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Original Research Article

Sonographic assessment of uterine scar thickness and associated factors among pregnant women with previous caesarean sections at a tertiary hospital in Tanzania

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ABSTRACT

Background: Uterine scar thickness has a practical application on the safe mode of delivery for pregnant woman with previous cesarean section (CS) lower uterine segment (LUS) scar. The study aimed to assess sonographic uterine scar thickness and associated factors among pregnant women with previous CS at a tertiary hospital in Mwanza, Tanzania.
Methods: An analytical cross-sectional analytical study was carried out at a tertiary hospital in Mwanza, Tanzania that included pregnant women with previous CS at term (≥ 36 weeks of gestation). Transabdominal obstetric ultrasound was performed. A uterine scar thickness was categorized as thin or thick using a cut off of 2.5 mm. Data were presented using descriptive statistics and analysed. A p value of less than 0.05 considered statistically significant.
Results: About 113 out of 400 women (28.3%) had thin uterine scars. Inter-pregnancy interval (p<0.001), history of wound infection (p=0.01) and placenta location (p=0.001) were significant factors associated with uterine scar thickness. On adjusted logistic regression analysis, inter-pregnancy interval [aOR (95% CI) =2.35 (1.38-3.99), p=0.002], estimated fetal weight [aOR (95% CI) =0.54 (0.34-0.87), p=0.01] and anterior placenta location [aOR (95% CI) =0.55 (0.34-0.90), p=0.02] were factors most likely to predict uterine scar thickness.
Conclusions: Uterine scar thickness assessment by sonography in pregnant women with previous cesarean sections can be easily integrated in an obstetric ultrasound. We recommend its routine application, and in combination with risk factors may guide decision on the mode of delivery and help prevent adverse maternal and fetal outcomes.

Keywords: Cesarean section, Obstetric ultrasound, Uterine scar thickness

INTRODUCTION

The rate of the cesarean section (CS) has increased globally. It has been projected that by year 2030, 28.5% of women worldwide will give birth by CS with 7.1% from sub-Saharan Africa alone.[1] A major challenge has always been whether a woman with history of previous CS should attempt vaginal birth with estimated risk of uterine rupture at 0.2-1.0% and trial of labor post-caesarean vaginal delivery success rates at 60% and 77%.[2,3] Sonographic assessment of uterine scar thickness is a reliable tool for assessing scar status and has practical applications in determining the mode of delivery in women with previous CS.[4] A thick uterine scar using a standardized ultrasound technique, is associated with a lower likelihood of uterine rupture.[5]

Ultrasound assessment of uterine scar thickness, particularly in the lower uterine segment (LUS), can be used to assess the risk of uterine rupture or dehiscence during labor or a subsequent pregnancy. Various cutoff values for LUS thickness have been suggested to predict dehiscence or rupture, ranging from 1.5 mm to 3.5 mm, or even 3.9 mm.[6,7] Several studies have found that LUS thickness of ≤2 mm or ≤2.5 mm is associated with a higher risk of dehiscence, with sensitivities ranging from 80.9% to 93%, while other studies have found that a thicker scar (≥3.5 mm) is associated with a lower risk of dehiscence and a higher chance of successful vaginal birth after cesarean (VBAC).[6,8-10] Both transabdominal and transvaginal ultrasound have been shown to have a sensitivity of 88% (95% CI 83-92%) and 75% (95% CI 52-97%), specificity of 77% (95% CI 70-83%) and 85% (95% CI 66-96%), positive likelihood ratio of 4.71 (95% CI 3.65-6.07) and 8.90 (95% CI 5.04-15.74) and negative likelihood ratio of 0.11 (95% CI 0.08-0.16) and 0.11 (95% CI 0.05-0.23) respectively in the assessment of uterine scar thickness.[4]

A wide range of studies have examined factors influencing uterine scar thickness, notably maternal age, parity, inter-pregnancy interval, prior cesarean deliveries, wound infection, amniotic fluid index, fetal weight and number, gestational age and placental location.[3,11-14] Currently, there are no clear guidelines in Tanzania on the mode of delivery in a pregnant woman with a previous CS. The aim of the study was to assess sonographic uterine scar thickness and associated factors among pregnant women with previous CS in a tertiary hospital in Mwanza, Tanzania.

