysterectomy rate (2).Reducing maternal morbidity via blood transfusions, hysterectomy, and febrile morbidity is the goal of the trial of labor after cesarean section (TOLAC) that leads to a vaginal birth after cesarean section (VBAC) (3). Prior cesarean section for dystocia, induction of labor, and absence of vaginal delivery are the risk factors for TOLAC failure. The potential for uterine rupture is the primary concern of obstetricians when it comes to TOLAC (4).

There is a 0.7% uterine rupture rate associated with cesarean scar dehiscence, which is a major complication of vaginal birth after cesarean section and may have fatal effects on the mother and the infant. The risks of complications from a successful VBAC are lower than those of a repeat cesarean section (5). For the purpose of predicting successful VBAC using patient clinical parameters, many prediction score approaches were investigated; however, none of these methods were determined to be completely predictive. Scar strength, which is inversely proportional to scar thickness, is the primary determinant of VBAC result (6).

The lower uterine segment (LUS) is a two-layered structure that sonography reveals in the latter stages of pregnancy. It consists of the echogenic muscularis and mucosa of the bladder wall, which includes a portion of the visceral-parietal peritoneum, and the comparatively hypoechoic myometrial layer. In most cases, the myometrium is necessary to view the chorioamniotic membrane and decidualized endometrial layer (7). Several

researchs looked at the use of ultrasonographic assessment of LUS thickness for uterine rupture prediction utilizing transabdominal (TAS) or transvaginal (TVS) techniques. The risk of uterine abnormalities is strongly correlated with the amount of LUS thickness.(8).

The goal of this research is to find out how well TVS and TAS ultrasonography measure the thickness of the lower uterine segment (LUS) and myometrial thickness in women who have had a prior cesarean section (CS) during a full-term pregnancy, and how well that measurement matches up with the actual intraoperative LUS thickness.

Patients and methods:

This The 68 women who participated in the cohort research were patients at the Benha University Hospitals outpatient clinic for prenatal care (ANC) and elective caesarean section (CS) between July 2023 and March 2024.

The Research Ethics Committee at Benha University's Faculty of Medicine gave its approval before the research could begin. We made sure to get patients' written informed permission. An explanation of the study's goal and a secret code number were given to each subject.

Pregnant women were eligible if they were between the ages of 18 and 40, had a singleton pregnancy, had cephalic presentation, were 37 to 40 weeks along in their pregnancy, had a previous low-transverse cesarean birth, and had a certain amount of time between their most recent and previous pregnancies.

Women who did not meet the inclusion criteria were those who had the following conditions during their pregnancies: uterine fibroids, polyhydramnios or oligohydramnios, an oversized fetus, fetal anomalies, a history of classical cesarean section (a vertical midline incision of the upper segment), incisional hernia at the site of the cesarean scar, a history of placental adhesion anomalies, a history of ruptured or perforations of the uterus, multiple pregnancies, previous myomectomy, or operations for the uterine septum.

Following were applied to each of the examples that were examined: Thoroughly collecting medical history, including [current medical conditions, prior hospitalizations, personal history, and the length of time between any cesarean sections that the patient has had and the current pregnancy]. Comprehensive medical evaluation: Checking the patient's vital signs, making a note of any jaundice, taking the patient's fundal height to match with their gestational age, feeling the baby's position and presentation using the umbilical and pelvic grips, and feeling the scar to see if it's sensitive or has changed form are all part of a comprehensive physical examination. Standard diagnostic procedures were carried out, including a full blood count, random blood sugar, kidney function tests, liver function tests, Rh, INR, and hepatitis markers.

Ultrasonography (TAS and TVS) were done between 37 and 40 weeks of pregnancy to measure the LUS and CS scar thickness before the baby was born. To isolate the myometrial layer, we measure the narrowest section of the LUS, which is located right above the CS scar. We do not include the bladder wall or amniotic fluid in our calculations. The complete thickness of a LUS may be measured and recorded in millimeters using calipers.

Prenatal ultrasound (TVS) measures the thickness of the lower uterine segment (LUS) between weeks 37 and 40 of gestation. Before being placed in the lithotomy or supine position, the patient is asked to empty their bladder. An ideal imaging setup consists of a sterile sheath, gel, and a transvaginal probe operating at 5 to 9 MHz. A sagittal midline image of the uterus is obtained by gently inserting the probe; this view focuses on the LUS and the cesarean scar. Finding the narrowest section of the LUS allows us to quantify its internal to exterior dimensions. In order to evaluate the uterine wall's integrity, the myometrial thickness is evaluated, with a focus on the scar region and an exclusion of the bladder and other tissues.

