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Lower uterine segment thickness is assessed by ultrasound in individuals who have had prior caesarean sections

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Abstract
Introduction: The increased number of caesarean births is causing a great deal of professional and public worry. Using transvaginal and abdominal ultrasonography, estimate the critical thickness over which a safe vaginal birth is foreseeable in women who have previously had caesarean delivery.
Method: 50 pregnant women who had previously had a caesarean section served as the case group in a case-control research, whereas 50 pregnant women who had never undergone a caesarean section served as the control group. The gestational age was between 38 and 40 weeks. The thickness of the LUS was measured using TA and TV ultrasonography in both groups; in the study group, a thickness of >2 mm was regarded as good healing and a thickness of 2 mm as poor healing; the mode of delivery for women was either trial VBAC (unless an obstetrical indication for CS existed) or ERCS. There was a correlation between U/S measures and every intraoperative LUS manifestation and delivery result.
Result: The total VBAC success rate was 52%, the incidence of dehiscence was 4%, and there was no uterine rupture. The overall VBAC success rate was 84%. Between TA and TV ultrasonography, there was a 95% correlation. The ROC curve's crucial cut off value for safe LUS thickness was 2.5mm.
Conclusion: In women who have had a prior caesarean section, sonography enables a reliable measurement of the LUS thickness, making it theoretically possible to utilise it to foretell the risk of uterine rupture during a trial vaginal delivery.

Keywords: Ultrasonographic, lower uterine segment, thickness, previous cesarean section.

Introduction
The increased number of caesarean births is causing a great deal of public and professional worry [1]. The percentage of the obstetric population with previous experience having a caesarean birth has increased as a consequence of rising primary caesarean section rates. An ERCS or a planned VBAC may be provided to women who have had a previous caesarean section. The percentage of women who reject VBAC is a significant factor in overall caesarean delivery rates, in turn [2-5]. All women who have previously had a caesarean section should be informed about the benefits and dangers of planned VBAC and ERCS before choosing the delivery method. The benefits and drawbacks should be discussed in light of the woman's particular circumstances, including her personal motivation and preferences to have a vaginal birth or ERCS, her attitudes towards the risk of uncommon but serious adverse outcomes, her plans for subsequent pregnancies, and her prospects for a successful VBAC (principally whether she has previously had a vaginal birth). In addition, if feasible, the operating records of the prior caesarean should be reviewed to determine the indication, kind of uterine incision, and any preoperative problems. 72–76% of planned VBACs following a single prior caesarean are successful [6-8]. Several variables are connected with VBAC success. Previous vaginal delivery, particularly previous VBAC, is the strongest predictor of successful VBAC and is related with an 87–90% success rate for planned VBAC [6-9]. Diagnostic ultrasonography can assess LUS scar integrity. Obstetrics uses diagnostic ultrasonography. Ultrasonic transducers send low-intensity, high-frequency (3-7.5 kHz) sound waves into the abdomen or pelvis. The transducer has curved piezoelectric crystals. Sequentially activating small groups of crystals produces a focused ultrasonic beam in pulses. Uterus signals reach the crystals between pulses. Piezoelectricity from these returning impulses creates visual signals for a cathode ray tube or video screen.

A water-soluble gel on the skin acts as a coupling agent, allowing the operator to move the transducer about the abdomen. High-quality photos require operator skill. The probe and transducer are crucial for foetal and uterine diagnostics [10]. Transabdominal examination with a curved-array 3- to 5-MHz transducer identifies all pelvic organs, making it the first method. A full bladder pulls the uterus up from behind the pubic symphysis and removes the small bowel, allowing for better visibility. The bladder improves sound transmission like an acoustic window. To locate the thinnest location, we examined LUS thickness in the sagittal slice under magnification. The lateral LUS was scanned for symptomatic dehiscence, ballooning, or funneling [43]. Higher-frequency (5- to 10-MHz) transducers improve sensitivity and spatial picture resolution. Before a transvaginal investigation, the bladder is emptied to focus on pelvic organs and ensure patient comfort. After locating the bladder in the cervical canal longitudinal plane with the vaginal probe in the posterior vaginal fornix, the LUS thickness was determined. Sagittal images are produced with modest transducer rotation and angulation [11]. The aim of study is to measure the threshold thickness at which a safe vaginal birth is foreseeable in women who have had a prior caesarean delivery, and to assess lower uterine segment thickness by transvaginal and abdominal ultrasonography.

