ORIGINAL ARTICLE

Evaluation of lower uterine segment thickness in pregnant women with previous cesarean section and pain at term

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ABSTRACT

Objective: The aim of this study was to evaluate the thickness of the lower uterine segment (LUS) by ultrasonography in patients with and without pain who had a previous cesarean section and to determine a cut-off thickness value that can predict uterine rupture by comparing the values found.

Material and Methods: A total of 100 pregnant women with previous cesarean section who presented to the emergency department with pain and 100 pregnant women without pain who were scheduled for elective cesarean section were evaluated. In both groups, endometrial wall thickness was measured by ultrasonography at presentation. Intraoperative findings were recorded according to the Qureshi scoring system.

Results: An LUS thickness of 1.75 mm was considered the critical cut-off value, obtained from the ROC curve with 90% sensitivity and 90% specificity using transabdominal ultrasonography. Linear regression model analysis revealed that a full LUS thickness <1.75 mm was the only factor associated with a translucent uterine segment (C3).

Conclusion: We found an increased risk of uterine rupture at an ultrasonographic thickness <1.75 mm in pregnant women with pain and previous cesarean section. Ultrasonographic niche measurement will enable appropriate obstetric care to prevent adverse maternal and fetal outcomes and will alert physicians for a planned cesarean section.

Keywords: Lower uterine segment, previous cesarean section, ultrasonography, uterine rupture, uterine thickness.

Göksu et al. Lower uterine thickness in painful pregnants

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INTRODUCTION

In recent years, cesarean section rates have increased in Türkiye, and these cases are often repeated as cesarean sections in subsequent deliveries. The most feared complication of labor before a subsequent delivery in women who have undergone a cesarean section is uterine rupture, with high rates of maternal and fetal morbidity and mortality.[1] The possibility of uterine rupture is also the main reason cited for the decrease in vaginal delivery after cesarean section and for avoiding attempted vaginal delivery.[2–5] Therefore, identifying women at high risk for uterine rupture is an important goal in obstetric care, as women at low risk can be assured of a safe vaginal delivery, while women at high risk can be scheduled for cesarean section.[2] In women at risk, the cesarean section can also be scheduled earlier to prevent uterine rupture.

Cesarean scar tissue is hard and does not stretch. In patients presenting with pain, uterine contraction and fetal head descent may elongate and thin the scar tissue, potentially leading to uterine rupture. Therefore, the quality of the lower uterine segment can be assessed by thickness measurement.[6] Recent studies suggest that lower uterine segment thickness measured by transabdominal and transvaginal sonography can successfully predict the risk of scar rupture and can be used as the gold standard.[7] The thinner the lower uterine segment on ultrasound, the higher the likelihood of uterine rupture.[8,9] The cut-off value of scar thickness for predicting uterine defects ranges from 2.0 to 3.5 mm.[10] However, no clear cut-off value for scar thickness predicting uterine defects has been recommended so far.

The aim of this study is to determine a lower uterine segment thickness to predict uterine rupture in patients with previous cesarean section presenting with pain. In this way, we aim to provide appropriate obstetric care during pregnancy follow-up and to establish warning criteria for physicians for planned cesarean section.

MATERIAL AND METHODS

This prospective case-controlled study was conducted at a tertiary referral center in Istanbul province between January 2019 and January 2021. The study protocol, which conforms to the provisions of the Declaration of Helsinki, was approved by the institution's Ethics Committee (KAEK/2019.05.117) and registered at ClinicalTrials.gov (NCT04070118). The study group consisted of 100 pregnant women with a previous cesarean section who presented to the emergency department with pain. The control group consisted of 100 pregnant women of the same parity and gestational age, who had no pain and were scheduled for elective cesarean section. Patients with previous cesarean section and pregnancy between 37–42 weeks of gestation were included in the study. Pregnant women with previous uterine surgery, non-term pregnancy, multiple pregnancy, polyhydramnios or oligohydramnios, and placental localization pathology were excluded.

Measurements of the lower uterine segment were performed by transabdominal ultrasound. The sonographic examinations were conducted with a Voluson E6 (General Electric, USA) consisting of a transabdominal convex array transducer with a frequency of 2–5 MHz and a transvaginal probe with a frequency of 5–9 MHz.

