Uterine Lower Segment Thickness as a predictor for Outcome of Vaginal Delivery in Women with Previous Cesarean Section

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Abstract: Objectives: To evaluate the applicability of estimation of lower uterine segment muscle thickness (LUST) using transvaginal ultrasonography (TVU) as a predictor for success of vaginal delivery trial in parturient with previous cesarean section (CS) and to determine the appropriate cutoff point for discriminating parturient valid for trial enrollment. Patients & Methods: Study was designed to start at 16th week of gestation including 100 multiparous parturient, TVU was conducted and LUST ≥2 mm without defects indicated good previous myometrial healing (Trial of vaginal delivery), but patients had LUST <2 mm, or abnormal thinning or the presence of myometrial defects indicated poor previous myometrial healing (Repeat CS). Intraoperatively, LUS myometrium was assessed and scored. Results: 48 parturient had LUST >2 mm, 14 had LUST=2 mm and 36 had thickness <2 mm. Fifty-seven parturient underwent trial of vaginal delivery and the trial succeeded in 39 parturient; while 18 parturient had failed trial and underwent emergency CS. Success rate for total parturient underwent trial was 68.4% and was 73% for those had LUST >2mm but was 44.4% for those had LUST =2mm. ROC curve analysis reported specificity of LUST as predictor for success of vaginal delivery trial (AUC=0.596) and LUST >2 mm as the appropriate cutoff point with AUC=0.650. Intraoperative evaluation of LUS defined 25 uteri as Class II, 11 as Class III and 5 as Class IV and ROC curve analysis defined LUST <2 mm as the appropriate cutoff point for prediction of poor LUS (AUC=0.722). Conclusion: LUST estimation using TVU is an appropriate modality for identification of patients with previous CS amenable for trial of vaginal delivery with success rate of 68.4% and at LUST >2mm as the appropriate cutoff point for success.
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1. Introduction

Caesarean section has become an increasingly common method of delivery. In developed countries, the rate of CS according to the Royal College of Obstetricians and Gynaecologists Clinical Effectiveness Support Unit (2001) was increased from 9% to 21% since 1980 to 2001 and was further increased to 23% from 2004 to 2005 according to Information Centre for Health and Social Care, NHS maternity statistics, England (2006).

Vaginal birth after one previous lower segment CS represents one of the most significant and challenging issues in obstetric practice. The old dictum "Once a cesarean always a cesarean" (Craigin, 1916) has changed because of the awareness of obstetricians about the safety of vaginal birth in a scarred uterus as well as the awareness of greater maternal morbidity and increased risk of maternal mortality in cesarean birth. The cost of this major operation is also another factor to make the obstetrician thinks about the trial of labor by vaginal route in scared uterus as an alternative of routine repeat CS; to reduce the overall CS rate it is equally important to reduce the repeat as well as the primary CS (Martel et al., 2004).

The safety of vaginal birth after cesarean section has been confirmed in various clinical trials. However, the possibility of uterine rupture exists with an incidence of 0.3-2.3%. Uterine rupture requires immediate surgical intervention and outcomes for infants and mothers are often disastrous (Kayani and Alfirvic, 2005).

Sonographic examination of LUS has been used to diagnose a uterine defect and to determine the degree of LUS thinning in women with previous CS. However, there was controversy to use transabdominal or transvaginal sonography; Jastrow et al. (2006) evaluated the reproducibility of sonographic measurement of the LUS in pregnant women had a previous CS at term using both transabdominal and transvaginal sonography and documented an intraobserver agreement that TVU measurement of the LUS can be considered good, compared with poor to moderate agreement using the transabdominal approach.

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 predicts a safe trial of vaginal birth after previous CS. However, the clinical application of LUS measurement in the management of vaginal birth after previous CS remains controversial. Because uterine rupture is rare and the number of women willing to attempt vaginal birth after previous CS is declining, it would be difficult to evaluate LUS measurement in predicting uterine rupture, (Cheung, 2008).

The current study aimed to evaluate the applicability of transvaginal estimation of LUST as a predictor for success of trial of vaginal delivery in parturient with previous CS and to determine the appropriate cutoff point for discriminating parturient valid for trial enrollment.

2. Patients and Methods

This prospective study was conducted at Obstetrics and Gynecology Department, Benha University Hospital and assigned to include 100 pregnant women with one or more previous CS. The study protocol was approved by the Local Ethical Committee and all enrolled women gave fully informed written consents.