Method

In the current study, we used TA and TV U/S to prospectively measure the thickness of LUS in a woman who had previously undergone a caesarean section. In order to prevent an unnecessary repetition of a caesarean scar or a potentially dangerous uterine rupture, we used this thickness to categorise the quality of the healed scar and chose patients for the mode of delivery. This prospective comparative research was conducted in the department of obstetrics and gynaecology in AL-Kadhimiya Teaching Hospital in Baghdad, Iraq, between the beginning of May 2010 and the end of June 2011. Both the inpatient wards and the outpatient clinic were used to find patients. 100 pregnant women participated in the research, and they were split into two groups: 50 randomly chosen pregnant women who had a prior transverse caesarean birth made up the study's study group. 50 expectant women in the control group had never had a caesarean birth before. The parity and gestational age (38–40 weeks) of the study and control groups were comparable. The following conditions must be met for inclusion: Previous history of one caesarean scar, one foetus, 37–40 weeks of gestation, no labour present or in the latent stage of labour. Being in active labour, a prior scar with a low-lying placenta, twin pregnancies, a prior scar with two or more scars, and a prior repair of a ruptured uterus or other gynaecological operations are all exclusion factors (myomectomy). In a well-developed LUS, three layers may be seen ultrasonographically in a midline sagittal view slice. They are as follows, starting from the inside out: a deep, less echogenic layer of chorioamniotic membrane with decasualized endometrium, A intermediate layer of the myometrium that is superficial, highly echogenic, and that contrasts with the muscularis and bladder mucosa. Pregnant women were divided into two groups for the mode of delivery based on the quality of the healed scar: either a trial for VBAC (if the LUS thickness is greater than 2mm and there are no other reasons for a caesarean section) or an ERCS (if the LUS thickness is less than 2mm, there are ballooning, funnelling, or other defects in the LUS, or there are recurrent reasons for a CS such as a contracted pelvis, malpresentation (CPD). During the caesarean birth, the LUS was evaluated intraoperatively using the technique created by Qureshi *et al*. [12]. SPSS 22 was used for the statistical analysis, which employed percentages and frequencies for categorical data and mean, median, and SD for continuous data. Chi-square is used to evaluate the relationship between variables, and person correlation demonstrates the relationship between continuous data. The T test is used to assess variations between the mean and median of ongoing variables. A more precise and sensitive cutoff point is also shown using the ROC curve. P-values of 0.05 or less are regarded as significant.

Results

Clinical characteristics of patients in control and study groups, the parameters (age, gestational age, inter-delivery interval, U/S thickness) were compared with each other among both groups using one-way p value. there was no significant difference in mean age of study and control groups (24.28±4.36 and 23.92±3.71 years respectively) (p>0.05), also there was no significant difference in the mean gestational age among groups (38.80±0.80 and 38.84±0.79 weeks respectively) (p>0.05), but there was a significant difference in inter-delivery interval (2.81±0.87and 2.38±0.72 years respectively) (p<0.05). There was a significant positive correlation between TA and TV U/S in the measurement of LUS thickness (mm) in each of the study and the control groups (p<0.001, p<0.001respectively) (p<0.05). as shown in table 1.

Table 1: Clinical characteristics of patients in control and study groups, the parameters (age, gestational age, inter-delivery interval, U/S thickness).

Variable	Study group Means ± SD*[1] N = 50	Control group Means ± SD N = 50	P-value
Age (years)	24.28±4.36	23.92±3.71	0.658
Gestational age (weeks)	38.80±0.80	38.84±0.79	0.803
Inter-delivery interval (years)	2.81±0.87	2.38±0.72	0.009
LUS thickness (mm)			
TAU/S	3.08±0.70	4.03±0.52	<0.001
TVU/S	2.78±0.68	3.66±0.47	<0.001

*[1] SD: standard deviation

The method of birth for research participants and the control group in their most recent pregnancies. In study group, out of 50, 8 (16%) cases delivered by ERCS, 16 (32%) cases delivered by emergency CS, 26 (52%) delivered by successful VBAC. In control group, out of 50, 0 case delivered by to ERCS, 4 (8%) cases delivered by emergency C/S, 46 (92) cases successful VD. The frequency of VD was high in control group than in study group. As shown in table 2.

Table 2: The method of birth for research participants and the control group in their most recent pregnancies.

Groups (n=100)	ERCS*[1]	Emergency CS*[2]	Successful VD*[3]	P value
Study (n=50)	8 (16%)	16 (32%)	26 (52%)	<0.001
Control(n=50)	0 (0%)	4 (8%)	46 (92%)	<0.001

*[1]ERCS: elective repeat cesarean scar
*[2]CS: cesarean scar
*[3]VD: vaginal delivery

Distribution of delivery mode by LUS thickness in the study group (n=50).3 groups were divided: 1st: >3mm, 20(64.51%) of 31women had successful VBAC. 2nd: 2-3mm had equal number of women with successful VBAC and emergency CS 6 of 13 women (46.15%). 3rd: <2mm, all had elective CS 6 women (100%). As shown in table 3.

Table 3: Distribution of delivery mode by LUS thickness in the study group.

