ORIGINAL ARTICLE
VALIDITY OF TRANSABDOMINAL ULTRASOUND SCAN IN THE PREDICTION OF UTERINE SCAR THICKNESS

Iram Sarwar, Faiza Akram*, Attiya Khan, Saqib Malik, Ansa Islam, Kinza Khan**

Department of Gynaecology, *Department of Radiology, **Department of Medicine, Ayub Teaching Hospital,
Abbottabad-Pakistan

Background: Caesarean section rate is increasing throughout the world, which increases the risk of complications in subsequent pregnancy with increased maternal and foetal morbidity and mortality. There is risk of uterine rupture in subsequent pregnancy with trial of labour after caesarean section (TOLAC). Therefore, accurate prediction of uterine rupture can be of significant value during the management of subsequent pregnancies after previous caesarean delivery. The aim of this study was to evaluate the accuracy of prenatal transabdominal sonography in determining the lower uterine segment thickness in women with previous caesarean section, to document relevant risk factors in the obstetric history of subjects predisposing to uterine scar rupture and to define a cut-off value of uterine thickness for prediction of uterine rupture. **Methods:** This cross-sectional validation study was conducted in the Department of Obstetrics and Gynaecology, Ayub Teaching Hospital, Abbottabad from May to October 2017.Transabdominal ultrasound was carried out in all patients before labour for the measurement of uterine scar thickness. Patients were followed till caesarean section and intraoperative findings were recorded. **Results:** A total of 117 patients were enrolled. Out of these 33% had thin or dehiscence/rupture scar. At the cut-off value of ≤5 mm the sensitivity was 76.9%, specificity 48.7% and accuracy was 58.12%. No significant association was found between clinical features and scar dehiscence/rupture. **Conclusion:** No definite USG cut-off limit could be established to provide guidance regarding the clinical decision of opting for VBAC or repeat caesarean/section; scar thicknesses ≤5.0 mm should be judged cautiously.

Keywords: Caesarean section; Ultrasonography; Uterine scar thickness; VBAC; TOLAC

INTRODUCTION

Decision regarding mode of delivery after caesarean birth has always been a major topic of debate and controversy. Caesarean section rate increases by 1.5 million every year.[1] Caesarean section rate reported in Agha Khan Hospital Pakistan is 31.26%.[2] The reported rate of caesarean section is higher in USA and Brazil.[3] Increase in caesarean section rate has also been observed in Europe and UK.[2] There are many underlying factors for this increased rate of caesarean section including increased knowledge, availability of facilities and patient's fear of vaginal birth. Caesarean section increases the risk of complications in subsequent pregnancy with increased maternal and foetal morbidity and mortality. Complications include placenta previa, accreta, increta, percreta, dehiscence or uterine rupture. The risk of uterine rupture with previous one caesarean section without trial of labour is 0.16%, while this risk increases to 0.4–1% in patients who underwent trial of labour after caesarean (TOLAC) during subsequent pregnancy.[4,5] Uterine rupture is associated with severe neonatal, and maternal morbidity and mortality.[6] As the rate of caesarean section has increased on the other hand the rate of vaginal birth after caesarean has steadily decreased mainly because of the fear of uterine rupture during labour, despite the advantages of decreased neonatal and maternal morbidity and mortality.[7]

Due to increasing number of patients with previous caesarean section, patients and obstetricians are faced with the challenge of choice of delivery between repeat elective caesarean section and trial of labour with previous caesarean birth. Increased risk of uterine rupture with previous caesarean section plays a major role in deciding the mode of delivery in subsequent pregnancy. Therefore, accurate prediction of uterine rupture can be of significant value during management of subsequent pregnancies after previous caesarean delivery. Many prediction score methods were evaluated to predict successful VBAC based on clinical characteristics of patients, but none was found to be useful.[8]

Several studies have been conducted using ultrasonographic measurement of lower uterine

segment thickness for prediction of uterine rupture using transabdominal and transvaginal approaches near term. Strong association has been found between the degree of lower uterine segment thickness and risk of uterine defects.[5,9] The cut-off value of scar thickness for predicting uterine defects varies between 2.0 and 3.5 mm.[5] However no clear cutoff value of scar thickness predicting uterine defects has been recommended so far.

