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DIAGNOSTIC ACCURACY OF SONOGRAPHIC MEASUREMENT OF THE LOWER UTERINE SEGMENT THICKNESS IN THIRD TRIMESTER IN PREDICTING THE OCCURRENCE OF UTERINE RUPTURE IN WOMEN WITH PRIOR CESAREAN SECTION

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Abstract

OBJECTIVE:
To determine the area under receiver operating curve analysis for lower uterine segment thickness in third trimester in predicting the occurrence of uterine rupture in women with prior cesarean section.

STUDY DESIGN:
Descriptive validation study

PLACE AND DURATION OF STUDY:
Department of Obstetrics & Gynaecology and Department of Radiology, Combined Military Hospital-Multan from 1st Oct 2024 to 30 March 2025.

MATERIAL AND METHODS:
In this descriptive validation study, 278 pregnant women with low-transverse cesarean scars who were between 30 and 36 weeks along participated. Evaluations of uterine scars, maternal data, and delivery outcomes were examined. Myometrial thickness and sonographic LUS were determined transvaginally and transabdominally. Clinical results were compared with LUS thickness's sensitivity and specificity for uterine rupture or dehiscence prediction.

RESULTS:
In this study, 278 women who had previously undergone cesarean sections had their diagnostic accuracy in predicting uterine rupture based on sonographic lower uterine segment (LUS) thickness assessed. With a cutoff of ≤2.25 mm, the overall diagnostic accuracy was 72.66%, the sensitivity was 71.25%, and the specificity was 73.23%. While mode of birth and LUS thickness were identified as important prognostic markers, no significant relationships were discovered with age, gestational age, or parity.

CONCLUSIONS:
Sonography improves uterine rupture risk assessment in patients who have had previous caesarean deliveries, allowing for safer treatment.

INTRODUCTION

A major complication that puts the mother's and the fetus' lives in immediate danger is uterine rupture (UR).[1] The pathologic separation of the entire uterine layer during pregnancy or childbirth is known as uterine rupture.[2] In an unscarred uterus (0.035%), uterine rupture is an uncommon occurrence.[3] It is comparatively higher (0.15–2.3%) in a scarred uterus.[4] The existence of a uterine scar from a prior cesarean delivery or other transmyometrial surgical operations, such as myomectomy or adenomyomectomy, is the primary cause of risk for uterine rupture.[5]

The prevalence of uterine rupture is almost 1 in 920 cases in underdeveloped nations in Asia and Africa. Location-specific reported prevalences in Pakistan range from 1.6% in rural regions to 0.74% in bigger cities.[6] Obstructed labor in unscarred uteri, poor obstetric practices, oxytocin abuse, instrumental deliveries, grand multiparity, and delayed hospital referrals are all common causes of uterine rupture in developing nations.The problem is made worse by inadequate healthcare systems and restricted access to emergency care.[7] Patients may choose the VBAC delivery if the scar rapture prognosis is accurate. In order to estimate the risk of uterine rupture-scar dehiscence, researchers looked into the thickness of the lower uterine segment (LUS) and the C/S scar.[8] When deciding on a birth location, elective C-section, and specialized care, a thinner cesarean scar in the second or third trimester may suggest an increased risk of dehiscence or uterine rupture in a later pregnancy.[9] Sonographic confirmation of the integrity of the lower uterine segment (LUS), comprising the hypo-echogenic uterine myometrium and the hyper-echogenic bladder wall, is crucial for a labor trial.[10]

The purpose of this study is to investigate the efficacy of measurement of lower uterine myometrium thickness at the site of uterine scar Predicting the likelihood of uterine rupture (dehiscence or full rupture) in the third trimester in our local setting and explore its effect on plan of delivery.This will provide us an opportunity to help in timely intervention and further management.

Methodology:

This descriptive validation study was conducted at Department of Obstetrics & Gynaecology and Department of Radiology, Combined Military Hospital-Multan, from 1st Oct 2024 to 30 March 2025, following approval by the institutional ethical review (Ethical committee approval number: 72/2024. After a thorough literature search, we calculated a sample size of 278 (each group 139) using the WHO calculator, keeping the prevalence of uterine defect (rupture and dehiscence) 25.9%, Area under ROC, AUROC0 60%,Area under ROC, AUROCa 70%,Power of the study 80% and Significance level 5%, respectively.[11]

INCLUSION CRITERIA: This study comprised pregnant women between ages of 19-35 being with uncomplicated singleton pregnancy (confirmed on antenatal scan), unbooked having single prior low-transverse cesarean scar and with low inter pregnancy interval or presenting with labour pains and gestational age 30 - 36 weeks (on LMP method) were all included in our study.

