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Transvaginal Ultrasonographic Assessment of Lower Uterine Segment Thickness and Prediction of Uterine Rupture In Cases of Vaginal Birth After Caesarean Delivery

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ORIGINAL ARTICLE

Transvaginal Ultrasonographic Assessment of Lower Uterine Segment Thickness and Prediction of Uterine Rupture in Cases of Vaginal Birth After Cesarean Delivery

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Abstract

Background: **The rise in elective cesarean section (CSs), which make about one-third of all CS cases, is primarily to blame for the rise in the cesarean birth rate.**

Objective: **To assess the strength of the association between transvaginal ultrasonographic measurement of the lower uterine segment (LUS) in women with prior one CS undergoing a trial of vaginal birth and uterine scar defect at delivery.**

Patients and methods: **A retrospective observational study was conducted at Al-Ahrar Zagazig Teaching Hospital during the period from June 2018 through June 2020. The LUS thickness was measured through transvaginal ultrasonography in 60 gravidas (36−40 weeks) with previous one CS undergoing vaginal birth after cesarean, and the scar was evaluated during delivery.**

Results: **Uterine dehiscence was found in four (6.7%) cases. There were no cases of uterine rupture. There was a significant correlation between the grade of scar and sonographic measurement of LUS thickness using transvaginal ultrasound ($P = 0.001$). The scar thickness in the third trimester (36−40 weeks) had a significant relation with the mode of delivery. LUS thickness of 2.4 mm was considered the critical cutoff value, above which safe vaginal delivery could be achieved. This critical cutoff value was derived from the receiver-operator characteristic curve with sensitivity, specificity, positive predictive value, and negative predictive value of 75.0, 85.7, 27.3, and 98.0%, respectively.**

Conclusion: **Measurement of the LUS thickness by transvaginal ultrasonographic seems to be a good screening test with its obviously high sensitivity and negative predictive values. LUS thickness of less than 2.4 mm is associated with a higher risk of uterine defect.**

Keywords: Lower uterine segment, Uterine dehiscence, Uterine rupture, Vaginal birth after cesarean

1. Introduction

With the exception of the years 1989−1996, when the annual rate of cesarean delivery actually declined, the rate of cesarean delivery has been steadily increasing. This decline was mostly attributable to a significantly increased rate of vaginal birth after cesarean (VBAC) and a closely paralleled fall in the primary rate. These gains were short lived, and in 2007, the main cesarean delivery rate was more than 30%, whereas VBAC rates fell to 8.5%.[1]

Physicians and patients should think about a woman's possibility of a successful VBAC as well as the risk of complications from a trial of labor when making plans for delivery. Between 60 and 80% of qualified candidates who attempt VBAC will be successful.[2]

VBAC helps women avoid major abdominal surgery, reduces their risk of bleeding and infection, and speeds up their recovery after giving birth. Additionally, it might assist women in avoiding potential dangers like hysterectomy, bowel and

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bladder injury, transfusion, and aberrant placenta abnormalities that could result from repeat cesarean sections (CSs) in the future (placenta previa and placenta accreta).[2]

At the individual level, VBAC is linked to lower rates of maternal morbidity and future pregnancy difficulties. VBAC is also linked, on a population level, to a decline in the total cesarean delivery rate.[3]

Both planned repeat cesarean deliveries and trial of labor after cesarean carry a risk to the mother and the baby.[4]

The complications following a successful VBAC are less severe than those following an intentional repeat cesarean, but those following a failed trial of labor after cesarean are more severe.[2]

Women should not be coerced into having a repeat cesarean delivery by the use of restrictive VBAC regulations. On the contrary, it is appropriate to refer a patient to another doctor or facility if, during prenatal care, a doctor feels unhappy with the patient's intention to undergo VBAC.[2]

Uterine rupture is a rare but possibly fatal complication of a VBAC trial.[5]

After induction of labor, the risk of uterine rupture in laboring women with a previous CS ranges between 0.2 and 1.5%, compared with 0.5% in women with spontaneous labor after a previous CS.[6]

