

Ultrasonographic Evaluation of Lower Uterine Segment Thickness in Patients with Previous Caesarean Section

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Abstract: ***Objective:** To evaluate the lower uterine segment (LUS) thickness in women with previous caesarean section and to determine the critical thickness above which safe vaginal delivery is predictable. **Methods:** A descriptive study of 200 pregnant women with a previous lower segment caesarean section (CS) was carried out. Transabdominal sonography (TAS) was used to evaluate the LUS thickness. In women who underwent CS sonographic findings were correlated with the intraoperative LUS appearance. The obstetric outcomes in patients with successful trial of vaginal delivery and those who delivered by CS were correlated with LUS thickness. **Results:** In the study group, out of 129 women who were allowed for trial of vaginal delivery, 67 (52%) had successful vaginal birth after caesarean section (VBAC) and 62 (42%) women delivered by emergency CS. Elective CS was done in 71 cases (35.5%). The mean LUS thicknesses among VBAC, emergency and elective CS group were $4\pm 0.74\text{mm}$, $3.6\pm 0.8\text{mm}$ and $3.4\pm 1.2\text{mm}$ respectively. The difference between the VBAC and caesarean groups was statistically significant ($p=0.03$ and 0.01 in association with emergency and elective CS respectively). Ultrasonographic LUS thickness assessment correlated significantly with intraoperative LUS appearance ($p<0.0001$). A cutoff value of 3.5mm was derived with sensitivity, specificity, positive and negative predictive values of 86.66%, 60.54%, 15.11% and 98.24%, respectively. Scar dehiscence and rupture rates were 2.5% and 1.5% respectively. **Conclusion:** Sonographic evaluation of LUS thickness is a reliable, practically useful method to predict the risk of scar rupture in a woman with previous CS. Ultrasonographic evaluation of LUS thickness correlates significantly with intraoperative LUS appearance. Trial of vaginal delivery is safe at LUS thickness of 3.5mm or more, provided there are no other risk factors.*

Keywords: lower uterine segment, ultrasonography, uterine rupture, previous caesarean delivery, VBAC

1. Introduction

The rupture of caesarean scar is potentially devastating complication of trial of vaginal delivery which increases maternal and perinatal morbidity and mortality. There is a need to assess the integrity of uterine scar and risk factors before planning for trial of vaginal delivery.

A number of methods have been used to evaluate the lower uterine segment (LUS) after caesarean section (CS) like hystero-sonography of uterine scar, per vaginal exploration of lower uterine segment scar, amniography, X-ray pelvimetry but none of them was proved to be useful in estimating the risk of uterine rupture. Several studies have suggested that ultrasonography may detect defective uterine scar after previous caesarean section.¹⁻¹³ The risk of uterine rupture is directly related to the degree of thinning of lower uterine segment. The aim of the present study was to evaluate the thickness of LUS by transabdominal sonography (TAS) at term and to assess the critical thickness above which safe vaginal delivery is predictable.

2. Methods

In this descriptive study, a total of 200 pregnant women who were admitted at term pregnancy to antenatal/ labour ward of JIPMER from august 2007 to may 2009 were recruited for the study. All these women had undergone one previous lower segment CS. The inclusion criteria were singleton

pregnancy with one prior lower segment caesarean section at 37 to 42 wks of gestation with vertex presentation and not in labour. The exclusion criteria were women in active labour, non vertex presentation, multiple gestation, polyhydramnios and placenta previa.

After obtaining informed consent sonographic examination was performed utilizing Toshiba color Doppler ultrasound machine, ECCOCHEE model, SSA – 340A, (Toshiba, Japan) consisting of trans abdominal convex array transducer with a frequency of 3.75MHZ with partially full bladder. If during the examination contraction is detected, examination was stopped and resumed after contraction subsided.

LUS was scanned in saggital section under magnification to localize the thinnest area. Average of 2-3 readings taken was recorded. Measurements were taken with cursors at urinary bladder wall – myometrium interphase and myometrium/chorioamniotic membrane – amniotic fluid interphase.¹ Sonography was also performed from lateral aspect of lower uterine segment to detect any asymptomatic dehiscence. Any ballooning, funneling or wedge defect was noted. The study was double blinded, i.e., neither the treating obstetricians nor the patients were aware of the findings.

The study group was divided into 2 subgroups based on mode of delivery as those undergoing elective CS for recurrent indications and those who were allowed to go into trial of vaginal delivery in the absence of any contraindication.

Women undergoing trial of labour were monitored continuously and were taken up for emergency CS if intrapartum maternal or fetal indications arise. LUS was assessed intraoperatively and graded according to system developed by Qureshi et al.²

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

The statistical analysis was done using Chi square test. The statistical significance was set when $p < 0.05$. The Receiver operating characteristic curve was used to find the upper limit and cut-off value for various measurements of LUS.

