THE PREDICTIVE VALUE OF ULTRASONOGRAPHIC ASSESSMENT OF LOWER SEGMENT SCAR INTEGRITY IN PATIENT WITH PREVIOUS CAESAREAN SECTION NEAR TERM.

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ABSTRACT

Purpose: to determine the predictive value of trans-abdominal (TA) US in assessing thickness of lower uterine segment by measuring lower uterine segment (LUS) scar thickness at term in patient with previous CS. **Patient and methods:** This study was carried out as tool- assessment cross-sectional case study on pregnant females, who had previous cesarean section at 36-40W of gestation and planning for elective CS. LUS thickness measured by TAUS and measured by the surgeon after labour using a sterile vernier caliper. The sensitivity, specificity, positive and negative predicted values of the TAUS measurement was determined. **Results:** eighty nine women were studied at a mean gestational age of 38.5±0.59weeks. With cut-off value equal to or less than 2.4 mm , the sensitivity, specificity, positive and negative predicted values were 90%, 100%, 100%, and 98.7%, respectively. **Conclusion:** LUS measurement is a useful clinical tool in the prediction of scar integrity. It should be performed routinely in women who had a previous cesarean before labour.

Key word: cesarean section(CS), lower uterine segment (LUS), trans-abdominal ultrasound (TAUS). scar thickness

INTRODUCTION

There is worldwide increase in the rates of cesarean births over the last two decades. Frequency of LUS scar dehiscence is reported to be similar to the uterine rupture during labor in women with unscarred uterus. In parous women, previous cesarean has been found to be the most common indication for cesarean section (CS) [(1)]**.**

Several methods ranging from postoperative echographic evaluation of uterine wound, interval hysterography, and magnetic resonance imaging to amniography have been employed to assess the thickness of scarred LUS. Several recent reports suggest that sonographic evaluation of LUS can be used effectively to assess its integrity to predict the risk of intrapartum uterine rupture [(2)]. Sonographic examination of the LUS can be used to diagnose a uterine defect and to determine the degree of LUS thinning in women with previous CS [(3)].

Sen et al. [(4)] determined the LUS by categorizing it into 4 grades: - I: indicating a well-developed LUS. Grade. II: indicates thin but without visible uterine contents (conception products). III: indicates partial scar defect – dehiscence.-IV: indicating a uterus with a dehisced or a ruptured scar. About timing of sonographic assessment, Quereshi et al. [(5)] began assessment from as early as 16th week of gestation in their study. Martins et al. [(6)] have examined women between 36 and 39 weeks of gestation, at the time when mode of delivery will be discussed. The cutoff value of LUS thickness above which the intrapartum uterine rupture is less likely has varied from 2 to 3.5 mm.

Several factors have been associated with intrapartum uterine rupture including, number of previous cesareans, inter-delivery interval, prior vaginal delivery, maternal age, gestational age at delivery, and birth weight [(7)].

PATIENTS & METHODS

Between June 2011 to June 2013, 89 pregnant females (aged 18-44y; mean 26.7y), underwent TAUS for assessment of the LUS thickness at 36-40 gestational weeks, before planning for elective CS in Zagazig university hospitals. Written informed consent was obtained from all patients and the study was approved by local ethics committee of the university.

Inclusion criteria:

- Maternal age: 18-44 years.
- Gestational age: 36-40 weeks.
- Pregnant woman with singleton pregnancy.
- Women not in labor.
- Normal findings as evidenced by ultrasound scanning as regards: gestational age, fetal structures and placental site.
- Cephalic vertex presentation.
- All patients must have at least one previous CS.

All included women were subjected to:

1) History taking: (age, gravidity. parity. number of deliveries, time interval between previous CS).
2) Full examination: General &Abdominal ex. (fundal level, fundal grip, umbilical grip& first pelvic grip).
3) Ultrasound examination:
   -The LUS thickness was evaluated by TA U/S, with a partially full bladder, (waiting for 2 hours after the last micturation) as an over distended bladder could elongate the cervical length by stretching the lower

uterine segment and, also done in the absence of any uterine contraction which may distort the LUS. US done within 48 hours prior to undergoing elective CS.