Uterine rupture necessitates rapid surgical intervention and can result in serious morbidity and mortality for both the newborn and the mother. Accurate prediction of uterine rupture would thus be enormously beneficial, allowing women at low risk to proceed with termination of labor, whereas women at high risk might undergo scheduled CS.[6]

Ultrasonography has been proven in studies to predict uterine rupture in women who have had a previous cesarean delivery. The degree of thinning of the lower uterine segment (LUS) is strongly connected to the likelihood of uterine rupture in the presence of an LSCS scar (LUS).[7] The aim of this study was to assess the strength of the association between transvaginal ultrasonographic measurement of the LUS in women with prior one CS undergoing a trial of vaginal birth and uterine scar defect at delivery and to ascertain the best cutoff value for predicting uterine rupture.

2. Patients and methods

After approvals were taken from the ethical clearance committee and the Department of Gynecology and Obstetrics, Al-Azhar University and written informed consent was taken from all the patients, this retrospective observational study was conducted from June 2018 through June 2020. The study included 60 cases with previous one CS presented in labor who were admitted to the Obstetrics and Gynecology Department of Al-Ahrar Zagazig Teaching Hospital.

Inclusion criteria were as follows: pregnant women without any medical disorders affecting the course of labor, gestational age from 36 to 40 weeks, singleton pregnancy, normal ultrasonographic findings (fetal structures and placental site), cephalic vertex presentation, parity cases, and all patients must have a history of previous one low transverse CS. Exclusion criteria were as follows: permanent indication for the previous CS, previous repair of ruptured uterus, prior T-shaped classic incision or myomectomy scar, pregnant women in active phase of labor, placenta previa, oligohydramnios, polyhydramnios, and premature rupture of membrane.

All women participating in this study were motivated to proceed with vaginal delivery and counseled for the values and risks of VBAC.

An abdominal ultrasound was performed to check gestational age, fetal lie and presentation, placental location, and its relationship to a previous CS scar.

2.1. Transvaginal ultrasound

The LUS is divided into three different layers. The outermost layer is located right outside the muscle layer and above the bladder. The muscle layer is the second layer. The decidual layer of the endometrium is placed directly inside and beneath the muscle layer in the third layer. The chorioamniotic membrane and the decidualized endometrial layer are usually not visible as separate layers from the myometrium during late gestation. If the fetus is vertex presenting, the presenting part may be pressing against the LUS, with no amniotic fluid visible between these two structures. Only the muscle layer at its thinnest point was measured.[8]

Measurement of LUS thickness was done in the absence of any uterine contraction which may stretch the LUS (not in active phase of labor). Two to three measurements were taken, and the lowest value was taken as the LUS thickness.

The image was magnified in this investigation so that a 0.1 mm shift in measurement was achieved by moving the callipers. Following bladder identification, the thickness of the LUS was measured. To allow free movement of the probe, the patient was positioned supine, knees softly flexed, and hips elevated slightly on a pillow. A sonographer used a Medison US machine to perform the examinations (the transvaginal ultrasound probe of 7-MHz frequency). If the LUS appeared to be in good condition, an attempt would be made to locate the previous uterine scar (Figs. 1–4).

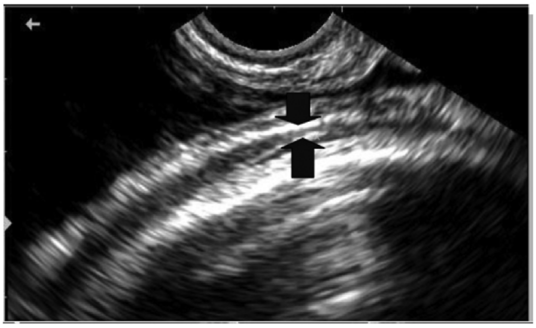

Fig. 1. LUS showing the urinary bladder wall—myometrium interface (arrows) and the myometrium/chorioamniotic membrane— amniotic fluid interface (arrowheads). AF, amniotic fluid; B, urinary bladder; LUS, lower uterine segment.