Study was designed to start at 16th week of gestation, at time when the uterus elongates and unfold and the lower uterine segment becomes well developed and could be clearly visualized on US examination. Ultrasonographic examinations were conducted using a RT 3000 (Aloka, Japan) scanner with a 5 MHz transducer. Scanning was performed with partially filled bladder, about 2-hrs after last micturation because an over distended bladder could elongate the cervical length by stretching the lower uterine segment (Mason and Maresh, 1990). Discrimination of layers was performed according to Michaels et al. (1988) in a midline section of a sagital view as follows from inside outwards: 1- chorioamniotic membrane with decidualized endometrium, 2- a middle layer of myometrium and 3- uterovesical peritoneal reflection juxtaposed to the muscularis mucosa of the bladder. Muscle thickness was identified as the distance from the 3rd layer to the 1st one. The lower uterine segment was visualized in sagital section in the midline and lateral planes and topography was performed to detect asymptomatic uterine contraction that gives false measurement (Karis et al., 1991) and measurements were conducted in absence of uterine contraction. Cases with a low lying placenta were excluded of the study due to high vascularization and congestion of the lower uterine segment that appeared thicker than normal.

Utrasonographic findings were categorized after Qureshi et al. (1997) as following: normal, symmetrical or asymmetrical thickness of >2 mm; thin,

symmetrical or asymmetrical thickness of <2 mm; abnormal thinning, loss of sonographic definition of myometrium and/or loss of continuity, presence of defects of the myometrium of LUS irrespective of thickness.

For the present study, a lower uterine segment myometrial thickness of >2 mm without defects indicated good previous myometrial healing and was scored 3 and these patients were recruited for the trial of vaginal delivery if no other obstetrical indication for a repeat cesarean section was present. A lower uterine segment myometrial thickness of 2 mm was scored 2 and these patients were recruited for the trial of vaginal delivery if no other obstetrical indication for a repeat cesarean section was present. A lower uterine segment myometrial thickness of <2 mm, or abnormal thinning or the presence of myometrial defects indicated poor previous myometrial healing and was scored 1 and were assigned a repeat cesarean section.

Intraoperatively, lower uterine segment myometrium was assessed and compared to assure ultrasonographic findings. Lower uterine segment was assessed as follows: well developed lower segment (Class I), a thin lower segment but uterine contents were not visible (Class II), visible uterine contents through translucent lower segment (Class III) and a well circumscribed defect present in lower uterine segment (Class IV). No oxytocin infusion or prostaglandin tablets were used.

The obtained ultrasonographic were interpreted with both trial outcome and operative findings in cases underwent CS to evaluate the predictability of ultrasonographic evaluation for both patients' selection and success of trial of vaginal delivery.

3. Results

The study included 100 parturient with mean age of 27±3.5; range: 21-35 years, mean gravidity rate of 2.2±0.4; range: 2-3 and mean parity rate of 1.2±0.4; range: 1-2. Sixteen women were G3P2 and 84 women were G2P1. Mean time of first examination for enrollment in the study was 21.8±3.9; range: 15-29 gestational weeks and the last was 34.7±1.2; 32-37 gestational weeks.

Estimation of LUST defined 48 patients with thickness >2 mm, 14 patients with thickness=2 mm and 36 with thickness <2 mm. Two parturient had frequent uterine contraction that hampered LUST estimation and were excluded of the study. Parturient with LUST <2 mm included 15 parturient had previous 2 CS, 21 parturient had previous one CS of which 2 had transverse lie and 2 had macroscomic fetus. Parturient with LUST =2 mm included 2 parturient had transverse lie, 1 had macroscomic fetus and 2 had past-history of postparteum hemorrhage.

Parturient with LUST >2 mm included 48 parturient who had previous one CS with normal sized fetus in longitudinal lie and occiputo-anterior cephalic presentation. Parturient had previous two CS, had obstetric indication for CS and those had LUST <2 mm were assigned for elective CS.

Fifty-seven parturient underwent trial of vaginal delivery; 9 parturient had thickness =2 mm and 48 had thickness >2 mm. The trial succeeded in 39 parturient (68.4%); 35 had LUST >2 mm and 4 had LUST=2 mm; while 18 parturient (31.6%); 13 had LUST >2 mm and 5 had LUST=2 mm had failed trial of vaginal delivery and underwent emergency CS. The reported success rate for total patients underwent trial was 68.4% and for those had lower uterine segment thickness >2mm was 73% but was 44.4% for those had lower uterine segment thickness =2mm (Table 1).