A well-developed lower uterine segment can be identified ultrasonographically by three layers:[11] (1) chorioamniotic membrane with decidualized endometrium, (2) middle layer of myometrium, and (3) utero-vesical peritoneal reflection juxtaposed to the muscularis and mucosa of the bladder. According to these criteria, the full thickness of the lower uterine segment was measured by two experienced observers. If uterine contraction was detected during the examination, the examination was stopped and continued after the contraction ended.[12] On transabdominal examination, the lower uterine segment was scanned under magnification in the sagittal section to locate the thinnest area. Two to three measurements were taken, and the thinnest measurement was recorded. All participants then underwent cesarean delivery. During surgery, the lower uterine segment was evaluated intraoperatively and graded according to the system developed by Qureshi et al:[13]

- C I: Well-developed lower uterine segment.
- C II: Thin lower segment, content not visible.
- C III: Translucent lower segment, content visible.
- C IV: Well-circumscribed defect, either dehiscence or rupture.

Data were classified in a computer and analyzed using IBM Statistical Package for the Social Sciences version 28.0.1.0 (SPSS Inc., Chicago, IL, USA) software. For continuous variables, mean±standard deviation was calculated, and for categorical variables, percentage and numeric values were provided. The independent samples T-test was used to compare the means of the independent groups. ANOVA was used to find any statistical differences between the means of more than two independent groups. To select an optimal cut-off value, the ROC curve was used. Results with $p<0.05$ were reported as statistically significant.

RESULTS

The demographic characteristics of the patients are given in Table 1. The number of previous cesarean sections, gestational week, birth weight, and niche thickness affected the occurrence of pain in patients ($p<0.05$), while age and BMI were not related to the occurrence of pain in patients ($p>0.05$). It was observed that birth weight was lower, labor occurred at earlier weeks, and niche thickness was less in the study group. There was no significant difference between the study and control groups in terms of previous cesarean section rates (p=0.064). There was also no difference between the gestational weeks, newborn birth weight, and demographic characteristics of patients with and without pain (Table 1). However, niche thickness was 2.1±1.0 mm in patients presenting with pain and 2.9±0.8 mm in patients presenting without pain.

In the intraoperative evaluation, 30 patients in the study group were classified as C3 and above, while 91 patients were classified as C1–2 and 9 patients as C3 and above in the painless elective cesarean section group. This constituted a statistically significant difference between the groups ($p<0.05$). The number of patients with Qureshi classifications C3 and C4 was significantly higher in the study group ($p<0.05$) (Table 2).

The sensitivity, specificity, positive predictive value, and negative predictive value for detecting a translucent lower uterine segment thickness (C3) by ultrasonography were calculated. For a cut-off val-

Table 1: Comparison of patients' demographic characteristics

	Cesarean section with pain study group (n=100)	Cesarean section without pain control group (n=100)	p
Age (year)	28.6±5.7	30.0±5.6	0.085
BMI (kg/m^2)	30.8±3.9	31.6±5.1	0.234
Gestational age at the time of usg	37.7±1.4	38.5±0.6	**0.012**
LUS thickness (mm)	2.1±1.0	2.9±0.8	**0.029**
Number of previous cesarean sections	1.7±0.7	1.8±0.8	0.064
Neonatal weight (gr)	3113.8±477.3	3279.3±458.6	**0.013**

Independent samples t-test; p<0.05; LUS: Lower uterine segment; BMI: Body mass index.

Table 2: Difference in Qureshi scores and neonatal Apgar scores between the two groups

	Cesarean section with pain study group (n=100)	Cesarean section without pain control group (n=100)	p
Qureshi C1-2	70	91	**0.000***
Qureshi C3-4	30	9	**0.000***
Apgar at 1 min	6.6±0.8	6.8±0.5	**0.193****
Apgar at 5 min	8.8±0.5	8.8±0.5	**0.150****

*: Chi-square test p<0.05; **: ANOVA p<0.05.