METHODS

Study design, duration and setting

An analytical cross-sectional analytical study was carried out between December 2023 to July 2024 at Bugando Medical Centre (BMC), a tertiary hospital in Mwanza, Tanzania.

Study population

The study included all pregnant women with previous CS at term (≥36 weeks of gestation).

Sample size and sampling technique

Minimum sample size was estimated at 384 participants based on the formula:

$$n = \frac{z^2 p(1-p)}{d^2}$$

Where z = z-score for 95% confidence interval =1.96; p = prevalence =50% as the prevalence of thin uterine scars was unknown in our setting; d = tolerable error =5%.

Convenient sampling technique was used.

Eligibility criteria

Inclusion criteria were all pregnant women with previous CS at term (≥ 36 weeks of gestation). All participants with obstetric emergencies, active phase of labor, uterine masses, low-lying placenta, placenta accreta spectrum, classical previous CS or uterine surgery were excluded.

Study variables

Independent variables included maternal age, socio-economic status, parity, inter-pregnancy interval, number of previous CS, previous CS health facility, wound infection history, VBAC history, amniotic fluid index, estimated fetal weight, gestational age, number of fetuses and placenta location. Dependent variable was uterine scar thickness.

Data collection and procedures

Data were collected using a structured pretested questionnaire. Transabdominal obstetric ultrasound was performed on a GE Logic E8 (GE Healthcare, USA) ultrasound machine using a 3.5 MHz curvilinear probe. To optimize visualization, participants were instructed to fill their urinary bladder by drinking at least 500 millilitres of water one hour before the examination. During the scan, each participant lay in the supine position with the abdomen and pelvis exposed. The curvilinear probe was placed on the suprapubic region after applying ultrasound gel, and probe manipulated manually along the sagittal plane to visualize the lower uterine segment scar in anatomical relation to the urinary bladder. Uterine scar thickness was measured in millimeters (mm) by placing one cursor at the interface between the uterine wall and the bladder, and a second cursor at the interface between the amniotic fluid and decidua. Measurements were taken at three different points, and the lowest value among the three measurements was recorded as the final scar thickness. A uterine scar thickness of less than 2.5 mm was categorized as thin, while a thickness of 2.5 mm or more was categorized as thick. Additional parameters were assessed during the ultrasound and included amniotic fluid index (AFI), estimated fetal weight (EFW), gestational age, number of fetuses, and placental location. To ensure the reliability and consistency of measurements, a dedicated sonographer was specifically trained in obstetric abdominal ultrasound examination and assessment of uterine scar thickness. Each measurement was validated by an experienced radiologist.

Data management and analysis

Data was entered into Microsoft Excel spreadsheet, cleaned and analyzed using Stata version 15 (StataCorp LLC, USA). Mean with standard deviation (SD) or median with interquartile range (IQR) depending on distribution were used to describe continuous variables depending on

distribution. Frequencies and proportions were used to describe categorical variables. Chi-square (χ^2) or Fisher exact test was applied to test for the significance of association. Univariate and multivariate logistic regression analyses were further applied to determine predictors of uterine scar thickness. A p value of less than 0.05 was considered statistically significant.

RESULTS

Among the 400 participants enrolled, 208 (71.7%) had thick uterine scars while 113 women (28.3%) had thin uterine scars (Figures 1-3). No uterine rupture was encountered. Majority of the participants were aged less than 35 years (70.3%), had given birth more than twice (62.5%) and had one previous CS (51.5%) as shown in Table 1. Inter-pregnancy interval (p<0.001), history of wound infection (p=0.01) and placenta location (p=0.001) were factors significantly associated with sonographic uterine scar thickness (Table 2).