EXCLUSION CRITERIA: Patients were excluded from the study if they were medically complicated pregnancy assessed on history and medical record (like Diabetes mellitus , hypertension, renal diseases , ischemic heart diseases , anemia), any detectable structural fetal anomaly, assessed sonographically, PROM and PPROM (premature rupture of fetal membranes <37 weeks gestation, assessed from maternal history and sterile speculum examination, Planned delivery at another instituition and with Intrauterine deat.

Pregnant women's fulfilling the inclusion criteria were enrolled in third trimester (30 to 36 weeks), after informed written consent. Age, BMI, parity, previous cesarean information (pregnancy/delivery intervals, labor trial, medical history), and current delivery characteristics (gestational age, labor progress, cesarean indications) were among the maternal data gathered. The ways of delivery (emergency cesarean or vaginal birth after cesarean) were noted. They were followed until delivery and separated into two groups based on the outcome of the pregnancy: the group with uterine rupture

(discovered during the pregnancy or during the cesarean operation) and the group without uterine rupture (containing women who delivered vaginally and those who did not have uterine rupture during the cesarean surgery time).

The sensitivity and specificity of quantitative lower uterine segment myometrium thickness in the third trimester was contrasted in terms of forecasting the likelihood of uterine rupture (dehiscence or full rupture). All the obtained data was noted on performa designed for the study. The on-call obstetrician requested that two specialists do ultrasound tests using transvaginal and abdominal probes. Myometrial thickness (MT) and lower uterine segment (LUS) were measured transabdominally while the bladder was full, and transvaginally while the bladder was empty. The space between the amniotic cavity and the bladder wall was known as the LUS thickness, as measured at the junction of the amniotic fluid and decidual endometrium and the bladder wall. MT, which only involves the myometrium, was described as the thinnest layer that covers the amniotic cavity at the uterine scar level. A normal transvaginal LUS thickness of 2.5 mm and a reduced transabdominal LUS thickness of 1.5 mm were among the typical measurements. In order to reduce the suffering that labor contractions generated, measurements were taken during uterine retraction. Results from labor and delivery were examined, and evaluations of uterine scars were contrasted with sonographic findings. Complete scar separation with communication to the peritoneal cavity was referred to as uterine rupture, and it was visibly verified during cesarean sections. Subperitoneal scar separation with a visible chorioamniotic membrane was recognized as uterine dehiscence. Only in situations of severe bleeding or hypovolemia symptoms following vaginal delivery was physical uterine examination carried out.

The collected data was entered and analyzed using SPSS 23.0. The Shapiro-Wilk test was applied to assess the normality of the data. Quantitative variables were presented as median and interquartile range (IQR), while qualitative variables were presented as frequencies and percentages. A receiver operating characteristic (ROC) curve was used to determine the cutoff value of lower uterine myometrium thickness for predicting uterine rupture. The diagnostic accuracy of lower uterine myometrium thickness was evaluated using the clinical outcome as the gold standard. A p-value of ≤0.05 was considered statistically significant.

Results:

A total of 278 pregnant women were included in this study. The median age of participants was 28.00 (31.00-25.00) years. The association of uterine rupture with various demographic and clinical characteristics is presented in Table I. Age group (p=0.338), gestational age (p=0.408), and parity (p=0.635) did not show significant associations with uterine rupture. However, the mode of delivery (p<0.001) and lower uterine segment (LUS) thickness (p<0.001) were significantly associated with uterine rupture, indicating their potential role in predicting rupture risk.

