

Ultrasonographic assessment of lower uterine segment thickness and perinatal Outcomes in patients with a previous cesarean history

Nezaket Kadioğlu¹, Başak Güler², Eda Özkan³, Ebru Aslan Patlakoglu⁴, Umit Yasemin Sert^{5*}, Şevki Çelen⁶

¹ Yüksek İhtisas University, Dept of Obstetrics and Gynaecology, Ankara, TR

² Liv Hospital, Dept of Obstetrics and Gynaecology, Ankara, TR

³ Oztan Hospital, Dept of Obstetrics and Gynaecology, Usak, TR

⁴ Private Parkhayat Hospital, Dept of Obstetrics and Gynaecology, Kütahya, TR

⁵ University of Health Science, Ankara City Hospital, Dept of Obstetrics and Gynecology, Ankara, TR

⁶ University of Health Science, Etlik Zübeyde Hanım Women's Health, Training and Research Hospital, Dept of Obstetrics and Gynecology, Ankara, TR

* Corresponding Author: Umit Yasemin Sert E-mail: ysmn.sert88@gmail.com

ABSTRACT

Objective: The purpose of the study was to establish the validity of the abdominal evaluation of lower uterine segment (LUS) thickness in patients having a previous cesarean section (CS) in predicting uterine rupture, and to evaluate if there is any effect of the number of a previous surgeries on adverse maternal and perinatal outcomes.

Materials and methods: A prospective case-control study was carried out between December 2017 and June 2018 in Dr. Zekai Tahir Burak Women's Health Education and Research Hospital. 555 patients were classified into three groups; Group 1: patients having one previous CS, Group 2: patients having two previous CS, Group 3: patients having more than the two previous CS). Ultrasonographic measurements of the LUS, intraoperative findings and, adverse pregnancy outcomes were assessed.

Results: LUS thickness of group 2 was significantly less than the LUS thickness of the other groups ($p=0.022$). The feeling of pain was significantly more in the patients of group 2, when compared with the other groups ($p=0.019$). Pregnancy interval was the only parameter that had significant predictivity for adverse pregnancy outcomes for group 1 ($\#CS=2$) and group 3 ($\#CS\geq 4$) ($p=0.042$, and $p=0.021$, respectively). In group 2 ($\#CS=3$), age, the thickness of LUS, and thickness of subcutaneous adipose tissue were found to have significantly high predictivity for adverse pregnancy outcomes ($p=0.012$, $p\leq 0.001$, and $p=0.007$, respectively).

Conclusion: Measurement of LUS, in the patients who had previous CS, can be used for risk assessment and management. It is a non-invasive, reliable and, easily applicable method. Standardization of the measurement technique is a necessity.

Keywords: Cesarean, Ultrasonography, Lower, Uterus, Segment, Thickness

Research Article

Received 06-03-2020

Accepted 20-03-2021

Available Online: 26-03-2021

Published 30-03-2021

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INTRODUCTION

Uterine rupture is an intrapartum emergency, characterized by the disruption of muscular integrity of the uterine wall, which causes high maternal and neonatal mortality and morbidity (1). Its incidence in an unscarred uterus is 0.033 %, whereas it occurs in 1 of 100 scarred uterus. The main factor is the previous uterine surgery, mainly cesarean section (CS), whose incidence increases worldwide (2, 3). Uterine rupture risk is approximately 0.3 % in patients who had a previous CS, without regarding the delivery route (4).

The complications may be severe like maternal hemorrhage needing a blood transfusion, or hysterectomy, bladder injury, maternal death, as well as fetal prematurity, lower Apgar scores, and death (5, 6).

The poorer outcomes may result from the delayed diagnosis and management because of the unexpectedness and rareness. Although it is not enough for a definite diagnosis, the patients who had previous CS may be evaluated for their higher rupture risk, and adverse pregnancy outcome with the following criteria; advanced maternal age, a gestational week beyond 40 weeks, estimated fetal weight more than 4000g, the short period between two surgeries, and previous surgical technique (7).