Table 1: Baseline participants characteristics (n=400).

Variable	Category	N (%)
Maternal age, years	<35	281 (70.3)
	≥35	119 (29.7)
Marital status	Married	384 (96.0)
	Single	16 (4.0)
Residence	Urban	381 (95.2)
	Rural	19 (4.8)
Employed	Yes	286 (71.5)
	No	114 (28.5)
Formal education	Yes	397 (99.2)
	No	3 (0.8)
Gravidity	2	119 (29.7)
	>2	281 (70.3)
Parity	1	150 (37.5)
	≥2	250 (62.5)
Number of previous CS	1	206 (51.5)
	≥2	194 (48.5)

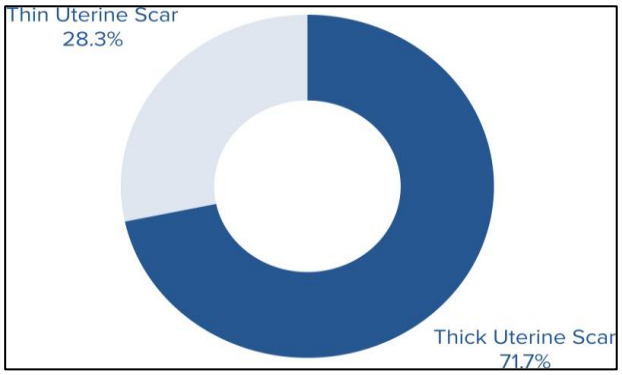

Figure 1: Donut chart showing proportion of sonographic uterine scar thickness.

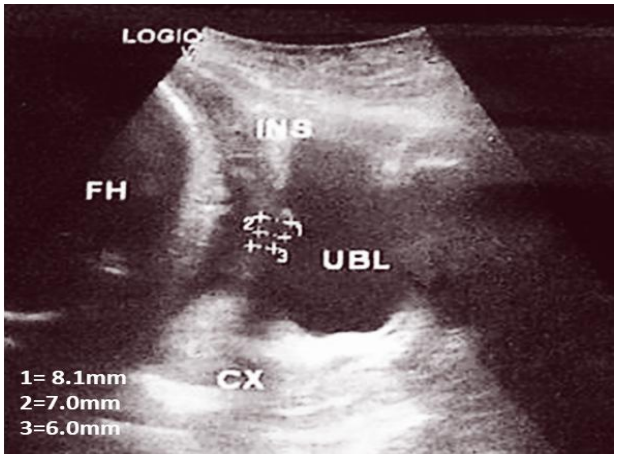

Figure 2: An ultrasound sagittal image illustrating a thick uterine scar.

Lowest measurement =6.0 mm. CX=cervix, FH= fetal head; INS=incision site; UBL=urinary bladder.

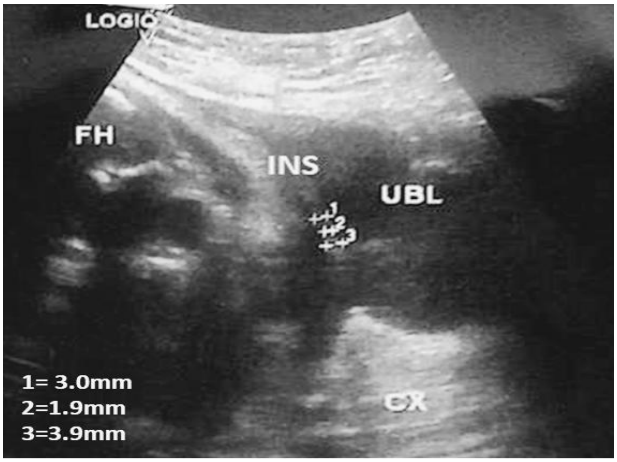

Figure 3: An ultrasound sagittal image illustrating a thin uterine scar.