Table (1): Distribution of trial recruited patients according to the outcome of the trial

	>2 mm	=2 mm	Total
Succeeded	35 (61.4%)	4 (7%)	39 (68.4%)
Failed	13 (22.8%)	5 (8.8%)	18 (31.6%)
Total	48 (84.2%)	9 (15.8%)	57 (100%)

Evaluation of LUST measured by TVU using ROC curve analysis reported specificity for success of trial of vaginal delivery with AUC=0.596, (Figure 1). Moreover, evaluation of LUST cutoff points for prediction of success of trial of vaginal delivery in patients with previous CS defined thickness >2 mm as the appropriate cutoff point with AUC=0.650, (Figure 2), while thickness =2 mm showed AUC=0.350, (Figure 3).
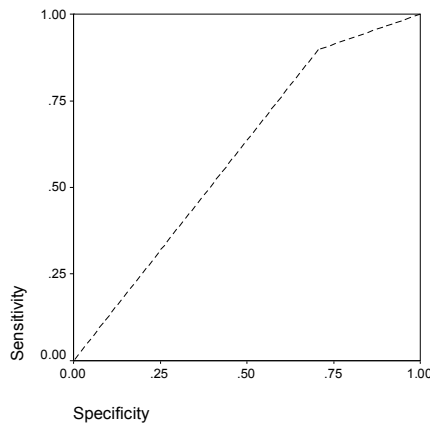

Figure 1. ROC curve analysis of the predictability of LUST estimation for the success of the trial of vaginal delivery
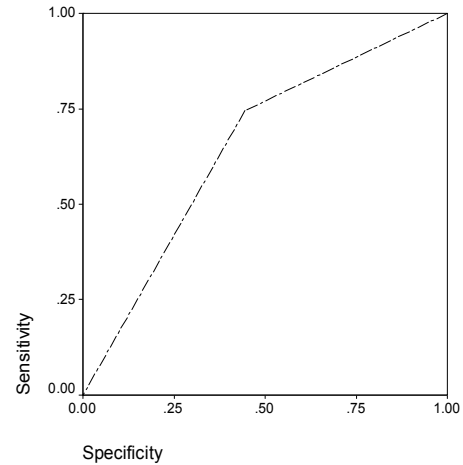

Figure 2. ROC curve analysis of the predictability of LUST estimation at cutoff point of >2mm for the success of the trial of vaginal delivery
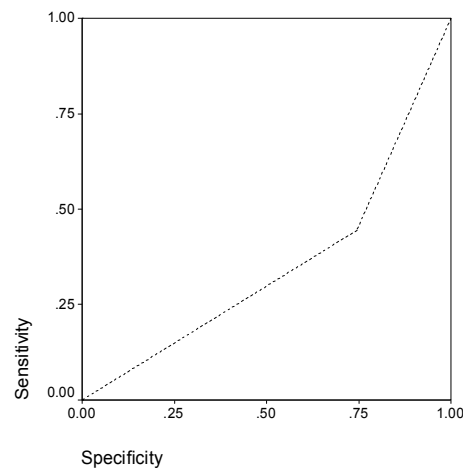

Figure 3. ROC curve analysis of the predictability of LUST estimation at cutoff point of =2mm for the success of the trial of vaginal delivery of patients with previous CS

Intraoperative evaluation of the lower uterine segment defined 25 uteri as Class II, 11 as Class III and 5 as Class IV. Only 5 of these patients had lower uterine segment thickness equal 2 mm and 36 had lower uterine segment thickness of <2 mm. Evaluation of lower uterine segment thickness cutoff point for prediction of lower uterine segment intraoperative class in patients with previous CS irrespective of number of previous sections defined thickness <2 mm as the appropriate cutoff point for prediction of poor lower uterine segment with AUC=0.722, (Figure 4), while thickness =2 mm showed AUC=0.278.
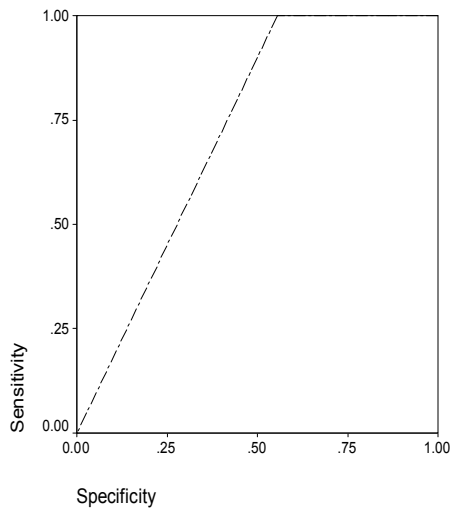
Figure 4. ROC curve analysis of the predictability of LUST estimation at cutoff point of <2mm for intraoperative class of lower uterine segment

4. Discussion

Unplanned second operative abdominal delivery is associated with maternal anxiety, maternal and neonatal morbidity and increased resource use. However, identification of women at increased risk of operative delivery appears feasible. Thus, the current study aimed to evaluate the applicability of transvaginal estimation of lower uterine segment thickness as a predictor for success of trial of vaginal delivery in parturient with previous CS.

