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Sonographic Assessment of Lower Uterine Segment Thickness Preoperative vs. Intraoperative Assessment in Women with Previous Cesarean

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Abstract
Objectives: In this study we compared transabdominal ultrasound to transvaginal ultrasound to determine which one of them is most accurate in measuring the LUS.
Methods: A prospective observational study on 100 pregnant at term women with history of previous one CS visited Maternity Teaching Hospital between period Jan 2020 to Sep 2020.
Results: Of total 100 women (age range 20–42 years), more than half were primiparous and majority were with no history of miscarriage, mean LUS was 4 mm with standard deviation 1.09 in abdominal ultra sound 3.4 with standard deviation 1.14 in transvaginal and 3.45 mm with standard deviation 1.2 in intraoperative before delivering head of the baby ($P < 0.001$).
Conclusion: Trans vaginal ultrasound is more accurate than transabdominal ultrasound in measuring lower uterine segment.
Keywords: Ultrasonography, transvaginal, transabdominal, Iraq

Introduction

Cesarean section (CS) is the commonest surgical procedure in obstetric and it regarded as one of the commonest operation procedure performed in general. That is why the rates of CS are rising all over the world,[1] further more Previous CS is becoming the most common indication for CS, also for women who have had previous cesarean section, choices for mode of birth in their next pregnancy are either trial of vaginal birth after caesarean (VBAC) or an elective repeat caesarean (ERC).[2] VBAC has high success rates of up to 87%, that is why frequently offered to women after previous cesarean section.[3,4] However successful VBAC avoid most of abdominal surgery complications like urinary bladder or bowel injury and has lower rate of post-partum complication such hemorrhage or infection, while failed trail of VBAC has more life threatening complication than elective cesarean section.[5] Uterine rupture is the most dangerous complication of TOLAC due to dehiscence of the previous C.S. scar despite its low incidence (0.4–.0.9)% it may lead to hysterectomy, urologic injury, a need for blood transfusion, maternal death, and perinatal complications, including neurologic impairment and death.[6] Also with the luck of randomized clinical trial and depending only on observational study for comparing maternal or neonatal outcomes between women undertaking TOLAC and those undergoing a repeat cesarean delivery making percentage of complication extremely deferent and the unpredictable nature of this complication and its grave consequences for both mother and baby has resulted in decreased rates of trial by labour after CS (TOLAC) in many countries.[7-9]

The successful outcome of VBAC depends on the thickness scar of previous CS, which is directly related to the thickness of lower uterine segment.[9] Many methods have been suggested to measure or estimate the lower uterine segment, including Hysterography, sonohysterography, hysteroscopy, magnetic resonance imaging and ultrasonography.[10] Some authors measured the entire thickness of the lower uterine segment,[11] while others measured the muscular layer thickness.[11]

Measurement of lower uterine segment (LUS) is simple and non-invasive method for prediction of scar dehiscence/rupture.[9]

The aim of this paper was to evaluate the lower uterine segment (LUS) thickness through transabdomenal sonography (TAS) and transvaginal sonography (TVS) in full term pregnancies with a single previous Cesarean section, to correlate the obtained LUS measurements with intraoperative observations.

Materials and Methods

This is a prospective observational study conducted on 100 pregnant women who attended Hawler Maternity Teaching Hospital during the period from Jan 2020 to Sep 2020. The study was approved by local ethics committee and informed consents about the study and expected value and outcome and consents for abdominal and transvaginal ultrasound examination were obtained.

All the pregnant women were with singleton pregnancies, with the gestational age between 36 and 38 weeks, they were cephalic in presentation not in labor with intact membrane and most importantly they were with history of single previous cesarean section (CS). About 27 participants were excluded because they were having other abnormality like disorders of amniotic fluid or placenta Previa or uterine scar for other causes rather than CS like myomectomy. And 19 patients excluded because they refused to do TVS.

Detailed history, including age, parity, menstrual cycle to estimate the expected delivery date, information about the last CS including the indication & the inter-delivery interval, were obtained. Also full examination, general, abdominal & obstetrical examination, has been done.

Ultrasound examination was done using a Acuson S2000 ultrasound machine with 2–6 MHz convex trans-abdominal transducer & 4–9 MHz for transvaginal. Full thickness of lower uterine segment was measured with 2D transabdominal ultrasound while the muscular thickness measured by transvaginal ultrasound. All participants at time of ultrasound examination were with comfortable full bladder, i.e. they were not with the feeling of urge to urinate, because over distended bladder can elongate the cervix causing stretching of lower uterine segment which could lead to inaccurate measurement.