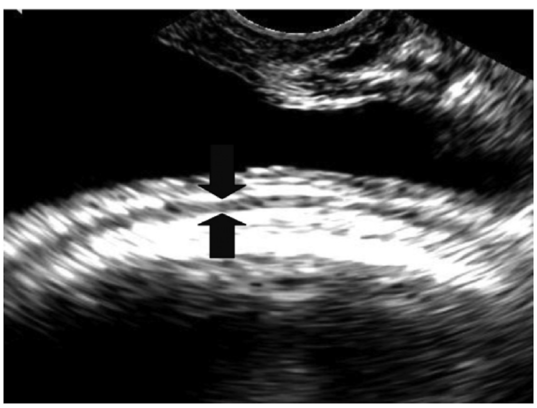

Fig. 2. A case from our study with LUS thickness = 2.07 mm. LUS, lower uterine segment.

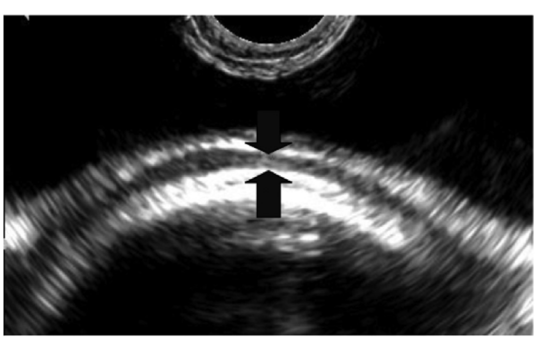

Fig. 3. A case from our study with LUS thickness = 4.08 mm. LUS, lower uterine segment.

2.2. Outcomes

Primary outcome was success of VBAC.

Secondary outcomes were fetal outcome (Apgar score and weight) and maternal complication (rupture uterus and blood transfusion).

The patient was followed up till delivery, and the mode of delivery was documented, whether CS or VBAC. The CS scar was assessed whether intraoperatively or after vaginal delivery. Intraoperative CS scar was assessed to see whether it was intact or there was a scar dehiscence, using a grading system developed by Qureshi et al.[9] For patients delivered vaginally after previous CS, the scar integrity was assessed by digital examination as instructed by a senior consultant on duty.

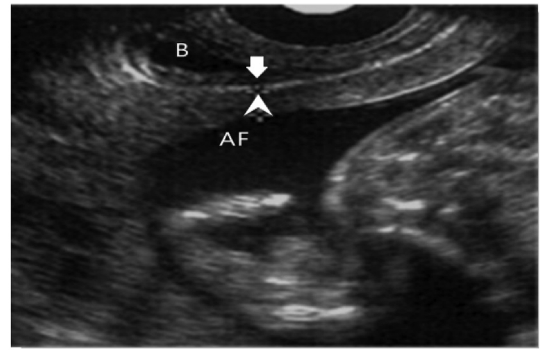

Fig. 4. A case from our study with LUS thickness = 3.21 mm. LUS, lower uterine segment.

2.3. Statistical analysis

All information was gathered, checked, and statistically examined using Windows SPSS 20.0 (2011; SPSS Inc., Chicago, Illinois, USA). Qualitative data were expressed as percentages and numbers, whereas quantitative data were expressed as the mean ± SD and range. Two groups' normally distributed variables were compared using the *t* test. When appropriate, the χ^2 test or Fisher exact test was used to compare the percentage of categorical variables. Every test had two sides. *P* values less than 0.05 were regarded as statistically nonsignificant and those above 0.05 as statistically significant.

3. Results

Table 1 shows that the mean gestational age was 36.78 ± 0.99 weeks and ranged from 36 to 40 weeks. Mean LUS thickness was 3.36 ± 0.87 and ranged from 1.9 to 5.1 mm.