In 1988, Fukuda et al. reported that ultra-sonographic examination could detect the thinner part of the lower uterine segment (LUS) and predict uterine scar dehiscence at repeat CS (8). Systematic reviews and meta-analyses of several studies confirmed the relation between LUS thickness and uterine scar defects (scar dehiscence or scar rupture) (9-15).

The purpose of this study was to establish the validity of the abdominal evaluation of LUS thickness in patients having previous CS in predicting uterine rupture and to evaluate if there is any effect of the number of previous surgeries on adverse maternal and perinatal outcomes.

MATERIAL and METHODS

A prospective case-control study was carried out between December 2017 and June 2018 in Dr. Zekai Tahir Burak Women's Health Education and Research Hospital. The study protocol was performed according to the principles of the Declaration of Helsinki and approved by the local Ethical Committee of our hospital. Informed consent was taken from all patients.

555 patients, who had one previous CS, within 37th and 40th weeks of gestation, were recruited in the study. All patients had an elective repeated CS (not in labor). Exclusion criteria were; active labor (4–6 cm dilatation), multiple pregnancies, abnormal amniotic fluid volumes, low lying placenta, leiomyoma in LUS of the uterus, previous classical CS, or other uterine surgeries (myomectomy, hysterotomy, polypectomy, lysis of uterine synechia, or hysteroscopic metroplasty).

Patients were classified into three groups; Group 1: patients having one previous CS, Group 2: patients having two previous CS, Group 3: patients having more than two previous CS). All the patients underwent ultra-sonographic evaluation for their LUS before the scheduled surgery. The measurement was made by the surgeon who operated.

For decent imaging of the LUS, the transabdominal sonographic examination was implemented with a full urinary bladder (in this way the patient had the urge barely). When the uterine contraction was detected during the ultrasonographic examination, the examination was stopped, then resumed after the contraction had moderated. Along the cervical canal at the midsagittal plane, the thinnest zone of a lower segment was spotted visually. The distance between the bladder wall and the amniotic cavity was defined as full LUS thickness.

It was measured by placing one caliper at the link between the urine and bladder wall and the other at the link between amniotic fluid and decidual endometrium.

At least 3 measurements were made, and the lowest value was taken as the full LUS thickness (15).

We compared the ultrasonographic measurements with the intraoperative findings of the LUS to identify women who have higher risk of uterine scar dehiscence and rupture.

Uterine scar dehiscence is also called a uterine 'window' was defined as loss of integrity of the myometrial layer without whole rupture of the LUS. Rupture was defined as total separation of the uterine scar causing transmission between the peritoneal cavities and uterine. Adverse pregnancy outcomes (scar dehiscence, uterine rupture, adhesions, low Apgar score, need for neonatal intensive care unit, or maternal blood transfusion) were assessed for all patients.

Statistical analysis: Data analysis was performed by using SPSS for Windows, version 17 (SPSS Inc., Chicago, IL, United States). Data were shown as mean (95% Confidence Interval) or number of cases and (percentage), where applicable. The mean differences between groups were compared by Student's T-test.

Nominal data were analyzed by Pearson's chi-square test. The variables for the three groups were analyzed with one-way ANOVA. Multiple logistic regression analyses were applied for calculating odds ratios and 95% confidence intervals for the prediction of adverse pregnancy outcomes in groups. A p-value less than 0.05 was considered statistically significant.

RESULTS

555 patients were included in the study, 230 of which had 2 previous CS, (group 1), 276 of which had 3 previous CS (group 2), and 46 of which had 4 or more CS (group 3). The clinical and laboratory parameters of the patients were demonstrated in table 1.

The increase in CS rate with increasing age was significant ($p=0.001$). LUS thickness of group 2 was significantly less than the LUS thickness of the other groups ($p=0.022$). The feeling of pain was significantly more in the patients of group 2, when compared with the other groups ($p=0.019$) (Table 1).

Multivariate and univariate logistic regression analyses were performed to detect risk factors effective on the adverse gestational outcome (presence of 2 of the following criteria were needed: scar, dehiscence, uterine rupture, adhesion, neonatal unit admission, need for neonatal respiratory support, need for maternal blood transfusion).