Transabdominal ultrasound with full obstetric information, estimated age, lie, presentation, placenta location & amniotic fluid volume, were obtained. The second step was measuring the thickness of LUS. The view in which the study conducted with was mid-sagittal plane and has been magnified so the thinnest area obtained. Also a lateral view examined to make sure there was no apparent rupture. The measurement taken by a cursor at the urine-urinary bladder interface with the amniotic fluid-decidua interface after magnification and the nearest to tenth millimeter has been taken. Four measurements were taken and the least one recorded.

Transvaginal ultrasound was done after transabdominal ultrasound with the same operator. The examination done with the patient in supine position, knee gently flexed, hip mildly elevated using a pillow. The probe inserted to posterior vaginal fornix. Clear view of LUS obtained in midsagittal plane visualizing the cervical canal to be sure that the view is midline not oblique.

During the examination the LUS was clearly seen as hypoechoic line between the hyperechoic uterovesical fold and the decidualized endometrium and the chorioamniotic membranes. The scar area was magnified until it occupied about 75% of the image, the measurement taken by measuring caliber placed at the urinary bladder wall-myometrium interface and the myometrium/chorioamniotic membrane interface. Four measurment taken and the least one recorded.

The time interval between the ultrasound and CS was from 24–48 hours.

At time of operation after putting the patient on the operation table in supine position, after induction of general anesthesia, giving iv antibiotic, insertion of urinary catheter, preparation of the skin by iodine and allowed to dry, draping by sterilized surgical drape, pfingsten incision done, sharp dissection of subcutaneous and rectus sheath, blunt entry to peritoneal cavity, identifying and separation of the urinary bladder, LUS was defined as the part of the uterus below uterovesical peritoneal reflection which was found after opening peritoneum and performing bladder dissection. LUS was assessed by operating surgeon and measurement of it was taken by digital caliper before delivering the head.

Data Analysis

Data were analyzed using the Statistical Package for Social Sciences (SPSS, version 25). Chi square test of association was used to compare proportions. McNemar test was used to compare the proportions of the same sample using different methods of examination. Kappa statistics was calculated in order to assess the agreement degree between two methods of assessment of the LUS. Pearson correlation coefficient was calculated to assess the strength of the correlation. A *P*-value of ≤ 0.05 was considered as statistically significant.

Results

One hundred women participated in the study, their mean age ± SD was 29.77 ± 5.77 years, ranging from 20–42 years. The median was 29 years. It is evident in Table 1 that the largest proportion (56%) of the sample was aged 25–34 years. More than half (60%) were primiparous women, and the majority (77%) had no history of miscarriage. The most common indication for the previous cesarean section were cephalo-pelvic disproportion (23%), poor progress in labor (21%), and mal-presentation (15%), in addition to the other indications mentioned in Table 1.

It is evident in Table 2 that the proportions of women having lower uterine segment of ≤ 3 mm thickness were 31%, 46%, and 43% as assessed by abdominal US, transvaginal US, and by intraoperative measurement respectively. The other percentages are presented in the mentioned table.

It can be concluded from Table 3 that the transvaginal US is better than the abdominal US in predicting the thickness of the lower uterine segment (LUS). There was no significant difference between the results of transvaginal US and the intraoperative measurement ($P = 0.648$). The kappa was 0.616 ($P < 0.001$), and the total agreement was 81%. While the total

Table 1. **Basic characteristics of the studied sample**

	No.	(%)
Age		
< 25	19	(19.0)
25–34	56	(56.0)
≥ 35	25	(25.0)
Parity		
Primiparous	60	(60.0)
Multipara	33	(33.0)
Grand multipara	7	(7.0)
Miscarriage		
No	77	(77.0)
Yes	23	(23.0)
Indication of previous CS		
Cephalo-pelvic disproportion	23	(23.0)
Poor progress in labor	21	(21.0)
Mal-presentation	15	(15.0)
Diabetes	12	(12.0)
Preeclampsia	11	(11.0)
Decreased fetal movement	5	(5.0)
Twin	4	(4.0)
Meconium	3	(3.0)
Oligo-hydramnious	3	(3.0)
Poly-hydramnious	2	(2.0)
Maternal wish	1	(1.0)
Total	100	(100.0)

agreement between the abdominal US and the intraoperative measurement was 68%.