LUS thickness	Number of cases	Elective CS	Successful TOL*[1]	Emergency CS*[2]
>3mm	31	1 (3.22%)	20 (64.51%)	10 (32.25%)
2_3mm	13	1 (7.69%)	6 (46.15%)	6 (46.15%)
<2mm	6	6 (100%)	0 (0%)	0 (0%)
Total	50	8	26	16

p<0.001 *1 TOL: trial of labor *2 CS: cesarean scar

Preoperative and intraoperative assessment of scarred LUS thickness in the study group (n=50). Preoperative 3 groups: 1st >3 mm, 2nd 2-3 mm, 3rd <2 mm. Intraoperative 4 classes I, II, III, IV. Cases with well-developed LUS during the operation were all assessed preoperatively with >3 mm LUS thickness. Conversely the thin and translucent intraoperative LUS were all measured ≤2mm preoperatively. There was a strong association between the LUS's intraoperative grade and the ultrasonography measurement of its thickness. As shown in table 4.

Table 4: Preoperative and intraoperative assessment of scarred LUS thickness in the study group.

USG* Thickness Of LUS	Total Number of cases	Number of cases with TOL	Number of cases with CS	Assessment of LUS			
				Class I	Class II	Class III	Class IV
>3 mm	31	30 (71.42%)	11 (45.84%)	9 (81.81%)	2 (18.18%)	0 (0%)	0 (0%)
2_3 mm	13	12 (28.57%)	7 (29.16%)	0 (0%)	5 (71.42%)	2 (28.58%)	0 (0%)
<2 mm	6	0 (0%)	6 (25%)	0 (0%)	0 (0%)	5 (83.33%)	1 (16.67%)
Total	50	42	24	9 (37.5)	7 (29.18%)	7 (29.18%)	(8.33%)

*Ultrasonography

Predictive values for LUS thickness in TA US and TV U/S in both control and study group (n=100): show that a high specificity and a PPV for TA and TV US patients with LUS thickness ≤2mm. in addition, we can notice a high sensitivity and a NPV for patient with LUS thickness ≤ 5mm. the same thing is applicable regarding LUS thickness≤ 2.5, 3, 3.5, 4, 4.5 respectively. The PPV of the U/S measurement was weak in our study, suggesting that all thin LUS are not abnormal. On the other hand, the US measurement had a good NPV confirming that a thick LUS is generally strong. As shown in table 5.

Table 5: Predictive values for LUS thickness in TA US and TV U/S in both control and study group.

LUS thickness	Sensitivity		Specificity		PPV*[1]		NPV*[2]	
	TAUS	TVUS	TAUS	TVUS	TAUS	TVUS	TAUS	TVUS
≤ 2 mm	14.3	47.9	100	98.6	100	100	73.5	75
≤ 2.5 mm	74.3	78.6	85.1	80.4	80.1	65.1	93.7	90.9
≤ 3 mm	82.1	85.7	91.7	72.2	87.1	73.7	98.6	100
≤ 3.5 mm	92.9	96.4	63.9	50	58.3	45.2	100	100
≤ 4 mm	99.4	98.8	31.6	8.3	42.4	33.3	100	100
≤ 4.5 mm	99.9	100	11.1	5.6	31.8	29.2	100	100
≤ 5 mm	100	100	5.6	2.8	29.2	28.6	100	100

*1PPV: positive predictive value *2 NPV: negative predictive value

The ROC curve demonstrating sensitivity and 1-specificity for various LUS thickness cut off thresholds. The LUS thickness was determined to have a critical cutoff value of 2.5 mm. ROC curve comparison between TA and TV U/S in predicting LUS thickness scar. For the prediction of LUS thickness, the area under the curve (AUC) did not substantially vary (0.932, 0.930, p=0.001, respectively).

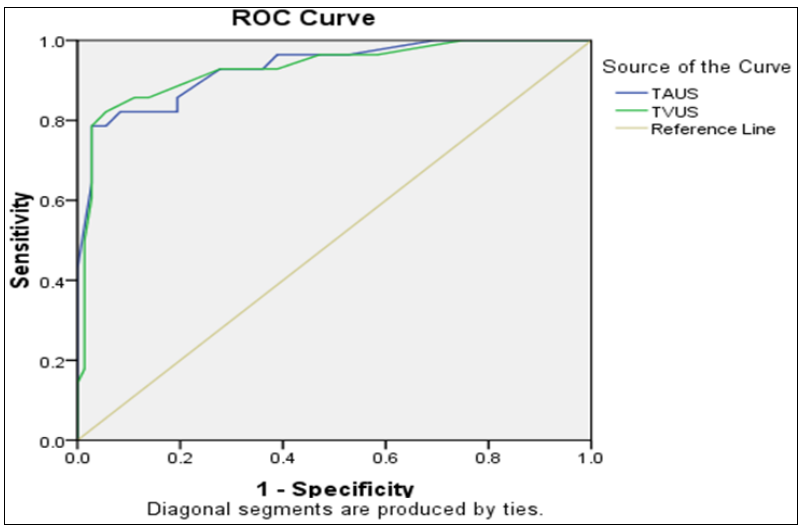

Fig 1: ROC curve between TA and TV U/S.