- Examinations were performed with Medison Accuvix XG machine using a TA convex array transducer with a frequency of 3.75 MHz.
- The LUS was obtained in the midsagittal plane in an adequately magnified view. The thickness of the LUS was measured by ATS as a single measurement taken with the cursors at the urinary bladder wall–myometrium interface and the myometrium/ chorioamniotic membrane–amniotic fluid interface (Figure1).

4) At the time of surgery, The LUS was identified as the part of the uterus below the loose reflection of the vesico-uterine serosa. Intra-operative CS scar was assessed to see whether it is intact or there is a scar dehiscence. After delivery of the neonate, the thickness of the LUS was measured by the surgeon using a sterile vernier caliper up to the nearest millimeter in the following manner: Two Green-Armytage forceps were used to hold the lower flap of the uterine defect about 2 inches apart on either side of the midline. The vernier caliper was placed on the LUS in the middle between the two Green-Armytage forceps and the measurement was taken.

(5)**Statistical analysis**: using SPSS version 16.0 software for analysis. The study population was presented as frequencies and percentages (%) in qualitative data or mean values and standard deviations (SD) in quantitative data. Differences between frequencies and means were compared by Chi-square and paired samples t tests, respectively. A p value of < 0.05 was considered significant. Analysis Of Variance (ANOVA) test followed by logistic regression analysis model of the dependent variable and other studied variables (independent predictors) were performed. The best fitting predictors were evaluated using multivariate regression analysis. Receiver Operating Characteristic (ROC) curve of the optimal cutoff point values in the studied patients was done. The sensitivity, specificity, positive and negative predicted values were also assessed.

RESULTS

The mean age of the studied population was 26.7±2.9 years with 83.1% of them were below 30 years. The mean gestational age was 38.5±0.59 weeks. Placenta was anterior position in relation to scar in 39.3% of the women while it was posterior in 60.7% of the women. The mean fetal weight was 3123.3±138.7 gram. Scar integrity was thin or defected in 6.7% of the cases. The mean LUS scar thickness was 3.02±0.53 mm (table1).

Intra-operative evaluation of the studied women reported in (table 2). The mean fetal weight of the studied population was 3124.7±137.97 gram. Scar integrity was normal in 83(93.3%)(Figure 2) thin in 9(10.1%) (Figure 3), and there was a defect in 1(1.1%) (Figure 4). The mean LUS scar thickness measured by caliper was 2.5±0.48 mm.

There was significantly lower sonographic LUS thickness in maternal age group ≥30 years than in maternal age group <30 years. There was significantly lower sonographic LUS thickness in the group with gestational age ≥38 weeks than in the group with gestational age <38 weeks. There was significantly lower sonographic LUS thickness in the group with birth weight >3000 gram than in the group with birth weight ≤3000 gram. There was significantly lower sonographic LUS thickness in the group with abnormal scar integrity than in the group with normal scar integrity ($p<0.01$) (table 3).

There was significantly lower caliper LUS thickness in the group with last CS duration >2 years than in the group with last CS duration ≤2 years. There was significantly lower caliper LUS thickness in the group with gestational age ≥38 weeks than in the group with gestational age <38 weeks. There was significantly lower caliper LUS thickness in the group with birth weight >3000 gram than in the group with birth weight ≤3000 gram. There was significantly lower caliper LUS thickness in the group with abnormal scar integrity than in the group with normal scar integrity ($p<0.01$) (table4).

There was a strong significant positive correlation between sonographic LUS thickness and caliper LUS thickness ($r=0.95$, $p<0.0001$) (figure 5).

The optimal cutoff point (predictive) value of sonographic LUS scar thickness in the studied women was ≤2.4 mm, presented by the Receiver Operating Characteristic (ROC) curve (figure 6). The sensitivity, specificity, positive and negative predicted values were 90%, 100%, 100%, and 98.7%, respectively .

Table 1. Ultrasonographic evaluation of the studied women (n=89).

	No.	%
Gestational age (weeks)		
Mean ±SD		38.5±0.59
Range		36.4-39
Placental position (in relation to scar)		
anterior	35	39.3
posterior	54	60.7
Placental grade of maturity		
Grade 3 maturity	82	92.1
Grade 3 maturity with minimal calcifications	6	6.7
Grade 3 maturity with vacculation	1	1.1
Fetal weight (grams)		
Mean ±SD		3123.3±138.7
Range		2700-3350
Scar integrity		
Normal thickness	83	93.3
Thin	4	4.5
Defect	2	2.2
LUS scar thickness (mm)		
Mean ±SD		3.02±0.53
Range		1-4

Table 2. Intra-operative evaluation of the studied women (n=89).