3. Results

In the study group, mean age was 25.4 years with majority of them being in the age group of 21- 25 years, mean parity was 1.19 ± 0.46 , mean gestational age was 39^{+5} weeks and mean birth weight was 2.95 kg.

In the present study, 129 women were allowed for trial of vaginal delivery of which 67 had successful VBAC (52%) and the remaining 62 (42%) women delivered by emergency CS. Fetal distress was the most common indication for emergency CS (40.3%). Elective CS was done in 71 cases (35.5%). Doubtful scar integrity was the main indication for repeat CS (36.1%). The mean LUS thicknesses among VBAC, emergency and elective CS groups were 4 ± 0.74 mm, 3.6 ± 0.8 mm and 3.4 ± 1.2 mm respectively.

The LUS thickness difference between VBAC and caesarean (both emergency and elective) groups was statistically significant ($p = 0.03$; $p = 0.01$). There was no statistically significant difference between emergency and elective caesarean groups ($p > 0.05$).

Table 1: Comparison of Qureshi's grading with LUS thickness and Caesarean section

Qureshi's grading	EM LSCS		EL LSCS		LUS THICKNESS (mm)										Total
	N	%	N	%	≤ 1.5		1.6-2.5		2.6-3.5		3.6-4.5		> 4.5		
					N	%	N	%	N	%	N	%	N	%	
I	36	58.1	45	63.4	0	0	5	26.3	25	52.1	34	77.3	17	89.5	81
II	17	27.4	20	28.2	2	67	13	68.5	14	29.2	6	13.6	2	10.5	37
III	3	4.8	4	5.6	0	0	1	5.2	5	10.4	1	2.3	0	0	7
IV	6	9.7	2	2.8	1	33	0	0	4	8.3	3	6.8	0	0	8
Total	62	100	71	100	3	100	19	100	48	100	44	100	19	100	133

[EM LSCS – emergency LSCS, EL LSCS – elective LSCS]

In the CS group 81 women (60.9%) had well formed LUS. Eight women had scar disruption, amongst them 2 women were detected during elective CS and the rest by emergency CS. LUS thickness and intraoperative observation as observed by Qureshi's grading failed to show significant difference between the elective and emergency caesarean groups ($p > 0.05$). This observation shows that labour did not seem to affect the intraoperative LUS appearance. Ultrasonographic LUS thickness correlated significantly with intraoperative LUS appearance ($p < 0.0001$) suggesting that risk of uterine defect is directly related to the degree of thinning of LUS at term (Table 1).

In our study 88% women with scar disruption (7/8 of Qureshi grade IV) and 86% with grade III (6/7) LUS had LUS thickness of < 3.5 mm. Two patients had ballooning of LUS on sonography at LUS thickness of 2 and 2.9 mm, intraoperatively these women had thin LUS (Picture 1). Also, window detected in LUS in a patient on sonography, had scar dehiscence which was confirmed intraoperatively (Table 2).

considered abnormal, and grade I and II were considered normal intraoperatively. The receiver operating characteristic curve was used to define the sensitivity and specificity for each measurement value of LUS and to determine critical thickness at which safe vaginal delivery is predictable.



Picture 1: Longitudinal sonogram of LUS showing abnormal ballooning (arrow)

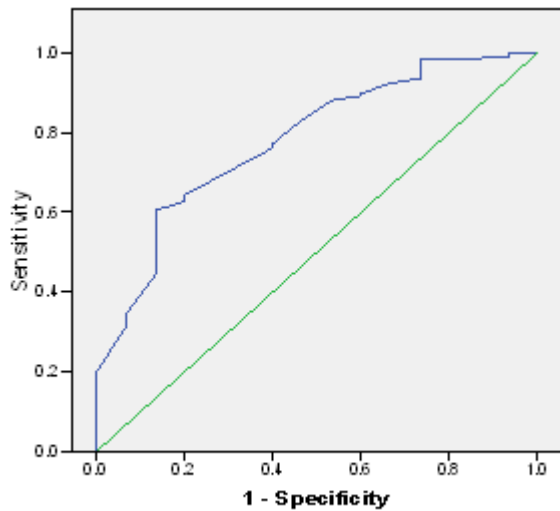
The thickness of LUS ranged between 1.1 to 6.9 mm, mean LUS thickness was 3.69 mm. Grades III and IV were

Table 2: Comparison of scar disruption with Delivery mode and LUS thickness

Scar disruption	EM LSCS	EL LSCS	LUS Thickness (mm)					Total
			≤ 1.5	1.6-2.5	2.6-3.5	3.6-4.5	> 4.5	
Dehiscence	3	2	1	0	4	0	0	5
Rupture	3	0	0	1	1	1	0	3
Total	6	2	1	1	5	1	0	8

Graph 1 shows the receiver operator characteristic curve illustrating sensitivity and 1- specificity for different cutoff levels of LUS.