Lowest measurement =1.9 mm. CX=cervix, FH=fetal head; INS=incision site; UBL=urinary bladder.

On univariate regression analysis, factors most to least likely to predict uterine scar thickness included inter-pregnancy interval [aOR (95% CI) =2.67 (1.65-4.34), p<0.001], history of wound infection [aOR (95% CI) =2.59 (1.24-5.44), p=0.01], number of previous CS [aOR (95% CI) =1.33 (1.04-1.71), p=0.02], parity [aOR (95%CI) =1.26 (1.05-1.51), p=0.01], estimated fetal weight [aOR (95% CI) =0.49 (0.32-0.75), p=0.001] and anterior placenta location [aOR (95% CI) =0.47 (0.30-0.73), p=0.001]. On multivariate regression analysis, factors most to least likely to predict uterine scar thickness were inter-pregnancy interval [aOR (95% CI) =2.35 (1.38-3.99), p=0.002], placenta location [aOR (95% CI) =0.55 (0.34-0.90), p=0.02] and estimated fetal weight [aOR (95% CI) =0.54 (0.34-0.87), p=0.01] as illustrated in Table 3.

Table 2: Factors associated with sonographic uterine scar thickness.

Variable	Categories	Thick N (%)	Thin N (%)	χ^2	P value
Maternal age, years	<35	206 (73.3)	75 (26.7)	1.13	0.29
	≥35	81 (68.1)	38 (31.9		
Parity	1	111 (74.0)	39 (26.0)	0.60	0.44
	≥2	176 (70.4)	74 (29.6)		
Inter-pregnancy interval, months	<18	52 (55.3)	42 (44.7)	16.37	<0.001
	≥18	235 (76.8)	71 (23.2)		
Number of previous CS	1	150 (72.8)	56 (27.2)	0.24	0.63
	≥2	137 (70.6)	57 (29.4)		
Previous CS hospital	Tertiary	117 (72.5)	67 (27.5)	0.19	0.66
	Other*	110 (70.5)	46 (29.5)		
Wound infection history	No	271 (73.4)	98 (26.6)	6.72	0.01
	Yes	16 (51.6)	15 (48.4)		
VBAC history	No	280 (71.6)	111 (28.4)	**	0.51
	Yes	7 (77.8)	2 (22.2)		
Amniotic fluid index (cm)	≤25	250 (71.4)	100 (28.5)	0.14	0.71
	>25	37 (74.0)	13 (26.0)		
Estimated fetal weight (kg)	≤3.5	242 (70.4)	103 (29.9)	3.19	0.07
	>3.5	45 (81.8)	10 (18.2)		
Gestational age (weeks)	Preterm (<37)	52 (69.3)	23 (30.7)	0.27	0.61
	Term (≥37)	235 (72.3)	90 (27.7)		
Number of fetuses	Singleton	279 (72.0)	109 (28.1)	**	0.45
	Multiple	8 (66.7)	4 (33.3)		
Placenta location	Not anterior	86 (61.4)	54 (38.6)	11.32	0.001
	Anterior	201(77.3)	59(22.7)		

*Health center, district or regional hospital; **Fisher exact test. cm=centimeters. CS = cesarean section; VBAC = vaginal birth after caesarean section; cm=centimeters; kg=kilograms.

Table 3: Factors likely to predict sonographic uterine scar thickness.