Discussion

"Once a caesarean, always a caesarean" no longer applies. If a woman had one CS delivery, all others had to be the same. Many women can deliver vaginally following CS. VBAC. LUS thickness indicates LUS quality and integrity. Ultrasonography is used to quantify LUS thickness, which is crucial to the obstetrician's delivery route choice, however its application in VBAC care is contentious [13]. On one line with our study Sen *et al*.,[14] and Mohammed *et al*., [15] measured the LUS thickness using both TA and TV U/S. On the contrary to our study, other studies as Rozenberg *et al*., [16] 1996 and Kushtagi *et al*., [17] reported a significant relationship between TA sonographic measurement of the entire LUS thickness in women near term who had had a previous cesarean section and the risk of uterine rupture or dehiscence. While Gotoh *et al*., [18] Fukuda *et al*., [19] Qureshi *et al*., [12] and Asakura *et al*., [20] measured the LUS thickness using TVU/S. Armstrong *et al*. [21] Valenzano *et al*., [22] Osser *et al*., [23] and Marasinghe *et al*., [24] made comparison between TA versus TV U/S to measure thickness of the LUS at term and found TV U/S is a more accurate method of assessing the thickness of the LUS. Although the LUS measurement can potentially be used as a tool to determine the risk of uterine rupture, other factors may operate to influence the accuracy of this tool. In the present study, it is shown that the risk of scar dehiscence was higher with short period of inter-delivery interval. This is agreeing with Shipp *et al*., [25] and Bujold *et al*. [26] concluded that inter-delivery interval of up to 18 months were associated with increased risk of symptomatic uterine rupture during a trial of labor after cesarean. In the same theme, Suzuki *et al*., [27] Reported derived cut *off* value was 2mm above which no surgical finding of dehiscence in the LUS. On the contrary, Rozenberg *et al*., [16] 1996 in their study examined the scarred uterus and found that the risk of uterine rupture was highest when the LUS thickness was between 1.6-2.5mm. While Papov *et al*., [28] also described a thickness of < 3mm as an insufficient scar and confirmed the assessment according to the mode of delivery. And Bujold *et al*., [26] found that full LUS thickness of <2.3mm was the optimal cut *off* for the prediction of the uterine rupture. Our study had a high NPV value, implying that a thick LUS is generally strong. This may encourage obstetricians to offer trial of labor to women with LUS thickness of 2.5 mm or greater. This study is consistent with the study done by Fukuda *et al*., [19] Sen *et al*., [14] Mohammed *et al*., [15] and found the derived cut off was 2.5 mm. With a high NPV value. While in comparsiom to our study, other studies as Rozenberg *et al*., [16] 1996 and Montanari *et al*., [29] Kushtagi *et al*., [17] and Cheung VY [30], 2OO5 with different cut off values but with a high NPV. Rozenberg *et al*., [16] 1996 and Montanari *et al*., [29] were found the derived cut off value was 3.5mm, with a high NPV value of 95.3% and 100% respectively. Kushtagi *et al*., [17] reported the cut off value of the LUS thickness of 3mm, with a high a NPV value of 98%. Cheung VY [30], 2OO5 reported the cut off value of the LUS thickness of 1.5mm, with a high NPV of 96.2%. While Gotoh *et al*., [18] and Qureshi *et al*., [12] analyzed women with previous scar underwent serial TV ultrasonographic measurement of the thickness of the LUS in the late second trimester, the studies found an inverse relationship between thickness of the LUS and uterine rupture. On the contrary to our study Qureshi *et al*., [12] found ≤ 2mm as a criterion for poor healing, with a high PPV of 100%. Thus, LUS thickness and uterine defect detection methods vary across studies.

Ultrasonography does not appear to increase the rate of uterine ruptures, and it may even decrease it. This ultrasound examination should encourage obstetricians who frequently perform repeat CS, even for women with a single scar, to suggest a trial of labor by providing an additional risk factor. This new approach's experience would enrich the debate.

Conclusion

The extent to which LUS thins seems to be correlated with an increased risk of uterine scar defects. Therefore, in VBAC candidates, LUS thickness can be a sign of a uterine scar defect. With an extremely low risk of uterine rupture, we anticipated that new guidelines for women considering a VBAC may be developed using rigorous standards for determining LUS thickness.

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Author's Contribution

Not available

Conflict of Interest

Not available

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