	No.	%
Fetal weight (grams)		
Mean ±SD		3124.7±137.97
Range		2650-3350
Scar integrity		
Normal	79	88.8
Thin	9	10.1
Defect	1	1.1
LUS scar thickness (mm)		
Mean ±SD		2.5±0.48
Range		0.8-3.5

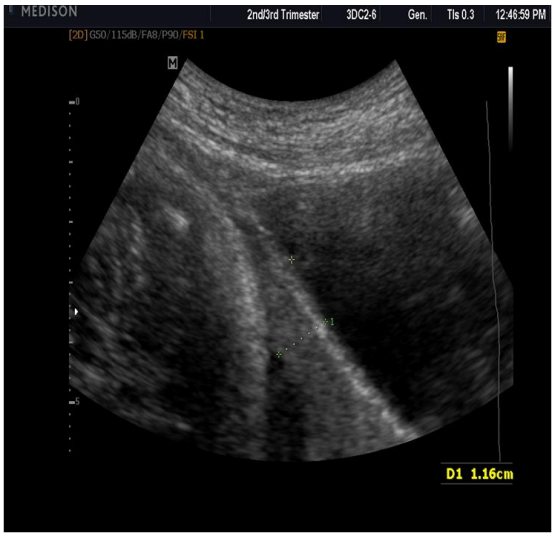
Table3. Relationship between sonographic LUS measurement and demographic, intra- and post-operative data of the studied women (n=89).

Variables	LUS thickness (mean ±SD)	t-test	p-value
Maternal age			
<30 (n=74)	3.1±0.5	2.1	0.038*
≥30 (n=15)	2.78±0.7		
Last cesarean section (CS) duration			
≤2 years (n=47)	3.08±0.63	1.1	0.29
>2 years (n=42)	2.96±0.39		
Gestational age			
<38 (n=15)	3.43±0.32	3.6	0.0006**
38-39 (n=74)	2.94±0.52		
Birth weight (gram)			
≤3000 (n=17)	3.42±0.31	3.7	0.0004**
>3000 (n=72)	2.93±0.53		
Scar integrity			
Normal (n=79)	3.16±0.33	10.1	<0.0001**
Abnormal (n=10)	1.94±0.55		

**P-value is significant at the 0.05 level (2-tailed), **P-value is significant at the 0.01 level (2-tailed).*

Table 4. Relationship between caliper LUS measurement and demographic, intra- and post-operative data of the studied women (n=89).

Variables	LUS thickness (mean ±SD)	t-test	p-value
Last cesarean section (CS) duration			
≤2 years (n=47)	2.60±0.53	2.96	0.004**
>2 years (n=42)	2.31±0.37		
Gestational age			
<38 (n=15)	2.86±0.36	3.7	0.0003**
38-39 (n=74)	2.38±0.47		
Birth weight (gram)			
≤3000 (n=17)	2.86±0.34	4.1	<0.0001**
>3000 (n=72)	2.37±0.46		
Scar integrity			
Normal (n=79)	2.57±0.35	9.1	<0.0001**
Abnormal(n=10)	1.45±0.48		



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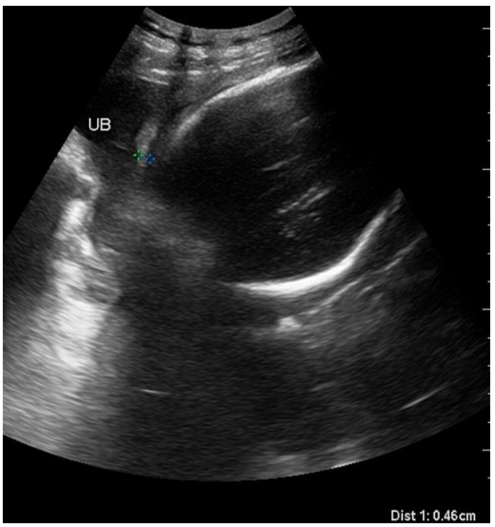