Variable	cOR	95%CI	P value	aOR	95% CI	P value
Maternal age, years	1.02	0.97-1.07	0.56	0.97	0.92-1.04	0.41
Parity	1.26	1.05-1.51	0.01	1.25	0.95-1.64	0.11
Inter-pregnancy interval, months	2.67	1.65-4.34	<0.001	2.35	1.38-3.99	0.002
Number of previous CS	1.33	1.04-1.71	0.02	1.12	0.80-1.57	0.51
Previous CS at a tertiary hospital	1.10	0.71-1.72	0.66	1.05	0.65-1.72	0.83
Wound infection history	2.59	1.24-5.44	0.01	1.90	0.83-4.37	0.13
VBAC history	0.72	0.15-3.52	0.69	0.86	0.16-4.50	0.86
Amniotic fluid index (>25 cm)	0.88	0.45-1.72	0.71	1.02	0.48-2.14	0.96
Estimated fetal weight (>3.5 kg)	0.49	0.32-0.75	0.001	0.54	0.34-0.87	0.01
Gestational age (≥ 37 weeks)	0.87	0.50-1.50	0.61	0.76	0.42-1.38	0.37
Multiple fetuses	1.28	0.38-4.34	0.69	1.48	0.41-5.35	0.55
Anterior placenta location	0.47	0.30-0.73	0.001	0.55	0.34-0.90	0.02

cOR=crude odd ratio; CI=confidence interval; aOR=adjusted odd ratio; CS = cesarean section; VBAC = vaginal birth after cesarean section; cm=centimeters; kg=kilograms.

DISCUSSION

Ultrasound assessment of uterine scar thickness can serve as a valuable tool in predicting the risk of uterine rupture or dehiscence during labor or in subsequent pregnancies. This can significantly inform clinical decision-making regarding the mode of delivery. Recent studies have shown a significant association between a thin uterine scar, as measured by sonography following a previous CS, and an increased risk of uterine dehiscence or rupture in subsequent deliveries.[7,15,16] However, there were no cases of uterine rupture.

An inter-pregnancy interval of more than 18 months, as demonstrated in this study, was significantly associated with a thicker uterine scar, consistent with findings from

another study.[17] A longer interval allows for adequate vascularization and proper healing of the uterine scar, ultimately enhancing scar integrity. In contrast, a shorter inter-pregnancy interval may result in inadequate vascularization and poor scar healing, which has been linked to significant morbidity, including the development of a caesarean scar niche and adverse perinatal outcomes.[3,18-20]

Women with high parity, multiple previous CS and history of wound infection had a likelihood of having a thin scar on univariate regression analysis. These findings are analogous to other studies.[11-13] On multivariate regression analysis, increased estimated fetal weight and an anterior placental location demonstrated a mild positive relationship with a thin uterine scar. It is expected that macrosomic fetuses may contribute to a thinner uterine scar due to over-distension of the uterus. An anterior placenta overlapping with the uterine scar may create an apparent increase in uterine scar thickness.

It is crucial to note that, factors such as socioeconomic and nutritional status, indication for the previous CS, the surgeon's experience, the type of incision closure and sutures used may have potential residual confounding effect on the uterine scar thickness. However, these variables were not included in this study due to incomplete or missing records.

This study provides valuable insights into the sonographic assessment of uterine scar thickness and its associated factors. These findings contribute to groundwork for developing evidence-based guidelines on the mode of delivery for pregnant women with a previous CS, particularly relevant in an era marked by a rising number of caesarean deliveries. CS has increased morbidity and mortality compared to astutely selected patients for VBAC.[21,22]

The potential implication of this study is that lower uterine segment scar thickness in women with a previous CS can be effectively assessed at term during an obstetric ultrasound. Based on the measured uterine scar thickness, clinical decisions regarding the mode of delivery especially VBAC can be better informed. The limitation of this study was that intraoperative uterine scar thickness assessment which is considered the gold standard was not included to validate sonographic uterine scar thickness assessment due to resource constraints.

CONCLUSION

Uterine scar thickness assessment by sonography in pregnant women with previous cesarean sections can be easily integrated in an obstetric ultrasound. We recommend its routine application, and in combination with risk factors may guide decision on the mode of delivery and help prevent adverse maternal and fetal outcomes.

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