Table-I: Association of Uterine Rupture with Demographic and Clinical Characteristics

		Uterine Rupture (Scar Dehiscence Complete-Partial)		Total	p-Value
		Yes (n=80)	No (n=198)		
		n (%)	n (%)		
Age Group	19-25 years	18 (22.5%)	62 (77.5%)	80 (28.8%)	0.338
	26-30 years	36 (31.0%)	80 (69.0%)	116 (41.7%)	
	31-35 years	26 (31.7%)	56 (68.3%)	82 (29.5%)	
Total		80 (28.8%)	198 (71.2%)	278 (100%)	
Gestational Age	30-33 Weeks	32 (27.6%)	84 (72.4%)	116 (41.7%)	0.408
	34-36 weeks	48 (29.6%)	114 (70.4%)	162 (58.3%)	
Total		80 (28.8%)	198 (71.2%)	278 (100%)	

Parity	1	18 (24.7%)	55 (75.3%)	73 (26.3%)	0.635
	2	48 (30.8%)	108 (69.2%)	156 (56.1%)	
	3	14 (28.6%)	35 (71.4%)	49 (17.6%)	
Total		80 (28.8%)	198 (71.2%)	278 (100%)	
Management Plan for Delivery	Spontaneous Vaginal Delivery	16 (14.7%)	93 (85.3%)	109 (39.2%)	<0.001
	Assisted Child Birth	17 (20.7%)	65 (79.3%)	82 (29.5%)	
	Cesarean Surgery	47 (54.0%)	40 (46.0%)	87 (31.3%)	
Total		80 (28.8%)	198 (71.2%)	278 (100%)	
		Median, IQR	Median, IQR		
LUS Thickness (mm)		2.00 (2.30-1.90)	2.50 (2.70-2.00)		<0.001

As illustrated in Figure 1, receiver operating curve analysis revealed a correlation between LUS thickness and uterine rupture, with an area under the curve of 72.2% (95% CI), 65.6–78.8%, p<0.001. By choosing the numbers that yielded the maximum sensitivity plus specificity combination value, the cutoff value of full LUS was established. The cutoff value for the uterine deficiency with the best sensitivity and specificity (71.25% and 73.23%, respectively) was 2.25 mm for the full LUS thickness.

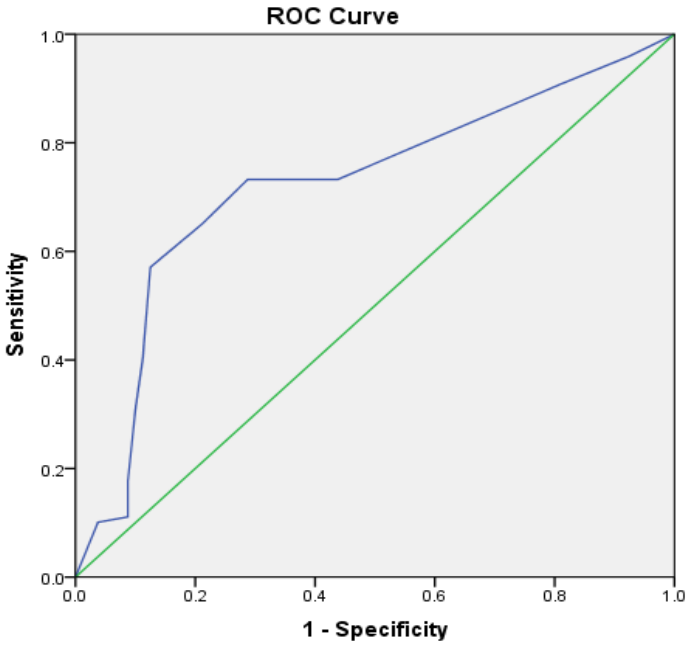

Figure-1: Receiver operative curve (ROC) comparing the sensitivity and specificity of lower uterine segment (LUS) thickness

Table-II presents the diagnostic performance of lower uterine segment (LUS) thickness in predicting uterine rupture. The sensitivity and specificity were 71.25% and 73.23%, respectively. The positive predictive value (PPV) was 51.81% and the negative predictive value (NPV) was higher at 86.30%.

Overall, the diagnostic accuracy of this threshold was 72.66%, demonstrating its potential utility in risk stratification for uterine rupture.