Uterine rupture is more likely in women with myometrial thicknesses below 2.0 mm and complete LUS thicknesses below 3.5 mm. As previously mentioned, ultrasound evaluations reveal three distinct layers in a mature LUS: the chorioamniotic membrane containing decidualized endometrium, the middle myometrial layer, and the utero-vesical peritoneal reflection next to the bladder. The myometrial layer is characterized as the hypoechoic area between the interfaces of the bladder wall and myometrium, as well as the myometrium-amniotic fluid interface (9-11). The complete LUS thickness is determined between the amniotic fluid and bladder.

Approval code:MS19-7-2023

Statistical analysis

The IBM SPSS Statistics (Version 25.0) was used for reviewing, coding, and tabulating the gathered data. We used the Shapiro-Wilk test to check whether the data was normally distributed. For numerical data, we utilized descriptive statistics like mean, standard deviation, median, and range. For non-numerical data, we used frequency and

percentage. To compare means between two groups, analytical statistics used the Student T Test. To evaluate relationships between quantitative variables, correlation analysis was used. The odds ratio (OR) was estimated using linear regression analysis with a 95% CI. A narrower confidence interval (CI) denoted more accuracy, while a wider CI denoted less accuracy.

Results:

The study were found to have a mean BMI of 27.1 ± 2.3, a mean gestational age of 38.4 ± 1 week, and a mother age of 29.8 ± 5.9 years. The average thickness of the lower uterine segment (LUS) was 6 mm (± 1 mm) according to transabdominal ultrasound measures, and 4.2 mm (± 0.9 mm) according to transvaginal ultrasound measurements. The average thickness of the LUS was found to be 3.8 mm (± 1 mm) throughout the operation. Table 1 shows that there was a statistically significant difference between intraoperative LUS and TAS, suggesting that TAS was less accurate than TVS in terms of LUS thickness. Interaction between TVS and intraoperative LUS was statistically significant (p=0.006). Table 2 There was a very substantial positive connection (p<0.001) between intraoperative LUS and TVS LUS. There was a favorable and statistically significant relationship between intraoperative LUS and TAS LUS (p=0.040). Figures 1A and 1B

A pattern of increasing thickness with higher BMI categories is seen when analyzing the mean values for TAS LUS, TVS LUS, and intraoperative LUS thickness across various BMI categories. Regardless of these tendencies, statistical analysis indicates that there are statistically significant variations in LUS thickness across BMI groups for all kinds of measurements. Three tables

Table(1) Demographic data and trans abdominal US LUS thickness among studied subjects.

Total cases (n=68)		
Maternal age (years)	Mean ±SD	29.8±5.9
Gestational age (weeks)	Mean ±SD	38.4±1
BMI (kg/m2)	Mean ±SD	27.1±2.3
TAS LUS thickness (mm)	M±SD	6±1
	Mean	5.8 (5.6-6.5)
TVS LUS thickness (mm)	M±SD	4.2±0.9
	Mean	4.1 (3.8-4.4)
Intraoperative LUS thickness (mm)	M±SD	3.8±1
	Mean	3.7 (3.2-3.9)

bmi: index of metabolic rate Median, Mean ± Standard deviation, and total data were used for representation. TA: Ultrasound through the abdominal wall TVS stands for transvaginal ultrasound, whereas LUS stands for lower uterine segment.

Table(2) Mean difference between intraoperative, TAS and TVS LUS.

	Intraoperative and TAS LUS	**Intraoperative and TVS LUS**
Mean difference	2.19 ± 0.4	0.4 ± 0.2
95% confidence interval	-0.153 – 0.051	0.030 – 1.176
OR	-0.122	1.013
p	0.322	**0.006***

Using a linear regression model, we compared the means of intraoperative LUS, TAS, TVS, and TAS (transabdominal ultrasound) with those of TVS and TAS alone. TVS stands for transvaginal ultrasound, whereas LUS stands for lower uterine segment.

Table (3) Association between BMI and LUS measurements.

		TAS LUS thickness (mm)	**TVS LUS thickness (mm)**	**Intraoperative LUS thickness (mm)**
< 25 kg/m2	**n=17**	5.81 ± 1.15	4.04 ± 0.96	3.68 ± 1.07
25-30 kg/m2	**n=45**	5.93 ± 1.02	4.11 ± 0.86	3.73 ± 1.00
> 30 kg/m2	**n=6**	6.53 ± 1.08	4.62 ± 1.13	4.20 ± 0.95
Test Result		H= 3.910, p<0.001*	H= 3.277, p<0.001*	H= 2.389, p=0.04*

Kruskal-Wallis test (H) and transabdominalsonography (TAS) Let's talk about transvaginal ultrasound (TVS) and lower uterine segment (LUS).