ROC Curve



Diagonal segments are produced by ties.

Table 3 shows the sensitivity, specificity, positive and negative predictive values at different LUS thicknesses. At a cutoff value of 3.5mm, the sensitivity, specificity, and positive and negative predictive values are 86.66%, 60.54%, 15.11% and 98.24%, respectively.

Table 3: LUS thickness and sensitivity pattern

LUS thickness(mm)	Sensitivity (%)	Specificity (%)	PPV	NPV
≤ 2	20	98.37	50	93.81
≤ 2.5	40	89.72	24	94.85
≤ 3	60	77.29	17.64	95.97
≤ 3.5	86.66	60.54	15.11	98.24
≤ 4	93.33	34.59	10.37	98.46
≤ 4.5	100	18.91	9.09	100
≤ 5	100	8.1	8.1	100

[PPV –positive predictive value, NPV – negative predictive value]

4. Discussion

Although ultrasonography (USG) has been widely used for pelvic imaging, it has been reported that the lower transverse caesarean scars are visible in only 30% of cases.³ USG is now used as an imaging modality for the evaluation of LUS. A number of reports of sonographic evaluation of LUS have appeared in literature since 1982.⁴ It has been speculated that thickness of the LUS is related to the quality of wound healing. There is strong correlation between the anatomic status of scarred LUS as assessed by USG and its functional status which is tested during labour.

In our study the difference between the VBAC and caesarean groups was statistically significant suggesting that women with thicker LUS tend to have successful VBAC. This was evidenced by significantly higher NPV in our study of 98.24%. This inference closely correlates with studies by all the investigators.^{1,5,6,7,8,9,10} There was no statistically significant difference within the caesarean

groups in relation to LUS thickness and delivery mode ($p>0.05$). This was also evident in intra operative observation, suggesting that labour did not seem to affect the intraoperative LUS appearance. This evidence is similar to studies by Cheung et al⁵ and Sen et al.¹

Rozenberg et al⁶ in the largest study conducted so far with 642 patients using TAS of LUS at 36 to 38 weeks of gestation, included bladder mucosa and peritoneal layer in the measurement. With a cutoff value of 3.5mm, negative predictive value was high (99.3%) for predicting uterine defects but positive predictive value was low (11.8%) suggesting that all thin scars are not abnormal.

Sen et al¹ compared between TAS and transvaginal sonography in measuring LUS thickness with high correlation of 96% between the two. The critical cutoff value for safe LUS thickness was 2.5mm with sensitivity, specificity, NPV and PPV of 90.9%, 84%, 95.5% and 84% respectively. Both Cheung et al⁵ and Sen et al⁸ suggested that measurement of only the myometrial layer should be more representative of LUS thickness.

The other main objective of determining critical thickness of LUS above which safe vaginal delivery would be predictable and our results are comparable with study by Rozenberg et al⁶ and Asakura et al.⁷

Our study demonstrates high NPV 98.24%, confirming that, thick LUS is strong. In addition, since the negative prediction was obtained at term (37-42wks), the results of the sonographic evaluation can be used as a factor in deciding the mode of delivery. Irrespective of various measuring techniques used, most of the studies show a strong NPV (86.7 - 100%) in predicting the uterine rupture. This also shows that the safety of a trial of vaginal delivery can be predicted with reasonable certainty when LUS thickness is above cutoff level. However, clinical application of LUS measurement in the management of VBAC remains controversial.^{12,13}

The PPV of LUS thickness was weak in our study (15.11%), suggesting that all thin LUS are not abnormal which is similar to results of Rozenberg et al⁶, Michaels et al⁹ and Asakura et al.⁷ Therefore, the prediction of uterine scar dehiscence/ rupture is not highly reliable. This may be due to several factors other than LUS thickness which might be involved in the causation of scar dehiscence/ rupture. There is always a component of intraobserver error, which is relatively large for measurements with thin LUS.¹⁴ It is important to note that not all thin segments are abnormal, while relatively thick segments might be defective.

We conclude that sonographic evaluation of LUS thickness is a reliable, practically useful method to predict the risk of scar rupture in a woman with previous CS as risk of defective scar is directly related to degree of thinning of the LUS at term pregnancy. Ultrasonographic evaluation of LUS thickness correlates significantly with intraoperative LUS appearance. Trial of vaginal delivery is safe at LUS thickness of 3.5mm or more, provided there are no other risk factors. Needs further larger randomized controlled trials to correlate LUS thickness with uterine scar rupture .

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