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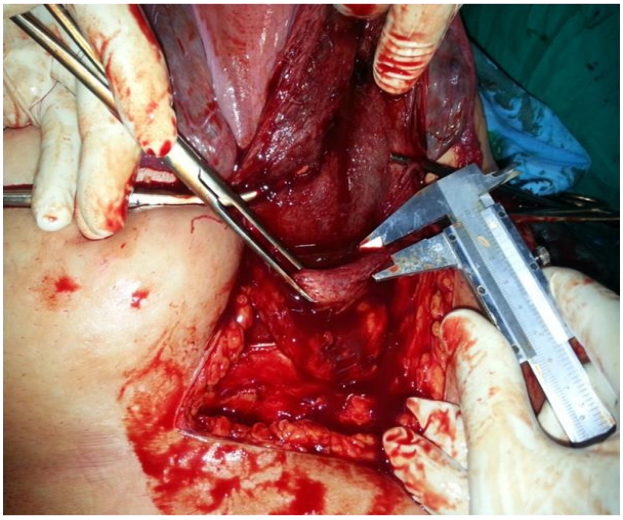
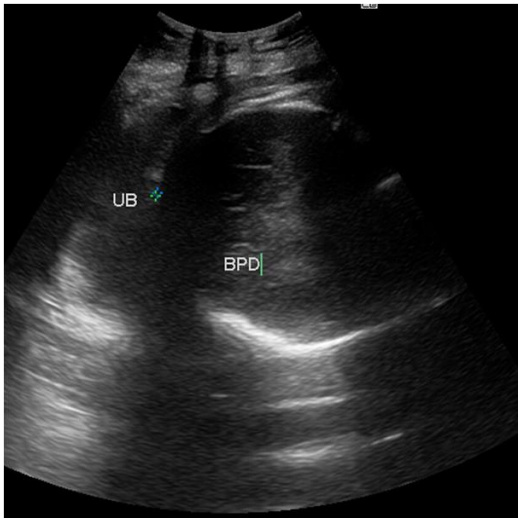


Figure 2-B



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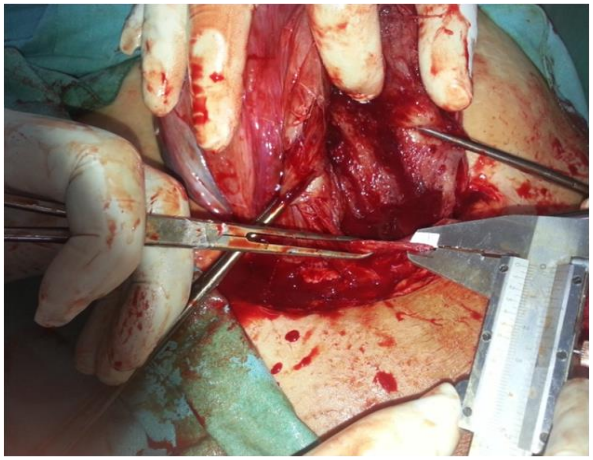

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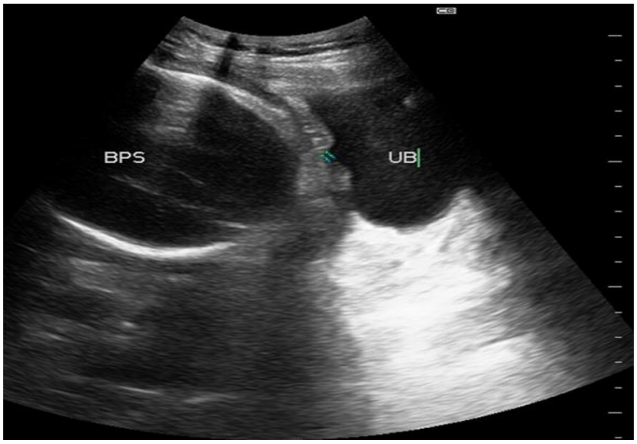

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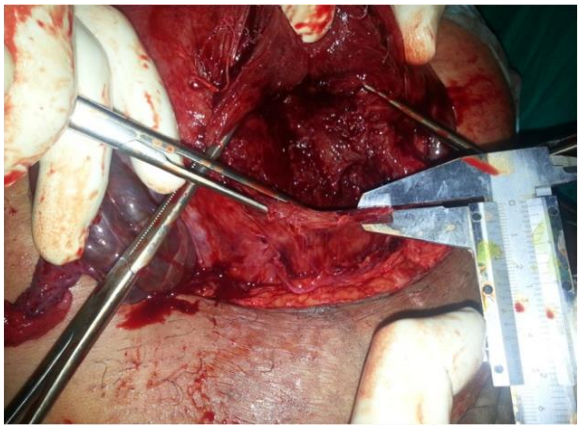