Figure 1: Receiver operating characteristic curve. Receiver operative curve compares the sensitivity and specificity of full lower uterine segment thickness (blue) for uterine dehiscence. Corresponding cut-off value was 1.75 mm.

ue of 1.75 mm in the muscle layer using transabdominal sonography, there was a sensitivity of 90%, specificity of 90%, positive predictive value of 90%, and negative predictive value of 90% for detecting the translucent lower segment C3. The frequency prediction ROC curves for the translucent lower uterine segment (C3) showed a 95% detection rate for a false positive rate (FPR) of 10% (Fig. 1). The corresponding cut-off value was 1.75 mm. The linear regression model showed that a full thickness of LUS<1.75 mm was the only factor related to the presence of a translucent scar in the lower segment (C3) (90%, p=0.00).

We found that the intraoperative grades of C1–2–3–4 rupture according to the Qureshi classification did not affect the Apgar1 and Apgar5 scores of the newborn (p>0.05).

DISCUSSION

Lower uterine segment (LUS) thickness measurement by transabdominal (TAS) and transvaginal (TVS) sonography in patients with a previous cesarean section has been primarily performed to determine the patient's next mode of delivery and to protect the patient from uterine rupture, but most studies remain inconclusive.[14] The relatively avascular and thin LUS is ideal for making surgical incisions d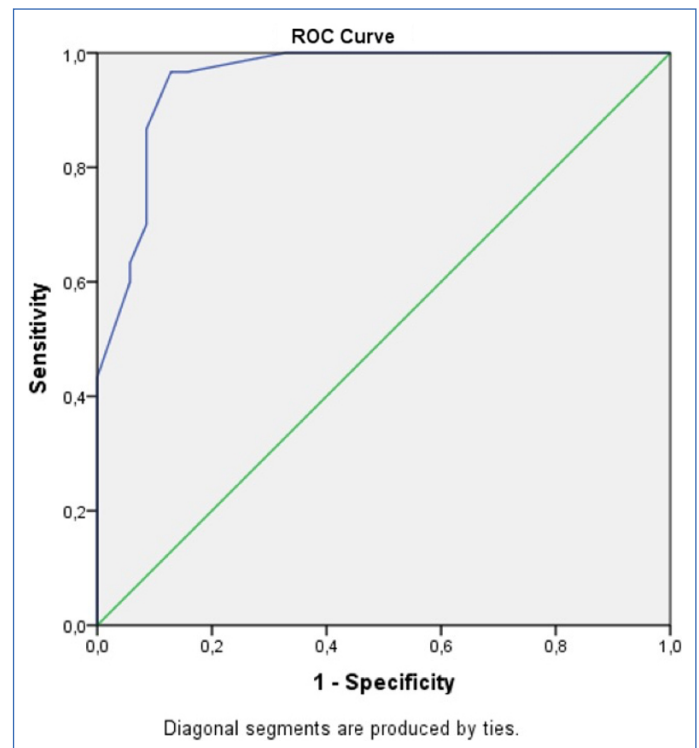uring cesarean section.[15] However, the presence of postoperative scarring on the LUS predisposes patients to various complications such as scar dehiscence or rupture, abnormal uterine bleeding, scar pregnancy, and subfertility.[16] Due to these risks, there has been a marked increase in repeat cesarean section rates. However, repeat cesareans are costly, invasive surgeries and have a significant financial impact on patients, especially in developing countries.[14]

To make informed decisions, there is a need to categorize these patients according to their relative risk of rupture and to apply current imaging technology prudently. In our study, the aim was not to decide the patient's subsequent mode of delivery based

Göksu et al. Lower uterine thickness in painful pregnants

Zeynep Kamil Med J 2024;55(4):187–191

on a threshold LUS value, as studied in the literature, but rather to determine whether the pain experienced during pregnancy follow-up, particularly after 37 weeks of gestation, increases the risk of uterine rupture in patients with a prior cesarean section and to protect them from adverse maternofetal outcomes. To assess how close uterine rupture is in patients undergoing emergency cesarean section due to labor pains, we studied both elective and emergency cesarean cases.