Table 4: Categorization of Inter-pregnancy intervals among studied patients.

Inter-pregnancy intervals (months)				
	>18	13-18	7-12	< 6
N (%)	44 (64.7%)	16 (23.5%)	5 (7.4%)	3 (4.4%)

LUS thickness (mm)	5.14 ± 0.42	4.30 ± 0.41	3.12 ± 0.40	2.85 ± 0.10

LUS: lower uterine segment

The largest mean lower uterine segment (LUS) thickness of 5.14 ± 0.42 mm was achieved by 64.7% of the 68 individuals who participated in the study, who had inter-pregnancy intervals longer than 18 months. The second biggest group, making up 23.5% of the total, had intervals ranging from 13 to 18 months with an average thickness of 4.30 ± 0.41 mm. Only 7.4% of the patients in the cohort had intervals between 7 and 12 months, and their average thickness was 3.12 ± 0.40 mm. In contrast, 4.4% of the patients in the smallest group had intervals between 6 months and fewer, and their average thickness was 2.85 ± 0.10 mm. This pattern suggests that there is a correlation between the length of time between pregnancies and the thickness of the LUS. Section 4

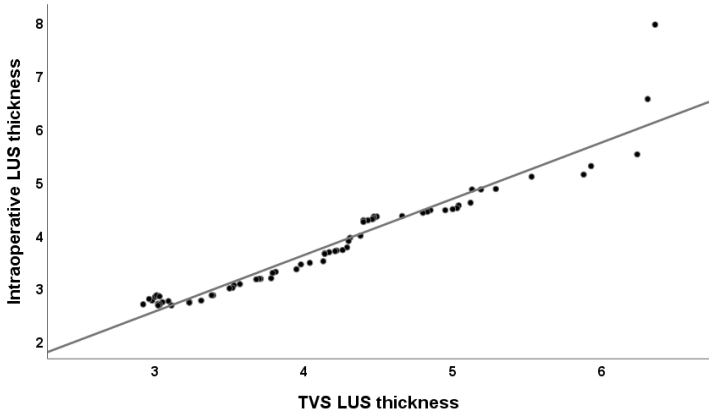

Fig. 1A: Correlation between intraoperative LUS thickness and TVS LUS

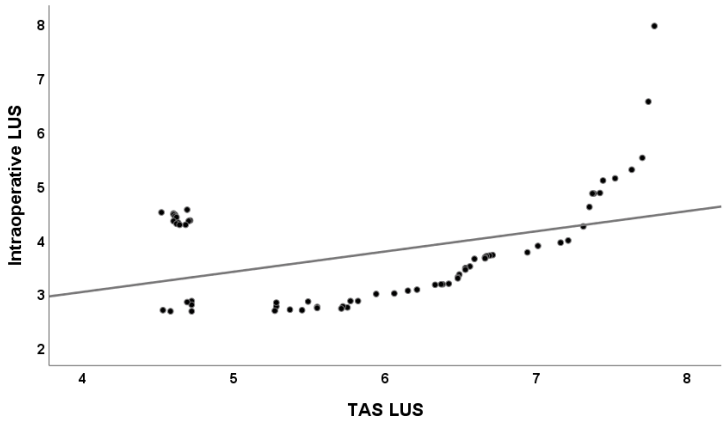

Fig. 1B: Correlation between intraoperative LUS thickness and TAS LUS

Discussion:

According The average age of the mothers in the study group was 29.8±5.9 years, according to the demographic data. Approximately 38.4±1 weeks is the average gestational age. Mean body mass index was 27.1±2.3 kg/m2. The average number of months since the last cesarean section for the women who participated in the study was 29.9 months. Our findings are in line with those of a research conducted at KasrEl-Ainy Hospital that compared the accuracy of TVS and TAS ultrasonography in determining the thickness of the lower uterine segment (LUS) in pregnant women who had undergone a prior cesarean section. The authors concluded that this approach was successful in determining the strength of the scar. For elective cesarean deliveries, 130 full-term pregnant women with a history of cesarean sections were hospitalized. Prior to the caesarean section, LUS thickness was measured using either TVS or TAS. In terms of age and body mass index, they recorded an average of 30 years and 27.4 kg/m2 (12).