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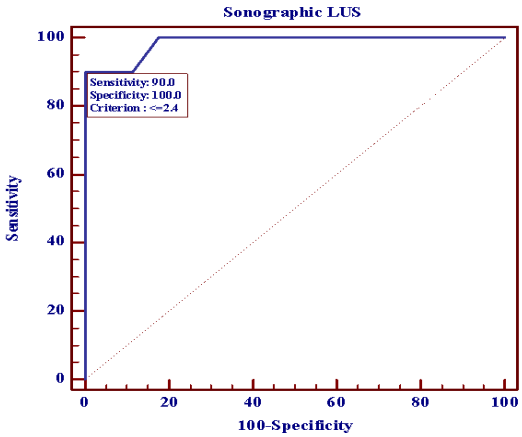

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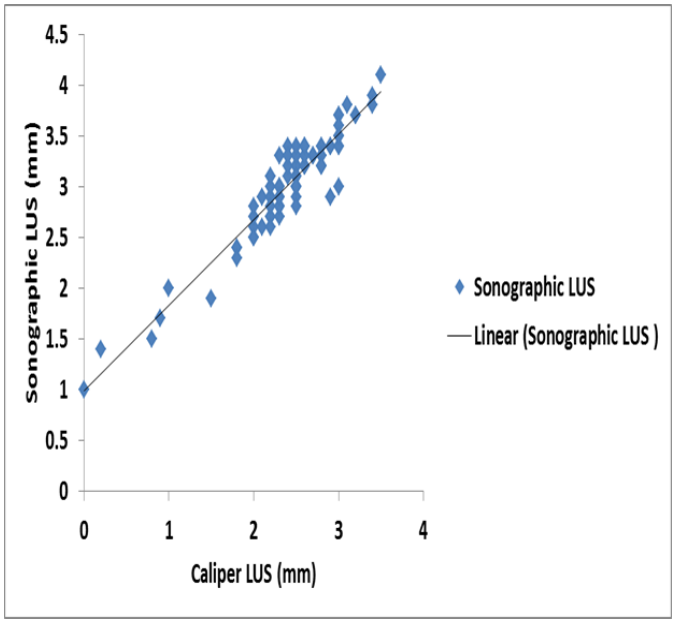

Figure 6:

Figure legends:

Figure 1: Arrows show the LUS thickness as measured by TAS.

Figure 2: 27 years old, gravida 2, para 1, previous 1CS, last one was from 18 months ago, 38 gestational weeks. (a)TAUS image showing normal Scar shape and the Scar thickness 4.6 mm. (b) Intra operative image showing normal scar shape and the Scar thickness 4.5 mm.

Figure 3: 31 years old, gravida 4, para 3, previous 3CS, last one was from 2yago, 37 w+ 2d gestational weeks. (a)TAUS image showing thin, its thickness 1.4 mm**.** (b) Intra operative image showing very thin scar and the thickness 1.2 mm.

Figure 4: 40years old, gravida 3, para 3, previous 3CS, last one was from 3yago, 39 gestational weeks. (a)TAUS image showing dehiscence with thickness 1mm. (b) Intra operative image showing thin transparent scar showing visible uterine content scar thickness about 0.7mm.

Figure 5: Correlation between LUS scar thickness measured by TAUS and manual caliper in the studied women.

Figure 6. ROC of sonographic LUS thickness for prediction of abnormal uterine scar integrity.

DISCUSSION

Several factors have been associated with reduced uterine segment thickness and impending intrapartum uterine rupture, including induction of labor [8,9], number of previous cesareans, inter-delivery interval[10], type of uterine closure during previous cesareans [11], prior vaginal delivery, maternal age, gestational age at delivery [12]and birth-weight [13]. Many studies have suggested that the risk of uterine rupture is inversely associated with sonographic thickness of the LUS near term, considering either full LUS thickness or myometrial layer only [3,7].