RCOG[10] guidelines 2015 and SOGC[11] guidelines 2005 recommend that trial of labour should be offered to women with previous one caesarean section with no absolute contraindications[12]. In our institution TOLAC is not offered and only patients who present with advanced labour are given trial of vaginal delivery. The aim of this study was to evaluate the accuracy of prenatal transabdominal sonography in determining the lower uterine segment thickness in women with previous caesarean section, to document relevant risk factors in the obstetric history of subjects predisposing to uterine scar dehiscence and to define a cut-off value of uterine thickness for prediction of uterine rupture. The results of this study would help the clinicians in making decision regarding mode of delivery in pregnancy after previous one caesarean section and whether trial of labour can be offered safely or not.

MATERIAL AND METHODS

This cross-sectional validation study was conducted in the Department of Obstetrics and Gynaecology, Ayub Teaching Hospital Abbottabad from May to October 2017. Patients with singleton pregnancy (on USG), gestational age 37 completed weeks to 41 weeks-calculated from early scan, with previous 1 caesarean section and not in active labour between the ages of 20–40 years were included in the study. Patients having placenta previa on ultrasound, previous history of myomectomy, previous history of uterine rupture and patients with lower uterine segment fibroid were excluded from the study. Sample size of 117 was completed.

All patients were enrolled in the study from outpatient department of Obstetrics & Gynaecology Unit C, Abbottabad after fulfilling the inclusion/exclusion criteria. Approval from the ethical committee of the hospital was obtained. A written informed consent was taken from each subject. History was taken including age, parity, period of gestation, duration since last delivery, indication of previous caesarean section, place of caesarean section, previous single- or double-layer closure and post-operative history of wound infection (from previous record). Examination including general and systematic examination was carried out with emphasis on looking for the presence or absence of scar tenderness. Ultrasound thickness was evaluated by transabdominal scan before caesarean section. Lower uterine segment was scanned in sagittal section under magnification to localize the thinnest area. Measurement was done with full bladder and the measurement was taken with the cursors at the urinary bladder wall, myometrium interface and the myometrium/chorio-amniotic membrane and amniotic fluid interface.[13] The subjects were followed till caesarean section and intraoperative surgical findings were recorded by the surgeons according to three categories: grade I – well-formed or no thinning of lower uterine segment, grade II- thinning of lower uterine segment with foetal hair not visible and grade III- window defect, dehiscence/rupture of lower uterine segment.[10]

Data was analysed using SPSS version 16.0. Quantitative variables like age, parity, duration of caesarean section, and thickness of scar were described as mean±standard deviation. Thickness of scar was categorized at ultrasound scan and during surgery, and was described as frequencies and percentages.

A 2×2 contingency table was constructed to measure sensitivity, specificity, positive and negative predictive values.

Measures of validity was calculated by stratifying for age, parity, duration since last caesarean section, single- or double-layer closure, postoperative wound infection after previous caesarean and scar tenderness. Post stratification chi-square was applied at 5% level of significance.

RESULTS

A total of 117 women were enrolled in the study. Their ages ranged from 19–39 years, with mode at 30 years (33.3%) and mean age of 28.9±4.0 years. The parity ranged from 1–5 with mode at 1 (69.2%) and mean of 1.56. Gestational age ranged from 37–42 weeks, with mode at 38 (12.0%) and mean of 38.4±1.3 weeks.

Duration since last caesarean section ranged from 1 to 9 years, with mode at 2 (61.5%) and mean of 2.12±1.1 years. Out of 117 patients 8 (6.83%) had less than or equal to 3 mm uterine thickness on scan while 109 (93.16%) had scar thickness more than 3mm. At cut-off of 5mm 70 (59.82%) patients had scar thickness of less than or equal to 5 mm while 47 (40.17%) had scar thickness of more than 5mm on scan.

