Ultrasonographic assessment of Cesarean Section Scar defect during Pregnancy

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Abstract: Objective: The objective of the study is to assess the value of ultrasonographic assessment of the cesarean section scar defect during pregnancy starting from first trimester till term hoping to reach cut off value for prediction of the scar dehiscence by measuring the niche parameters and the scar thickness. **Conclusion: (1)** The niche dimensions changes over the course of pregnancy in the majority of women. **(2)** The depth of the niche decrease over the course of pregnancy, RMT and LUS thickness get thinner over the course of pregnancy. **(3)** The greater the depth of the niche the smaller the RMT and the greater the risk of CS scar dehiscence. **(4)** The risk of CS scar dehiscence increase, when the thickness of LUS is less than 2.45mm and RMT less than 1.55mm. **(5)** Myometrial thickness is more accurate than full thickness in prediction of CS scar dehiscence, as dehiscence may occur with thick full thickness and thin myometrium.

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Keyword: Ultrasonographic; assessment; Cesarean; Section; Scar; defect; Pregnancy

Introduction

The number of deliveries by cesarean section has been increasing steadily worldwide in recent decades. Although it is often assumed that cesarean section improves neonatal outcomes. There is no hard scientific evidence to support this view. Cesarean section is also associated with long-term risks such as postoperative pelvic adhesions, uterine scar rupture, and placental complication such as placenta previa and accreta. The latter two complications are likely to be associated with poor uterine scar healing following cesarean section. Uterine scar dehiscence may present as an acute event in the antenatal or intrapartumperiod, leading to significant fetal and maternal morbidity. The frequency of uterine rupture is estimated at 0.2-3.8%and that of uterine dehiscence is between 0.6 and 3.8% ***(Ofili-Yebovi et al., 2007)***.

Cesarean scar defect, defined as myometrial discontinuity at site of previous cesarean section scar ***(Fabres et al., 2003)***. The incidence range from 19.4-25% as reported by ***(Ofili-Yebovi et al., 2007).Naji et al., 2012 a***reveled that The incidence of CS scars with an apparent "defect" ranged from 19-69%, and***Pomorski et al. (2016)*** revealed that the niche was found in 67.1% of women.

The word "niche" was introduced by ***Monteagudo et al. (2001)*** she described the "niche" using ultrasound as a triangularanechoic area at the presumed site of CS incision.

The term "niche" refer to a hypoechoic area of varying size within the uterine wall. A cesarean section scar is usually made up of two components: the hypoechoic part (or apparent defect) and scar tissue contained within the residual myometrium. The latter part of the scar can be usefully expressed as the residual myometrial thickness (RMT) ***(Naji et al., 2013)***. To date, the literature has focused on appearance of CS scars defect in the nonpregnant state or on single assessments of scarsizeormorphology ***(Vikhareva Osser and Valentin, 2011)***. Recently, **Naji et al**., studied both the size of the hypoechoic part of CS scar and RMT changes as pregnancy progresses***(Naji et al., 2013)***. And also introduce a standarized approach for imaging and measuring CS scar defect during pregnancy and provided reference values for CS scars dimensions up to the 34th week of gestation ***(Naji et al., 2012b).***

Technique of Evaluating Cesarean Section Scar

Several reports suggested that sonographic methods could be used to evaluate LUS for defects however, very little has been published on sonographic LUS measurement and the technique for measuring the LUS thickness hasn't been standardized. Sonographically the LUS appears as a two layered structure that consists from the urinary bladder inward of the echogenic visceral-parietal reflection, including the muscularis and the mucosa of the urinary bladder (the outer layer), and relatively hypoechoeicmyometrial layer***(Naji et al., 2012b).***

The hypoechoic shadow of the scar seen on the sagittal plane should be followed slowly while switching into the transverse plane of the uterus, it should appear between the hyperechoicuterovesical fold and the myometrial mantle; the caliber of the new shadow obtained represents the length of the scar ***(Naji et al., 2012a).***

In general, there are three layers that can be identified in the lower uterine segment in pregnancy using transvaginal ultrasonography: The chorioamniotic membrane with the decidualized endometrium, the middle muscular layer and the uterovesiacl fold reflection seen as hyperechoic line juxtaposed with the muscularis and mucosa of the bladder ***(Martins et al., 2009).***

Anatomically, an incision is made in the lower uterine segment 2-3cm below the upper edge of the uterovesical fold of the peritoneum. This is especially important when CS is performed at or near full dilatation, when the tendency is to enter the uterus too low, due to the stretched and ballooned out lower segment ***(Patterson-Brown and Lisa, 2009).***

Usually at late gestation the chorioamniotic membrane and the decidualized endometrial layer can't be seen as layers separate from the myometrium. If the fetus is vertex presentation the presenting part may be setting against the LUS, and no amniotic fluid could be seen in between these two structures ***(Cheung et al., 2004).***

Scar Morphology

Scar morphology and dimension have been described in different studies, and different grades of apparent deficiency reported according to the subjective impression by the operator of the filling defect occupied by the scar. However, the experience required to do this is not easy to gain, and so more objective quantification is needed that the CS scar should be measured in three dimension (length, width and depth) both in sagittal andtransverse plane ***(Jastrow et al., 2010).***