In the present study there was significantly lower sonographic LUS thickness in maternal age group ≥30 years than in maternal age group <30 years. There was significantly lower sonographic and caliper LUS thickness in the group with gestational age ≥38 weeks than in the group with gestational age <38 weeks. The mean fetal weight was 3123.3±138.7 gram. There was significantly lower sonographic and caliper LUS thickness in the group with birth weight >3000 gram than in the group with birth weight ≤3000 gram.

In the same line, *Jastrow et al.* [7]and *Cheung et al.* [14]evaluated the appearance of the LUS in pregnant women with previous CS and to compare the LUS thickness with that in women with unscarred uteri. There was lower sonographic LUS thickness in higher maternal age group than in lower maternal age group. There was lower sonographic LUS thickness in higher birth weight group than in lower birth weight group. Gestational age shows statistically insignificant differences.

The mean gestational age of our patients was 38.5±0.59 weeks. Different opinions are expressed regarding the period in pregnancy when the ultrasound assessment of LUS scar thickness can be carried out. *Quereshi et al* [5] began assessment from as early as 16th week of gestation in their study. In contrast, *Michaels et al* [15] thought it advantageous to assess between 28 and 36 weeks. *Martins et al*. [6] Suggested that, the most suitable time to perform US was from 36-38 weeks gestation, as this allows adequate lower segment development and avoids problems of diagnosis when the presenting part is deep in the pelvis and when the amniotic fluid is physiologically decreased. However, many studies have tried to assess the scar thickness even before conception [16].

In our study regarding the scar integrity, it was thin thickness or defected in 6.7% of the cases(the scar thickness was ≤0.9-1.1 mm) . The mean sonographic LUS scar thickness was 3.02±0.53 mm, while the mean caliper LUS scar thickness was 2.5±0.48 mm. There was significantly lower sonographic and caliper LUS thickness in the group with abnormal scar integrity than in the group with normal scar integrity (p<0.01).

In agreement with these findings, *Cheung et al.* [14] found that scar integrity was thin or defected in 7.5% of the cases. The mean LUS scar thickness was 2.5±1.6 mm. There was significantly lower LUS thickness in the group with thin or defected scar integrity (≤0.9-2.9 mm) than in the group with normal scar integrity (≥3 mm) (p<0.01).

Regarding the relationship between LUS thickness and previous CS, our study showed that there was significantly lower caliper LUS thickness in the group with last CS duration >2 years than in the group with last CS duration ≤2 years. There were also significant associations between lower LUS scar thickness and higher number of previous CS and last CS duration.

These findings were similar to several studies. These studies found significant associations between reduced LUS thickness and number of previous cesareans, and previous CS inter-delivery interval [10-12].

Our results reported that the optimal cutoff point (predictive) value of sonographic LUS scar thickness in the studied women using ROC curve analysis was ≤2.4 mm. The sensitivity, specificity, positive and negative predicted values were 90%, 100%, 100%, and 98.7%, respectively.

Consistent with our findings, *Mohammed et al.* [17] stated that when the thickness of the LUS is more than 2.5 mm, the possibility of dehiscence during the subsequent trials of labor is very small and a safe vaginal delivery can be achieved.

Similar to our data, *Bujold et al.* [18] using ROC curve analysis opined that full LUS thickness of <2.3 mm was associated with higher risk of complete uterine rupture. Similarly, others stated that the cut off value of LUS thickness above which the intrapartum rupture is less likely has varied from 2 to 3.5 mm [2]. *Rozenberg et al.* [19] found that LUS thickness correlated inversely with the risk of uterine rupture and concluded that thickness more than 3.5 mm is protective against uterine rupture. On contrary, *Kushtagi et al*[20] reported that LUS thickness of 3 mm measured by abdominal US prior to delivery at term in women with previous cesarean

is suggestive of stronger LUS but is not a reliable safeguard for trial of labor.

Previous studies have demonstrated that the LUS thickness measured sonographically has a high negative predictive value for uterine rupture, suggesting that a normal LUS thickness(3.5mm) predicts a safe trial of VBAC. However, the clinical application of LUS measurement in the management of VBAC remains controversial [(21)].

CONCLUSIONS

Based on the obtained results we conclude that ultrasound evaluation of the quality of the scar has practical application in the decision on the mode of delivery in women, also a useful clinical tool in the prediction of uterine rupture. It may be performed routinely in women who had a previous cesarean before labour.

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