Table-II: Diagnostic Accuracy of LUS Thickness (≤2.25 mm) in Predicting Uterine Rupture

LUS Thickness	Uterine Rupture (Scar Dehiscence Complete-Partial)		p-value
	Yes	No	
≤2.25 mm	57 (TP)	53 (FP)	<0.0001
>2.25 mm	23 (FN)	145 (TN)	
Sensitivity= TP/(TP+FN)= 57/(57+23)*100=71.25 %			
Specificity= TN/(TN+FP)= 145/(145+53)*100=73.23%			
Positive Predictive Value= TP/(TP+FP)*100= 57/(57+53)= 51.81%			
Negative Predictive Value= TN/(TN+FN)*100=145/(145+23)= 86.30%			
Diagnostic Accuracy=(TP+TN)/All patients*100 = (57+145)/278=72.66%			

Discussion:

VBAC rates have been declining over the past decade, primarily due to worries about the possibility of uterine rupture during the trial of labor (TOL) and the associated perinatal morbidity.[12] Dehiscence or rupture of the uterine scar during delivery is inversely connected with LUS thickness as determined by ultrasonography in the third trimester of pregnancy. Transvaginal ultrasonography should be included in the transabdominasl technique to enhance visualization of the thinnest LUS.[13] For women considering VBAC, an ultrasound examination during the third trimester may be utilized as an additional technique to anticipate uterine rupture.[14] Many other research investigated for a correlation between the thickness of the sonographic LUS in late pregnancy and uterine rupture in an effort to provide obstetricians with a quantifiable method of predicting the result of the labor trial in this particular group of women.[15]

The purpose of this research was to assess the diagnostic precision of sonographic lower uterine segment (LUS) thickness in anticipating uterine rupture in women who had previously undergone cesarean sections. 71.25% sensitivity, 73.23% specificity, and 72.66% overall diagnostic accuracy were shown for the cutoff value of ≤2.25 mm. This study's success rate for vaginal birth following cesarean section (VBAC) was 39.2%. This rate is consistent with current research, which shows that the rate of success trial of labor (TOL) ranges from 43% to 80% and rises to almost 90% following a previous vaginal birth.[16] After conducting a meta-analysis, Kok et al., 2013 determined that a threshold of 2.0 to 2.5 mm was a credible indicator of uterine rupture. In close agreement with the diagnostic performance noted in this investigation, their combined sensitivity and specificity were 72% and 74%, respectively.[17]

No obvious correlation existed between gestational age and uterine rupture (p=0.408). This outcome is in line with research by Bujold et al., 2009, who found that pregnancy age has less of an impact on rupture risk than LUS thickness and prior obstetric history. Nevertheless, the bulk of ruptures in the current study happened between 34 and 36 weeks, which might point to a pattern that needs more investigation.[18] With a sensitivity of 71.25% and the distinctiveness of 73.23%, a cutoff LUS thickness of ≤2.25 mm was found to be the highest predictive value for uterine rupture using receiver operating characteristic (ROC) curve analysis. AUC, or area under the curve, of 72.2%, the diagnostic accuracy was deemed moderate. Ibrahim et al., 2023 noted performance metrics that were almost equal. It is also significant that this study's high negative predictive value (NPV) of 86.30% highlights how reliable LUS thickness is in ruling out rupture danger and assisting with trial-of-labor judgments.[19]

In this study, the rate of scar dehiscence was 2.5 percent. The comparative study that found the greatest rate of scar dehiscence was 28% as reported by Muhammed et al., 2010 and the lowest rate was recorded by Sen et al., 2004 which was 2.82%.[20,21] The management approach that was most associated with rupture was cesarean surgery, highlighting the significance of clinical judgment and comprehensive sonographic examination. Because spontaneous

vaginal birth carries a lower risk, LUS thickness is a useful tool for properly directing VBAC attempts, as noted by Tanos et al., 2019.[22]

Limitations:

The lack of established measurement techniques, possible variability in ultrasound equipment and settings, and unmeasured interobserver variability are some of the study's weaknesses. Applicability to other gestational periods is limited by the emphasis on third-trimester measurements (35–37 weeks), and subjective variability may be introduced by the use of real-time imaging.

Conclusion:

Sonographic examinations provide safer management of this significant obstetric risk by improving the assessment of the possible danger of uterine rupture in patients having prior cesarean births. In order to try to lessen the risk of uterine rupture-scar dehiscence, it is recommended that ultrasound assessment of the lower uterine section be included in the final assessment of the delivery type for this group of women who have scarred uteruses.

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