The average thickness of the TAS LUS, as measured by the LUS, was 6±1 mm. The average thickness of the TVS LUS, as measured by LUS, was 4.2±0.9mm. The average thickness of intraoperative LUS, when considering the procedure, was 3.8±1 mm. In a study, the researchers found that the thickness of the LUS and myometrium, as assessed by TAS and TVS, were 3.96 ± 0.88 and 4.80 ± 1.08 mm for TAS LUS and 4.0 ± 0.82 and 4.93 ± 1.16 mm for TVS LUS. The TAS myometrium was 2.11 ± 0.42 and 2.62 ± 0.66

mm for TAS, while the TVS myometrium was 2.08 ± 0.53 and 2.72 ± 0.70 mm for TVS. (13).
The present study found a very significant positive connection between intraoperative LUS and TVS LUS ($p<0.001$). There was a favorable and statistically significant relationship between intraoperative LUS and TAS LUS ($p=0.040$). The authors of the research consistently found that there was a substantial association between the actual thickness of the lower uterine segment (LUS) and the thickness assessed with TAS ($r = 0.722$; $P < 0.001$), and an even greater correlation with TVS ($r = 0.944$; $P < 0.001$) (12).
The results showed that TVS LUS thickness was more accurate than TAS, as the mean difference between intraoperative LUS and TAS was much greater than the mean difference between intraoperative LUS and TVS. Interaction between TVS and intraoperative LUS was statistically significant ($p=0.006$). The accuracy of TVS was shown to be greater than that of TAS when compared to intraoperative LUS thickness (4.8 mm vs. 5.2 mm vs. 4.5 mm, respectively) (12). While we found TAS LUS to be the most sensitive (91% sensitivity) and specific (93% specificity) method compared to TVS myometrium (TVS MYO), another research indicated the opposite (13).
With a mean LUS thickness of 1.9mm, SD 1.5mm, and no clinical uterine rupture, 32 women (31.4%) were able to have a successful vaginal delivery. Three authors used transabdominal sonography to draw this conclusion, but they failed to specify the location of measurement (14, 15). Predicting a paper-thin or dehisced LUS with a sonographic LUS thickness of 1.5 mm exhibited a sensitivity of 88.9%, specificity of 59.5%, positive predictive value of 32.2%, and negative predictive value of 96.2% (16).Among women who gave birth by cesarean section, 74% experienced an incomplete uterine rupture, according to some writers who used transvaginal sonography (17).
Out of the 68 individuals who were included in the study, 64.7% had intervals longer than 18 months between pregnancies. This was linked to the thickest endometrial tissue, with a mean measurement of 5.14 ± 0.42 mm. The second biggest category, comprising 23.5% of the total, had intervals ranging from 13 to 18 months with an average thickness of 4.30 ± 0.41 mm. The average thickness of the cohort was 3.12 ± 0.40 mm, and 7.4% of the patients had inter-pregnancy intervals of 7-12 months. The group with the shortest intervals, 4.4%, had a mean thickness of 2.85 ± 0.10 mm and the shortest intervals were shorter than 6 months. There seems to be a correlation between longer intervals between pregnancies and thicker LUSs, according to this distribution. Our results are in line with those of other researchers who found that women whose interpregnancy intervals were longer than 18 months had significantly thicker CS scars than those whose IPIs were shorter. Our results are supported by research that found that IPI significantly reduced the thickness of scars caused by prior CS procedures.
However, there are a few caveats to keep in mind. For one, our research was conducted at a single site and had a limited sample size, so its results may not be applicable to a broader population. The proficiency and experience of the operators may also have an impact on the reliability of ultrasonography results. Term pregnant women had their LUS thickness measured once, rather than at many points during the pregnancy or during childbirth.
Finally, compared to TAS, TVS provided more accurate measurements of LUS thickness in women who had CS in the past during full-term pregnancies. Among clinical applications, TVS shows great promise for ensuring maternal safety and making informed choices about birth mode, including VBAC concerns. Its non-invasiveness makes it a useful tool for standard prenatal care, which in turn improves pregnancy outcomes by allowing for earlier detection of women at increased risk of scar dehiscence.

Funding mechanisms
Public, commercial, or non-profit funding entities did not provide any particular grant for this study.
Work contributed by the author.
Everyone who wrote a word to the research had an equal say.
Controversies There are no competing interests.

Conclusions

In conclusion, our study demonstrated that transvaginal ultrasonography (TVS) showed superior precision when assessing the thickness of the lower uterine segment (LUS) in women with previous cesarean sections during term pregnancies, in comparison to transabdominal ultrasonography (TAS). TVS offers promising accuracy in clinical applications, particularly for maternal safety and mode of delivery decisions, including VBAC considerations. Its non-invasive nature makes it a valuable tool in routine antenatal care, aiding in early identification of higher scar dehiscence risk and improving pregnancy outcomes.

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