Positive strong significant correlation (Figure 1) was detected between the measurements of the LUS assessed by abdominal US and the measurements done intraoperatively (r = 0.784, P < 0.001). A stronger correlation was detected between the vaginal US results with the intraoperative measurements (r = 0.961, P < 0.001) as presented in Figure 2.

No significant association was detected between the interval of birth spacing with the thickness of LUS as assessed by abdominal ultrasound (P = 0.767) and transvaginal ultrasound (P = 0.089), while there was slightly significant association with the thickness of the LUS as assessed intraoperatively (P = 0.030). The proportion of women with a LUS thickness of > 3 mm increased from 45.5% among those with birth spacing of less than 18 months, to 64.7% when birth spacing is between 18–24 months, and to 84.2% when birth spacing is 25–36 months, but then decreased to 50% when birth spacing was > 36 months. [Table 4]

Table 2. **Thickness of the lower uterine segment assessed by three methods**

Thickness of lower uterine segment	No.	(%)
Abdominal US		
≤ 3 mm	31	(31.0)
3.1–6 mm	64	(64.0)
> 6 mm	5	(5.0)
Transvaginal US		
≤ 3 mm	46	(46.0)
3.1–6 mm	53	(53.0)
> 6 mm	1	(1.0)
Intraoperative measurement		
≤ 3 mm	43	(43.0)
3.1–6 mm	56	(56.0)
> 6 mm	1	(1.0)
Total	100	(100.0)

Discussion

The uterus has a major role in pregnancy and parturition. Ultrasound proved its efficacy as a modality to examine the uterus especially abnormality in LUS like placenta previa and the strength of previous scar, by this morbidity and mortality is decreased.[12]

The aim of this study was to have a comparison between TAS and TVS in measurement of the thickness of the LUS at term to decide which method is most accurate and reliable to measure LUS by comparing the measurement of each method separately with the thickness obtained intraoperatively.

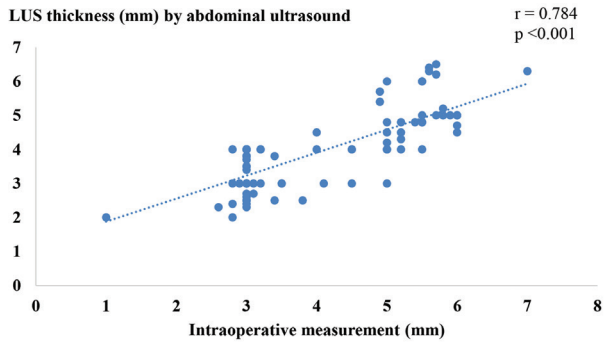

Fig. 1 **Correlation between abdominal ultrasound findings with intraoperative measurement of the lower uterine segment.**

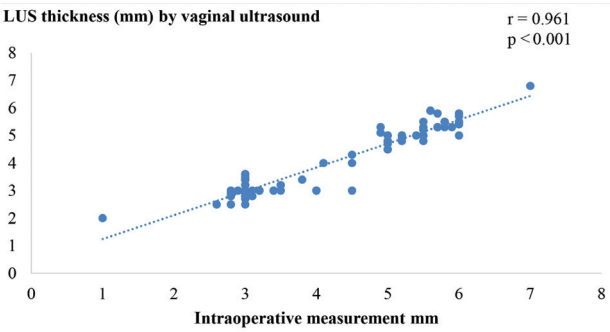

Fig. 2 **Correlation between vaginal ultrasound findings with intraoperative measurement of the lower uterine segment.**

Table 3. **Correlation of abdominal and transvaginal ultrasound results with the intraabdominal measurements of the lower uterine segment thickness**

	Intraoperative measurement								
LUST**	**≤ 3 mm**		**> 3 mm**		**Total**				
Ultrasound	**No.**	**(%)**	**No.**	**(%)**	**No.**	**(%)**	***P****	**Kappa**	***P***
Abdominal ultrasound									
≤ 3 mm	21	(67.7)	10	(32.3)	31	(100.0)			
> 3 mm	22	(31.9)	47	(68.1)	69	(100.0)	0.050	0.324	0.001
Total agreement: 68%									
Transvaginal ultrasound									
≤ 3 mm	35	(76.1)	11	(23.9)	46	(100.0)			
> 3 mm	8	(14.8)	46	(85.2)	54	(100.0)	0.648	0.616	P < 0.001
Total agreement: 81%									
Total	43	(43.0)	57	(57.0)	100	(100.0)			

*By McNemar test. **LUST: Lower Uterine Segment Thickness.