Table-1: Relevant Obstetric Data of Subjects

Relevant obstetric history	Frequency	Percentage
Place of Previous C / Section Tertiary Care Others	76 41	65.0 35.0
Previous single- or double-layer closure Single layer closure Double layer closure	10 107	08.5 91.5
Post-Op complications after previous caesarean Yes No	02 115	01.7 98.3

Table-2: Clinical and operative characteristics of uterine scars of subjects

Scar characteristics	Frequency	Percentage
Scar Tenderness Positive Negative	27 90	23.1 76.9
Condition of Scar at Surgery Normal Thinned Out Dehiscence / Window	78 38 01	66.7 32.5 0.8

Table-3: Validation of USG measurements at cut-off ≤3.0 mm

On ultrasound scan	At caesarean section		
	Positive (Thinned)	Negative (Normal)	Total
Positive (≤ 3.0 mm)	05	03	08
Negative (> 3.0 mm)	34	75	109
Total	39	78	117

Sensitivity = 5/39* 100 =12.82%, Specificity=75/78* 100=96.15%, PPV=5/8* 100=62.5%, NPV=75/109* 100=68.8%, Overall Accuracy=80/117* 100= 68.4%

Table-4: Validation of USG measurements at cut-off ≤5.0 mm

On ultrasound scan	At caesarean section		
	Positive (Thinned)	Negative (Normal)	Total
Positive (≤5.0 mm)	30	40	70
Negative (>5.0 mm)	09	38	47
Total	39	78	117

Sensitivity=30/39* 100=76.9%, Specificity= 8/78* 100=48.7%, PPV=30/70* 100=42.8%, NPV=38/47* 100=80.85%, Overall Accuracy=68/117* 100=58.12%

Table-5: Validity of five clinical features compared with USG uterine scar thickness measurements of ≤5.0 mm

Variable	Sensitivity	Specificity	PPV	NPV	DA
Age ≤ 30 years and scar thickness ≤ 5.0 mm	77.1%	25.5%	60.7%	42.8%	56.4%
Parity ≤ 2 and scar thickness ≤ 5.0 mm	84.2%	17.0%	60.2%	42.1%	57.3%
Duration since last caesarean ≤ 2 years and Scar Thickness ≤5.0 mm	78.6%	10.6%	56.7%	33.3%	51.3%
Double layer stitching and scar thickness ≤5.0 mm	91.4%	08.5%	59.8%	40.0%	63.5%
Scar tenderness present and scar thickness ≤5.0 mm	27.1%	83.0%	70.4%	43.3%	49.6%
Combined clinical features (mean)	71.7%	29.0%	61.6%	40.3%	55.6%

Table-6: Validity of five clinical features compared with operative scar thickness evaluation of thinning/dehiscence

Variables	Sensitivity	Specificity	PPV	NPV	DA
Age ≤ 30 years and operative scar thinning	79.5%	25.6%	34.8%	71.4%	56.4%
Parity ≤ 2 and operative scar thinning	82.1%	17.0%	60.2%	42.1%	57.3%
Duration since last caesarean ≤ 2 years and operative scar thinning	84.6%	17.9%	66.0%	70.0%	40.2%
Double layer stitching and operative scar thinning	92.3%	09.0%	33.6%	70.0%	36.7%
Scar tenderness present and operative scar thinning	48.7%	89.7%	70.4%	77.8%	76.1%
Combined clinical features (mean)	77.4%	32.0%	53.0%	66.3%	53.3%

DISCUSSION

In the present study majority of subjects were healthy with no major risk factors for scar thinness or dehiscence at a mean of two years post-previous caesarean. However, scar tenderness was present in about 25% of subjects and about 33% were labelled as having thin or dehiscent scars at caesarean. Many studies have shown that lower uterine segment thickness measured ultrasonographically is directly related to the risk of scar dehiscence/rupture.[9,14–17]

Ultrasound measurements showed scar thickness of ≤5.0 mm in almost 60% of subjects, which decreased to mere 18% at cut-off of ≤4.0 mm and 7% at a cut-off of ≤3.0 mm. Sensitivity increased as the cut-off was increased from ≤3.0 mm to ≤5.0 mm while Specificity decreased as the cut off was increased from ≤3.0 mm to ≤5.0 mm. Overall accuracy decreased from 68–58% as the cut-off was increased from ≤3.0 mm to ≤5.0 mm. A study conducted in Pakistan in 2018 showed significant association (*p*-value <0.001) between scar thickness (1–3 mm) and intraoperative findings of scar dehiscence and rupture.[14]

Sharma *et al* from India in their study also observed that lower uterine segment thickness was significantly less in patients with previous caesarean scar as compared to those without scar (*p*=0.000). They also reported that lower uterine segment thickness less than 3.65 mm has 91% sensitivity, 93% specificity, and 91% negative predictive value for prediction of scar rupture.[15] Another study from India also reported high sensitivity, specificity, positive and negative predictive value of ultrasonographic lower uterine segment thickness of <5 mm with uterine rupture.[10]