Pregnancy interval was the only parameter that had significant predictivity for adverse pregnancy outcome for group 1 (#CS=2) and group 3 (#CS \geq 4) ($p=0.042$, and $p=0.021$, respectively) (Table 2).

In group 2 (#CS=3), age, the thickness of LUS, and thickness of subcutaneous adipose

tissue were found to have significantly high predictivity for adverse pregnancy outcome ($p=0.012$, $p<0.001$, and $p=0.007$, respectively) (Table 2).

Table 1: Demographic, Clinical, and Laboratory Parameters of the Groups

	Group 1 (#CS=2) N=230	Group 2 (#CS=3) N=276	Group 3 (#CS≥ 4) N=49	p value*	p value
Age *	26.28 ± 5.36	29.66 ± 5.51	33.16 ± 4.50	p(12)<0.001 p(13)<0.001 p(23)<0.001	<0.001
Body Mass Index*	29.66 ± 5.48	28.58 ± 5.18	29.44 ± 6.71	p(12)=0.027 p(13)=ns p(23)=ns	0.078
Weight Gain *	12.50 ± 5.01	11.37 ± 4.96	12.37 ± 7.05	p(12)=0.015 p(13)=ns p(23)=ns	0.255
Interval*	4.33 ± 2.64	4.32 ± 2.67	4.34 ± 6.71	p(12)=ns p(13)=ns p(23)=ns	0.376
Lower Uterine Segment *	3.96 ± 1.34	3.66 ± 1.19	3.88 ± 1.13	p(12)=0.006 p(13)=ns p(23)=ns	0.022
Cervical Dilation (cm)**	[0-2]	[0-2]	[0-2]	p(12)=ns p(13)=ns p(23)=ns	0.782
Thickness of Subcutaneous adipose tissue (cm) *	3.375 ± 1.17	3.56 ± 1.21	3.50 ± 1.26	p(12)=ns p(13)=ns p(23)=ns	0.501
Uterine contraction*** (+)	45 (19.6%)	55 (19.9%)	11 (22.4%)	p(12)=ns p(13)=ns p(23)=ns	0.900
(-)	185 (80.4%)	221 (80.1%)	38 (77.6%)	p(12)=ns p(13)=ns p(23)=ns	
Feeling of Pain*** (+)	88 (38.3%)	140 (50.7%)	21 (42.9%)	p(12)= 0.005 p(13)= ns p(23)=ns	0.019
(-)	142 (61.7%)	136 (49.3%)	28 (57.1%)		
Weight of Newborn (grams)*	3235.59 ± 539.29	3188.42 ± 554.21	3257.35 ± 397.11	p(12)=ns p(13)=ns p(23)=ns	0.517
Hemoglobin level before caesarian*	11.87 ± 1.27	11.76 ± 1.47	11.89 ± 1.33	p(12)=ns p(13)=ns p(23)=ns	0.618
Hemoglobin level after caesarian*	10.97 ± 1.22	10.99 ± 5.63	10.71 ± 1.19	p(12)=ns p(13)=ns p(23)=ns	0.901

DISCUSSION

In the present study, mean LUS measurements in all three groups were thicker than the 3.5 mm which cut-off value introduced for foreseeing complications varied between 2.0 and 3.5 mm in the literature (9-13). Sonographic measurement of LUS thickness near term is correlated inversely with the risk of uterine scar defect, including uterine scar dehiscence and/or uterine rupture (10-15). A systematic review of 12 studies, including 1834 women, with a 6.6% rate of uterine scar defects, confirmed the strong association between the degrees of measure of LUS thickness in the third trimester of pregnancy and the risk of uterine scar rupture/dehiscence. The cut-off value proposed for predicting these complications varied between 2.0- 3.5mm (14). A precise cut-off value has not been able to be determined due to the heterogeneity of the studies. Another recent meta-analysis of 21 studies also confirmed these findings (15).

In our study, when we compared the LUS measurements of the groups, we observed that it was significantly thinner in group 2 (p=0.022). The studies reported that prior CS is associated with a sonographically thinner LUS when compared with those with prior vaginal delivery (11).