Table 4. **Thickness of the lower uterine segment (assessed by different methods) by spacing interval**

Thickness of LUS**	Birth spacing interval (months)				
	< 18	18–24	25–36	> 36	
	No. (%)	No. (%)	No. (%)	No. (%)	*P**
Abdominal ultrasound					
≤ 3 mm	16 (36.4)	5 (29.4)	5 (26.3)	5 (25.0)	
> 3 mm	28 (63.6)	12 (70.6)	14 (73.7)	15 (75.0)	0.767
Transvaginal ultrasound					
≤ 3 mm	26 (59.1)	5 (29.4)	6 (31.6)	9 (45.0)	
> 3 mm	18 (40.9)	12 (70.6)	13 (68.4)	11 (55.0)	0.089
Intraoperative measurement					
≤ 3 mm	24 (54.5)	6 (35.3)	3 (15.8)	10 (50.0)	
> 3 mm	20 (45.5)	11 (64.7)	16 (84.2)	10 (50.0)	0.030
Total	44 (100.0)	17 (100.0)	19 (100.0)	20 (100.0)	

*By Chi square test. **LUS: Lower Uterine Segment.

In the present study, the mean thickness of the LUS measured by TAS in those who had a previous cesarean section was (4.000) mm, whereas the mean thickness of the LUS measured by TVS was (3.400) mm. The two sonographic measurements were compared with the actual measurement during the cesarean section delivery and the mean thickness of the LUS was (3.450) this means that the measurement near the actual obtained from TVS.

The result was near with the result of Coleman et al.,[13] in which has been found that TVS is more superior than TAS to examine the female pelvis.

In this study, the above results were further confirmed by measuring the thickness of the LUS by electronic caliper during cesarean section.

The techniques which have been used to measure the LUS thickness and identify uterine defects have not been consistent among different studies, although some studies seemed to report good results with different measurement techniques.[14]

Our results are in agreement with those of Cheung,[15] who stated that sonography enables accurate evaluation of LUS thickness in women with previous CS which is expressively smaller (0.050 mm) than normal thickness of LUS.

The relation between LUS thickness obtained by TVS and TAS and electronic caliper, the measurements of caliper were much closer to those of TVS than of TAS. This relation shows a significant difference.

Kushtagi et al. had a study to correlate LUS thickness measured by TAS at term pregnancy with that measured by caliper at time of CS to determine the minimum LUS thickness which was Indicative for its integrity in women who had a previous CS. LUS measurement with the caliper done before fetal head delivery than after delivery because LUS would become thicker after delivery with the release of stretch factors and oxytocin. They found that the measurements which taken by US were correlated with caliper measurements of the lower part of the LUS. US determined LUS was thinner in women with a previous CS than with VBAC. Directly measured LUS thickness before the delivery of the baby showed smaller differences. This difference might be due to the inclusion of the posterior wall of the bladder during the measurements which taken by US. Mild stretch of the lower uterine flap may reduce the thickness to some extent during measuring it with calipers. They suggested that an US measurement of more than 3 mm of LUS at term before delivery it give the idea of strong LUS, but is not a reliable safeguard for trial of labor.[16]

The value of ultrasonographic measurement of LUS as a clinical tool is increased for the prediction of uterine rupture. Data from this study showed the superiority of TVS over TAS for assessment of LUS thickness, using TVS for the measurement of LUS thickness, if used in the management of women who with a previous cesarean section, give important information in planning for delivery and counseling women undertaking VBAC by predicting its safety and success.

Gotoh et al.[17] using TVS, found that 74% of women with a LUS of less than 2.0 mm had an incomplete uterine rupture at time of CS.

Thickness of the LUS can be measured by TAS or by TVS ultrasound examination in the third trimester.[18]

Hebisch and colleagues showed that TVS is more accurate than MRI in showing the condition of the LUS. The main limitation of frequent using of TVS it's that it may cause discomfort and difficulty in at term women.[19]

The study by Cheung et al. suggests that US surveillance for a defective LUS could be possible, but the population of his study was small, and the observers were not blinded. These preclude accurate estimates and limit the ability to establish clinically useful relationships.[7]

Conclusion and Recommendations

TVS is superior than TAS for measuring the LUS and the results of it was so near to the result of the manuals. We recommend routine use of TVS for women with previous CS at time of delivery to determine the route of management. Also we recommend further research at this field and this time to compare between TVS and MRI for diagnosing the defect in LUS.

Conflicts of Interest

None.

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