Abdul Baset *et al* in their study showed that lower uterine segment thickness was less in patients who had scar dehiscence, with a sensitivity, specificity, positive and negative predictive value of 90.9%, 84%, 71.4% and 95.5% respectively at a cut-off value of 2.5 mm.[13] Bejold *et al* also concluded that lower uterine segment thickness of <2.5 mm is associated with uterine rupture rate of 10% with specificity of 90%.[18] Rozenberg *et al* observed 88% sensitivity with 99.3% negative predictive value at a cut-off value of 3.5mm scar thickness for scar dehiscence prediction.[19] N kok *et al* in their meta-analysis published in 2013 concluded that lower uterine segment thickness of 3.1–5.1 mm has a strong negative predictive value for the occurrence of uterine defect in labour.[9]

Unlike the studies mentioned, our study failed to show strong association between scar thickness measured on ultrasound and scar dehiscence/rupture. The reason could be small sample size. We measured thickness in patients who were not in labour as during labour the descent of the foetal head may stretch the lower uterine segment further and make it thinner. Most of the studies measured thickness either by transvaginal or both transvaginal and transabdominal routes which could be the reason for difference in results because so far there is no standardized method of measurement. We included patients with previous one caesarean section only. Repeated caesareans can also decrease the thickness of scar.

Some studies showed an association between maternal age, inter-pregnancy interval, single layer closure and infection after previous caesarean section and scar rupture/dehiscence[20–22], the five recorded clinical indicators (risk factors) in our study did not show any consistent validity for predicting uterine scar thinness or risk of rupture when assessed through USG measurements or Operative findings. Failure of association between maternal age, wound closure technique and previous postoperative infection could be due to the fact that mean age in our study group was 28.9 years only and majority of our patients (91.5%) had double layer closure with only 0.2% having wound infection after previous surgery. The combined five clinical factors also did not achieve any significant validity and could not be used by themselves to predict the risk of uterine scar thinness or uterine rupture.

Despite the limitations of our study (small sample size), measurement of lower uterine segment thickness by ultrasound cannot be used alone as a predictor of uterine scar defects.

CONCLUSION

The study did provide some merit to ultrasonographic measurements of uterine scar thickness for predicting the risk of uterine rupture in subsequent pregnancies. No definite ultrasonographic cut-off limit could be established to provide guidance regarding the clinical decision of opting for VBAC or repeat caesarean /section; however, scar thicknesses ≤5.0 mm should be judged cautiously.

USG measurements should be used in conjunction with other clinical evidence and risks to foeto-maternal health as final arbiters of mode of delivery.

This article was presented in FIGO (International Federation of Gynaecology & Obstetrics) International Congress Rio de Janeiro, Brazil 2018.

AUTHORS' CONTRIBUTION

IS: Concept, write-up. FA: Ultrasounds. AK: Literature review. SM: Statistical help. AI, KK: Data collection.

REFERENCES

1. Pomorski M, Fuchs T, Zimmer M. Prediction of uterine dehiscence using ultrasonographic parameters of caesarean section scar in the non pregnant uterus: a prospective observational study. BMC Pregnancy Childbirth 2014;14:365.
2. Bano R, Mushtaq A, Adhi M, Saleem MD, Saif A, Siddiqui A, *et al*. Rates of caesarean section and trials and success of vaginal birth after caesarean sections in secondary care hospital. J Pak Med Assoc 2015;65(1):81–3.
3. Patah LE, Malik AM. Models of childbirth care and caesarean rates in different countries. Rev Saude Publica 2011;45(1):185–94.
4. Nahum GG. Uterine Rupture in Pregnancy: Overview, Rupture of the Unscarred Uterus, Previous Uterine Myomectomy and Uterine Rupture [Internet]. [cited 2016 Oct 7]. Available from: https://reference.medscape.com/article/275854-overview
5. Jastrow N, Vikhareva O, Gauthier RJ, Irion O, Boulvain M, Bujold E. Can third-trimester assessment of uterine scar in women with prior caesarean section predict uterine rupture? Ultrasound Obstet Gynecol 2016;47(4):410–4.
6. Guise JM, McDonagh MS, Osterweil P, Nygren P, Chan BK, Helfand M. Systematic review of the incidence and consequences of uterine rupture in women with previous caesarean section. BMJ 2004;329(7456):19–25.
7. Cunningham F, Bangdiwala S, Brown S, Dean T, Frederiksen M, Hogue CR, *et al*. National Institutes of Health Consensus Development Conference Statement: Vaginal Birth After Caesarean Section New Insights March 8–10, 2010. Obstet Anesth Dig 2011;31(3):140–2.
8. Macones GA, Cahill AG, Stamilio DM, Odibo A, Peipert J, Stevens EJ. Can Uterine Rupture in Patients Attempting Vaginal Birth after Caesarean Delivery be predicted? Am J Obstet Gynecol 2006;195(4):1148–52.
9. Kok N, Wireman IC, Opmeer BC, De Graaf IM, Mol BW, Pajkrt E. Sonographic measurement of lower uterine segment thickness to predict uterine rupture during a trial of labor in women with previous caesarean section: a meta- analysis. Ultrasound Obstet Gynecol 2013;42(2):132–9.
10. Jha NNS, Maheshwari S, Barala S. Ultrasonographic assessment of strength of previous scar during pregnancy.Int J Reprod Contracept Obstet Gynecol 2018;7(4):1458–63.