However Ginsberg et al. reported that neither the number of deliveries nor the presence of previous CS did change the wall thickness; if it was not a post-term pregnancy (16). Landon et al. reported that uterine rupture risk was 0.7% in women who had one previous CS; whereas it was 0.09% in patients who had more than one CS; and proposed that the number of the previous CS was not relevant to the complication of uterine rupture (17).

On the other hand, they had observed a higher maternal mortality rate and need for hysterectomy in the group in which the patients had multiple previous CS. LUS thickness had a high predictive value for proposing uterine rupture, in Group 2, which had thinner LUS (p<0.001) (17).

Complete uterine rupture is a rare peripartum complication, often associated with a ruinous outcome for both the fetus and pregnant woman. CS-based scarred uterus considerably increases the risk of uterine rupture. Qureshi graded the intraoperative scars into four.

Table 2: Univariate and Multivariate Regression Analyses for Adverse Pregnancy, Outcome In Groups (GROUP 1: # CS=2, GROUP 2: # CS= 3 and GROUP 3: # CS ≥4)

		GROUP 1 (# CS=2)				GROUP 2 (# CS=3)				GROUP 3 (# CS≥4)			
		Univariate OR (95% CI)	P value*	Multivariate OR (95% CI)	P value*	Univariate OR (95% CI)	P value*	Multivariate OR (95% CI)	P value*	Univariate OR (95% CI)	P value*	Multivariate OR (95% CI)	P value*
Age		1.028 (0.979- 1.080)	0.263			0.946 (0.902- 0.993)	0.025	0.938 (0.892- 0.986)	0.012	0.938 (0.824- 1.066)	0.326		
Body Mass Index		1.016 (0.969- 1.066)	0.506			1.018 (0.972- 1.066)	0.454			1.055 (0.964- 1.154)	0.248		
Weight Gain		1.009 (0.957- 1.063)	0.740			0.975 (0.929- 1.023)	0.305			1.021 (0.942- 1.108)	0.608		
Interval		1.114 (1.006- 1.234)	0.037	1.112 (1.004- 1.232)	0.042	1.037 (0.948- 1.134)	0.425			1.607 (1.102- 2.344)	0.014	1.569 (1.070- 2.302)	0.021
Lower Uterine Segment		1.065 (0.875- 1.296)	0.530			1.487 (1.199- 1.842)	<0.001	1.538 (1.232- 1.920)	<0.001	1.407 (0.833- 2.376)	0.201		
Feeling of Pain		0.725 (0.423- 1.241)	0.241			1.220 (0.756- 1.968)	0.415			0.682 (0.219- 2.126)	0.509		
Presence of Contractions		0.779 (0.405- 1.500)	0.455			0.856 (0.472- 1.551)	0.608			2.406 (0.601- 9.632)	0.215		
Cervical Dilation (cm)		1.154 (0.842- 1.581)	0.375			1.189 (0.864- 1.634)	0.288			1.540 (0.733- 3.235)	0.254		
Thickness of Subcutaneous Adipose Tissue (cm)		0.874 (0.696- 1.098)	0.248			0.793 (0.647- 0.972)	0.026	0.745 (0.601- 0.922)	0.007	0.676 (0.418- 1.094)	0.111		
Hemoglobin Level Before Caesarian		1.074 (0.872- 1.323)	0.502			0.965 (0.821- 1.135)	0.669			0.940 (0.614- 1.440)	0.776		
Hemoglobin Level After Caesarian		1.017 (0.821- 1.260)	0.878			0.907 (0.749- 1.097)	0.314			1.086 (0.675- 1.748)	0.732		