The study choice of transvaginal route for estimation of lower uterine segment muscle thickness relied on previously reported reproducibility of such route compared to transabdominal total thickness estimation (Barra et al., 2008) and goes in hand with Marasinghe et al. (2009) and Martins et al. (2009) who found TVS is a more accurate method of assessing the thickness of the LUS compared with TAS. Also, the study was conducted using bidimensional sonography depending on the non-significant difference of reproducibility of bi- versus tridimensional images that was reported by Barra et al. (2008).

Through the present study no induction was tried but all patients were followed and allowed to have spontaneous initiation of labor and such policy was dependent on the previous documents of Kayani and Alfirevic (2005) who reported that in women with previous caesarean section and no vaginal deliveries, induction of labor carries a relatively high risk of uterine rupture/ dehiscence despite all precautions, including intrauterine pressure monitoring.

Fifteen patients had previous two CS were excluded of the trial of vaginal delivery, despite consenting, such decision was supported where LUST was <2mm and/or showed irregular scar and these findings were evident intraoperatively where 3 patients had LUS of Class IV, 4 of Class III and 8 of Class II. Also, patients with traditional indications of CS as macrosomia, malpresentation were excluded of the trial irrespective of the number of previous CS or the estimated thickness to guard against the need for manipulations or the possibility of uterine tearing either at scar site or elsewhere. In support of such assumption nine patients were excluded because of this cause and four of them had LUST of <2 mm and five had LUST of 2 mm and introperatively these patients had LUS class ranged between Class II and III.

Moreover, patients had LUST of < 2 mm without traditional indications for CS were also excluded of the trial of vaginal delivery and were assigned for elective CS and intraoperative LUS class supported the decision where 2 patients had LUS of Class IV, 5 of Class III and 10 of Class II. Thus, the decision for exclusion off the trial was successful depending on operative findings and ROC curve analysis defined the specificity of the choice of LUST of <2 mm as a cutoff point for choice of patient to undergo the trial of vaginal delivery with AUC=0.722.

The decision to shift to elective CS depending on clinical and US data was dependent on the previously documented data provided by Hibbard et al., (2001) that patients who experience failed vaginal birth after CS have higher risks of uterine disruption and infectious morbidity compared with patients who have successful vaginal birth after CS or elective repeat CS. Furthermore, the determined policy goes in hand with guidelines approved by the Clinical Practice Obstetrics and Executive Committees of the Society of Obstetricians and Gynaecologists of Canada, (Martel et al., 2005) that a trial of labor in women with more than one previous CS is likely to be successful but is associated with a higher risk of uterine rupture and was in line with Dietz et al., (2006), who found the combination of clinical and ultrasound variables yielded a model that is likely to predict delivery mode accurately in up to 87% of cases with previous operative delivery.

The reported success rate for total patients underwent trial was 68.4% and for those had LUST >2mm was 73% but was 44.4% for those had LUST =2mm. The reported success rate was slightly superior to that reported by Kiran et al., (2006), who reported that successful trial of vaginal birth was accomplished in 60% and trial after estimated date of delivery did not alter this outcome significantly.

The obtained data illustrate the beneficial effect of estimation of LUST for identification of parturient most likely to respond successfully to the trial and was proved to be specific parameter for success with AUC=0.596 and spotlight on the accuracy of identification of thickness cutoff point at >2mm for such choice which was proved statistically using ROC curve analysis to be the appropriate cutoff point with AUC=0.650, while thickness =2mm as cutoff point showed AUC=0.350.

These results go in hand with Sen et al., (2004) who reported that the critical cutoff value for safe lower segment thickness, derived from the receiver operator characteristic curve, was 2.5 mm and with Cheung et al., (2005) who reported that women had a successful vaginal delivery had a mean LUS thickness of 1.9 mm and none had clinical uterine rupture and concluded that sonography permits accurate assessment of the LUS thickness in women with previous CS and therefore can potentially be used to predict the risk of uterine rupture during trial of vaginal birth. Also, the obtained results were in line with Barra et al., (2008), who compared the reproducibility of the muscle layer measurement, through the vaginal route and found the average bidimensional measurement of IUS thickness was 2.7 mm through the vaginal route that was more reproducible for prediction of success of trial of vaginal delivery.

It could be concluded that LUST estimation using TVU is an appropriate modality for identification of patients with previous CS amenable for trial of vaginal delivery with success rate of 68.4% and LUST >2mm is appropriate cutoff point for success of vaginal trial.

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