11. Society of Obstetricians and Gynaecologists of Canada. SOGC clinical guidelines for vaginal birth after previous caesarean birth. Number 155(Replaces guideline Number 147), February 2005. Int J Gynaecol Obstet 2005;89(3):319–31.

12. Uharcek P, Brestansky A, Ravinger J, Manova A, Zajacova M. Sonographic assessment of lower uterine segment thickness at term in women with previous caesarean delivery. Arch Gynecol Obstet 2015;292(3):609–12.

13. Mohammed ABF, Al-Moghazi DA, Hamdy MT, Mohammed EM. Ultrasonographic evaluation of lower uterine segment thickness in pregnant women with previous caesarean section. Middle East Fertil Soc J 2010;15(3):188–93.

14. Tazion S, Hafeez M, Manzoor R, Rana T. Ultrasound predictability of lower uterine segment caesarean section scar thickness. J Coll Physicians Surg Pak 2018;28(5):361–4.

15. Sharma C, Suriya M, Soni A, Soni PK, Verma A, Verma S. Sonographic prediction of scar dehiscence in women with previous caesarean section. J Obstet Gynnaecol India 2015;65(2):97–103.

16. Bujold E, Jastrow N, Simoneau J, Brunet S, Gauthier RJ. Prediction of complete uterine rupture by sonographic evaluation of the lower uteribe segment. Am J Obstet Gynecol 2009;201(3):320.e1–6.

17. Rozenberg P, Goffinet F, Phillipe HJ, Nisand I. Utrasonographic measurement of lower uterine segment to assess risk of defects of scared uterus. Lancet 1996;347(8997):281–84.

18. Glavind J, Madsen LD, Uldbjerg N, Dueholm M. Utrasound evaluation of caesarean scar after single- and double -layer uterotomy closure: a cohort study. Ultrasound Obstet Gynecol 2013;42(2):207–12.

19. Naji O, Wynants L, Smith A, Abdullah Y, Stalder C, Sayasneh A, *et al*. Predicting successful vaginal birth after caesarean section using a model based on caesarean scar features examined by transvaginal sonography. Ultrasound Obstet Gynaecol 2013;41(6):672–8.

20. Naji O, Daemen A, Smith A, Abdullah Y, Saso S, Stalder C, *et al*. Changes in caesarean section scar dimensions during pregnancy: a prospective longitudinal study. Ultrasound Obstet Gynecol 2013;41(5):556–62.

21. Gizzo S, Zambon A, Saccardi C, Patrelli TS, Di Gangi S, Carrozzini M, *et al*. Effective anatomical and functional status of the lower uterine segment at term:estimating the risk of uterine dehiscence by ultrasound. Fertil Steril 2013;99(2):496–501.

22. American College of Obstetrician and Gynecologists. ACOG practice bulletin no. 115: vaginal birth after previous caesarean delivery. Obstet Gynecol 2010;116(2)450–63.

Address for Correspondence:

Dr. Iram Sarwar, Department of Gynaecology, Ayub Teaching Hospital, Abbottabad-Pakistan

Email: isarwar@yahoo.com