Grades III and IV (incomplete or complete dehiscence) are occasionally observed in elective CS (18). Fortunately, the maternal as well as fetal outcome is unaffected in such situations. Other reports have shown that uterine dehiscence is a high risk condition for uterine rupture (19). Therefore, measurement of the LUS thickness before the onset of labor may have clinical significance if it can identify the uterine dehiscence. When we evaluated the adverse outcomes in our study, we observed that as the age of the mothers increased, the number of CS increased. Especially in group 2, this result had high predictivity for adverse pregnancy outcomes. Similarly, other studies confirmed that as the age of the mother got older than 30 years, there were a 2-3 times increased risk for complications (20). A short interpregnancy interval has been hypothesized to be linked with deficient healing of the scar in the uterine and thus an increased risk for rupture in the uterine and adverse pregnancy outcomes (21, 22). These findings were confirmed by our results. In group 2 which has thinner LUS measurements, there was a statistically significant difference in pain of the suprapubic region compared to other groups. Cohen and colleagues (23), observed that abdominal pain can not be the strong predictor of scar rupture alone, but it has a nearly 60 % positive predictive value for rupture with an additional sign or symptom. In our study, the patients of group 2, which had thinner LUS, felt significantly higher pain. The varied results of group 2 by sonographic measurement of LUS are

assumed to be due to pain with contractile state of the uterus and the engaged status of the fetal head may stretch the LUS further and makes the LUS thinner possibly leading to uterine dehiscence or rupture. Thus, the quantitative risk of rupture associated with scar thickness has not been determined, a thin LUS might have a low positive predictive value for rupture (9) and women with normal lower uterine segment thickness have gone on to rupture their uterus when in labor (24,25).

Several authors described the techniques of measuring the myometrial thickness and full LUS in the third trimester. LUS thickness can be measured on ultrasound by using a transabdominal or a transvaginal probe (13, 26, 27). When the examinations were done with full-bladders, a strong connection was observed between the two approaches (13); whereas no correlation was observed when the bladders were empty (28). While the transvaginal technique can be considered as the best approach to visualize scar defects located in the lowest part of the LUS, for the women who had previous CS performed late in the first or second stage of labor, we can observe that the transabdominal technique can detect scar defects located high on the LUS, for the women who had previous CS performed in early weeks of gestation and/or before labor (29). We preferred to make the examinations by transabdominal route with the full bladder, to evaluate LUS better; because we could not reach all of the information of the previous CS, i.e. surgical technique, emergent conditions, and labor period. However, the studies

done with the transabdominal approach showed greater margin values than the ones done with the transvaginal approach for predicting uterine scar dehiscence/rupture (10,14). The best way to measure LUS thickness is believed to be the combination of both approaches as the experts suggest.

In our study, we used full LUS measurement instead of myometrial thickness. Because myometrial thickness can be difficult to determine the limits of the myometrial layer in the LUS, which can be causing a less accurate measurement (14,15). Both of the measurement approaches were found to be linked to the risk of uterine scar dehiscence/rupture (10,15,26,27).

The methodical review of Jastrow et al. (14) suggests that full LUS thickness is more predictive than myometrial thickness for the envision of uterine scar dehiscence/rupture. More to that, the recent meta-analysis of Kok et al.(15) found no meaningful differences between these measurements for the envision of uterine scar dehiscence/rupture.

Observations of present study corroborate the fact that measuring LUS either with transabdominal or transvaginal technique is vital to save many pregnant women and babies from significant morbidity and mortality. Early diagnosis of uterine scar dehiscence/rupture, followed by neonatal resuscitation and expeditious laparotomy is crucial for reducing the leading morbidity and mortality. An observational study showed a potential upper limit for nonhypoxic neonatal delivery of 18 minutes from suspected uterine rupture to delivery (30).

It is important to acknowledge that scar dehiscence may be asymptomatic in up to 48 % of patients, and the classic triad of a complete uterine rupture (pain, vaginal bleeding, and fetal heart rate abnormalities) may present in less than 10% of cases (31). Though there was no accurate clinical prediction or prevention for uterine rupture; awareness and response at the right time could reduce maternal and neonatal morbidity rates.

One of the limitations of the study is that the number of the patients included to the study. We believe that further studies would help decision making on this topic

CONCLUSION

Measurement of LUS, in the patients who had previous CS, can be used for risk assessment and management, without regarding the delivery route. Standardization of the measurement technique is a necessity.


Author contributions: NK, BG, EÖ, EAP, UYS, ŞÇ; Study design, Data collection, Literature search, Data analyzes NK; Writing article and revisions

Conflict of interest: The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article. This research did not receive and a specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Ethical issues: All authors declare originality of research.

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