Table 2 defines the outcome of vaginal birth after cesarean delivery of studied group. Four (6.7%) women were exposed to dehiscence of uterus. A total of 36 (60.0%) women were delivered normally, but 24 (40.0%) of them were turned to CS. Nine (37.5%) of them had scar of grade 1, eight (33.3%) of them had scar of grade 2, three (12.5%) had scar of grade 3, and four (16.7%) women had scar of grade 4.

Table 3 shows that the mean ± SD time lapse from last CS of intact uterine outcome was 2.85 ± 0.64, with range from 1.8 to 4.5 years longer than patients

Table 1. Characteristics of current pregnancy of the studied group (N = 60).

Variables	Mean ± SD	Range
Gestational age (weeks)	36.78 ± 0.99	36−40
Lower uterine segment thickness (mm)	3.36 ± 0.87	1.9−5.1

Table 2. Outcome of vaginal birth after cesarean delivery of the studied group (N = 60).

Variables	*n* (%)
Current delivery	
Vaginal	36 (60.0)
Cesarean section	24 (40.0)
Outcome	
Dehiscence	4 (6.7)
Intact	56 (93.3)
Scar grade (*N* = 24)	
Grade 1	9 (37.5)
Grade 2	8 (33.3)
Grade 3	3 (12.5)
Grade 4	4 (16.7)

Table 3. Outcome of vaginal birth after cesarean delivery according to time lapse from it (N = 60).

	Outcome		*t*	*P* value
	Dehiscence (*N* = 4)	Intact (*N* = 56)		
Time lapse from last cesarean section				
Mean ± SD	2.17 ± 0.17	2.85 ± 0.64	5.58	0.0001 (S)
Range	2−2.4	1.8−4.5		

S, significant; *t*, *t* test of significance.
P value less than 0.05.

with dehiscence uterine outcome (mean ± SD was 2.17 ± 0.17, with range from 2 to 2.4 years). The difference was statistically significant ($P = 0.0001$).

Table 4 shows that the mean ± SD LUS thickness in intact uterine outcome was 3.43 ± 0.85, with range from 2.1 to 5.1 mm, which was thicker than thickness in dehiscence uterine outcome (2.37 ± 0.51, with range from 1.9 to 3.1 mm). The difference was statistically significant ($P = 0.018$).

Table 5 shows the performance of LUS thickness in dehiscence uterus at a cutoff value of less than equal to 2.4 mm; it had 75% sensitivity, 85.7% specificity, positive predictive value of 27.3%, negative predictive value of 98.0%, and accuracy of 85%. Therefore, a cutoff of 2.4 was a good diagnostic marker to predict dehiscence uterus.

Table 4. Outcome of vaginal birth after cesarean delivery according to lower uterine segment thickness (mm) (N = 60).

	Outcome		*t*	*P* value
	Dehiscence (*N* = 4)	Intact (*N* = 56)		
Lower uterine segment thickness (mm)				
Mean ± SD	2.37 ± 0.51	3.43 ± 0.85		
Range	1.9−3.1	2.1−5.1	2.43	0.018(S)

S, significant; *t*, *t* test of significance.
P value less than 0.05.

Table 5. Performance of lower uterine segment thickness among women at labor who had previous cesarean section at a cutoff value of 2.4 mm.

	Thickness of lower uterine segment (mm)	
	Dehiscence (*N* = 4)	Intact (*N* = 56)
Cutoff		
≤2.4 mm	3	8
>2.4 mm	1	48
Sensitivity	75%	
Specificity	85.7%	
Positive predictive value	27.3%	
Negative predictive value	98.0%	
Accuracy	85%	

4. Discussion

There was a statistically highly significant difference between the CS and VBAC groups regarding duration since last delivery, meaning that increased duration form the last delivery is associated with increased thickness of the scar and so decreased risk of rupture uterus. This is consistent with Bujold *et al.*[10] who stated that compared with an interval of more than 24 months of gestation, an interdelivery interval of less than or equal to 24 months of gestation was related to a two to three-fold increase in the risk of uterine rupture.[10]

The mean scar thickness as measured by transvaginal sonography from 36 to 40 weeks was 3.36 ± 0.87 mm with a range of 1.9−5.1 mm, and it was found that the group with intact had scar thickness of 3.43 ± 0.85 mm and the group with dehisence had scar thickness of 2.37 ± 0.51 mm.