Several studies have concluded that ultrasonography can be effectively used to predict the risk of intrapartum rupture, especially by assessing the appearance of the LUS on ultrasound in a pregnant woman in the late third trimester. Both TAS and TVS have been used to assess scar thickness, with a strong correlation index between the two methods.[1,14]

While most studies evaluate LUS thickness (scar thickness), some have also assessed the morphological appearance on sonography and vascularity on color Doppler. However, the rate of scar detection on ultrasound varies between 7% and 89% across various studies.[16] Furthermore, the methods used to calculate "scar thickness" and the recommended threshold values for predicting uterine rupture also vary across different studies.[17] The presence of so many ultrasound techniques in the literature suggests that none of these techniques is absolutely optimal.[15]

Sharma et al.[18] reported that a lower uterine segment thickness of less than 3.65 mm had 91% sensitivity, 93% specificity, and 91% negative predictive value in predicting scar rupture. Mohammed et al.[19] showed that lower uterine segment thickness was reduced in patients with scar dehiscence, with sensitivity, specificity, positive, and negative predictive values at a cut-off value of 2.5 mm being 90.9%, 84%, 71.4%, and 95.5%, respectively. Bujold et al.[20] also concluded that a lower uterine segment thickness of <2.5 mm was associated with a uterine rupture rate of 10% with a specificity of 90%. Sarwar et al.[21] observed 88% sensitivity with a negative predictive value of 99.3% at a cut-off value of 3.5 mm scar thickness for predicting scar dehiscence. In their meta-analysis published in 2013, Kok et al.[22] concluded that a lower uterine segment thickness of 3.1–5.1 mm has a strong negative predictive value for the occurrence of uterine defects at delivery. Uharček et al.[7] showed that a lower uterine segment thickness of more than 2.5 mm, measured by abdominal sonography within 2 weeks before delivery, allowed safe spontaneous vaginal delivery after cesarean section, whereas a thickness of <2.5 mm was associated with a higher risk of uterine rupture.

In our study, we demonstrated that a lower uterine segment thickness of less than 1.75 mm had 90% sensitivity and 90% specificity in predicting scar rupture. No intraoperative rupture appearance was detected in patients who underwent elective operation. Among all patients, the number of cases classified as C1 and C2 according to the Qureshi scoring system was 161. In emergency cesarean section patients, if the mean thickness was 1.75 mm or less, Qureshi C3 and above were detected during the operation. This indicates an increased risk of uterine rupture with uterine thickness less than 1.75 mm in patients with pain and previous cesarean section.

After cesarean section, the structure of the uterus changes; the cesarean scar and the sutured adjacent myometrium lose their nor-mal 3-layered structure, and the scar fibers do not integrate with the normal uterine fibers. The wound healing process and the quality of scar healing are compromised, resulting in tension with fetal growth, difficulty, and resistance in labor and delivery. In this case, scar separation and uterine rupture are more likely in the scarred uterus.[23] Detailed changes in the cesarean scar area were investigated by Pollio et al.;[24] they showed that the cesarean scar is formed by a series of biochemical changes, such as increased collagen levels and decreased (or absent) transforming growth factor levels. Lofrumento et al.[25] reported that uterine wound healing involves many cells and that a complex sequence of biochemical events mediated by proteins and peptides occurs in this process, which depends on both phenotype and genotype.

Our study had some limitations. Weaknesses included the subjective evaluation of pain scores, even though the Nonstress Test (NST) was used, and the evaluation of a single preoperative parameter, although the same ultrasonography device was used. The strengths of our study were that it was prospective and conducted with a sufficient number of patients, the ultrasonography evaluation was performed by the same person, all patients were in the term period, and the group was homogeneous.

CONCLUSION

If uterine rupture can be identified by ultrasonography before the onset of labor, or if the at-risk group can be identified in this respect, it holds significant clinical importance. In our study, we set a cut-off value of 1.75 mm for lower uterine segment thickness, and in patients with uterine wall thickness below this value, we observed at least grade 3 dehiscence according to the Qureshi scoring system during the operation. This provides us with information regarding patients who should not be kept waiting due to the risk of uterine rupture. We believe that the clinician's measurement of wall thickness by ultrasonography will be useful in planning scheduled cesarean sections or in deciding on a vaginal delivery plan after a previous cesarean section. Especially in high-volume hospitals, knowing this measurement in patients who present in labor and have a history of cesarean section will provide valuable information on whether urgent surgery is required.

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