These figures were in agreement with those of Sen *et al.*[11] who stated a mean scar thickness in the third trimester of 3.3 ± 1.09 mm, but were slightly higher than Gotoh *et al.*[12] who reported a mean scar thickness by transvaginal ultrasonographic at 39 weeks of gestation of 3 ± 0.7, and Vincent *et al.*[7] who reported a scar thickness in the third trimester of 1.9 ± 1.4 mm, consistent with the results reported.[13]

This significant global difference in the numbers may be the result of numerous contributing causes. One possible contributing factor is the variation in CS procedures, particularly in the uterine and peritoneal closure. Additionally, the healing process, which is yet not entirely understood, might have a role in this conundrum. The resolution, ultrasound equipment type, and interobserver error are all factors.[14]

One of the greatest aims of this study is not only to demonstrate a strong positive correlation between the scar thickness as measured by ultrasound in the third trimester (36–40 weeks) and the mode of delivery in patients with prior CS but also to determine a cutoff value for this scar thickness that can be clinically used with safety. This cutoff value must yield the best sensitivity and specificity in order not to have many CS for really good scars and in the same time not to jeopardize the life of the mother and the fetus in a useless trial of labor. This naturally has its implication on the diagnosis, prognosis, and policy of delivery.

In this study, a receiver-operator characteristic curve was constructed using the scar thickness in the third trimester (36–40 weeks) and then determining the sensitivity and specificity with a range of cutoff value. We concluded that a best cutoff value will be at 2.4 mm, and this yields a sensitivity of 75.0% and a specificity of 85.7%. At this cut-off value, the positive predictive value was 27.3%, whereas negative predictive value was 98.0% and the accuracy was 85.0%. This is consistent with Thomas *et al.*[15] who found that the best cutoff value was 2.4 mm (using transvaginal ultrasonographic), and this yields a sensitivity of 90.0% and a specificity of 43.5%. At this cut-off value, the positive predictive value is 12.5%, whereas negative predictive value is 98.3%.

In this study, 36/60 (60.0% of patients) delivered by VBAC, whereas the incidence of CS was 24/60 (40.0%), so VBAC success rate was 60.0%. This is similar to the results of Qureshi *et al.*[9] who had VBAC success rate of 57%, whereas Sen et al.[11] reported 64%. Moreover, Cheung[16] found in a trial of labor on 50 cases that 32/50 (64%) delivered by VBAC.

Regarding complications, we had no cases of uterine rupture in our study and only 4 cases of uterine dehiscences (6.7%). Asakura et al.[8] had nine (4.7%) cases of uterine dehiscence. Thomas et al.[15] had 11 (8%) cases of uterine dehiscence. Rozenberg et al.[17] discovered that the prevalence of defects increased as the thickness of the LUS decreased. They reported that the total frequency of faulty scars was 4.0% (25/642 cases, with 15 ruptures and 10 dehiscences). This might be explained by varying sample sizes and scar dehiscence grading scale variations. A spectrum of problems, including asymptomatic scar dehiscence and overt uterine rupture with full fetal ejection from the uterus into the maternal abdomen, are associated with uterine scar separation.

4.1. Conclusion

The LUS thickness measured by transvaginal sonography is related to mode of delivery. The best timing to perform the scan is at late third trimester (36–40 weeks). The success rate of VBAC is estimated to be 60%. Measurement of the LUS thickness by transvaginal ultrasonographic seems to be a good screening test with its obviously high sensitivity and negative predictive value. LUS thickness of less than 2.4 mm is associated with a higher risk of uterine defect. Applying this step to other parameters during assessment and counseling of women who may undergo a trial of VBAC may decrease the incidence of scar dehiscence and rupture during labor. Delivery by VBAC does not increase fetal morbidity or mortality.

Conflicts of interest

There are no conflicts of interest.

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