Figure (1): Scar defect in the sagittal plane ***(Naji et al., 2012a***)

It was proposed that the measurements of any identifiable CS scar by TV ultrasonography to be taken in three dimension: scar depth and width on sagittal plane and scar length on the transverse plane ***(Naji et al., 2012a).***

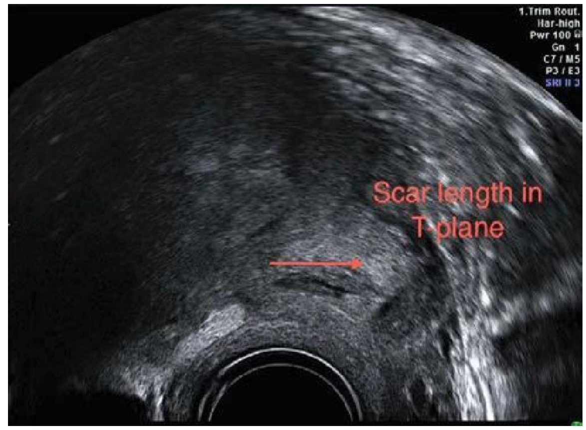

Figure (2): Scar length in the transverse plane (**Naji et al., 2012a)**

TAS is used to measure the entire lower uterine segment while TVS is used to measure the muscular layer, therefore it is more accurate***(Vikhareva Osser et al., 2010).***

Jastrow et al. (2010)also confirmed in their systematic review on sonographic LUS thickness that there is a strong association between LUS measurement in pregnancy and the risk of uterine scar complications. They have proposed that this may serve as a predictor of uterine rupture. However, no cut-off values have been developed and tested, underlining the need of more standardized measurement techniques.

The risk of uterine defect is directly related to the degree of thinning of lower uterine segment between 37 and 40 weeks of pregnancy ***(Sen et al., 2004).***

Uterine dehiscence and rupture

Uterine rupture refers to the complete nonsurgical separation of the uterine wall, resulting in communication between the uterine and peritoneal cavities ***(Cunningham et al., 2005)***.

Although uterine rupture can occur spontaneously or from other uterine scars (i.e., myomectomy, hysteroscopy), cesarean scar is by far the most common cause of uterine rupture. Uterine dehiscence refers to the incomplete separation or thinning of the uterine wall, occurs in an estimated 4% of patients who had prior cesareans, and usually does not result in major clinical problems ***(Chie and Levine, 2006)***.

Because the incidence of uterine rupture is much lower than that of uterine dehiscence, clearly not every thin uterus will rupture. What constitutes clinically important uterine wall thinning and increased risk of uterine rupture has been investigated in several studies, with a wide range of ''safe'' values of LUS thickness, from 1.6 mm or more to 3.5 mm or more ***(Suzuki et al., 2000).***

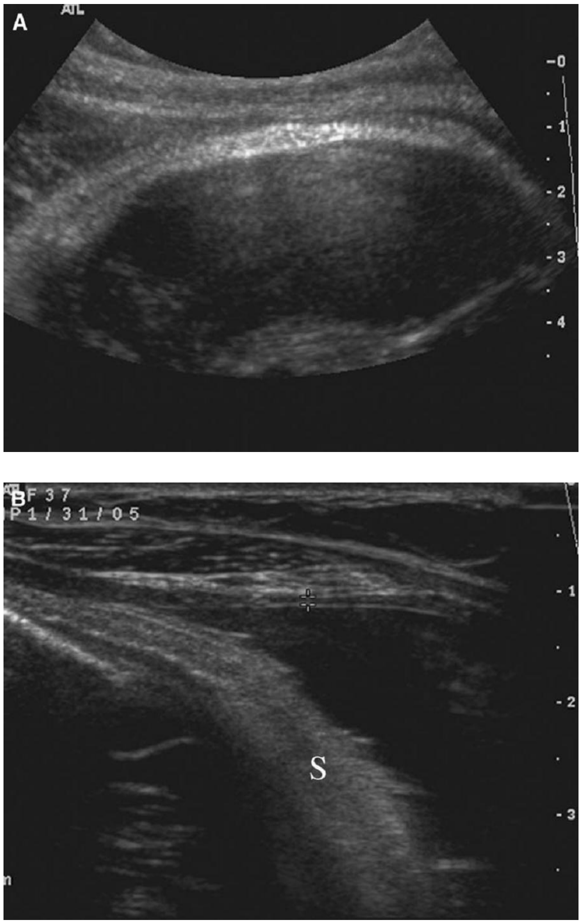

Figure (3): Thin LUS at 32 weeks gestational age. (A) Trans abdominal curvilinear image shows that the myometrium is difficult to measure secondary to pressure from the fetal head on the LUS. (B) Image taken with linear transducer with head slightly away shows thin myometrium (calipers) measuring less than 1 mm. Note the fetal scalp (S) ***(Chie and Levine, 2006)***.

The incidence of uterine dehiscence after a low transverse CS is approximately 1%, whereas the risk of uterine rupture has been reported recently to globally occur in approximately 1:2900 deliveries. Uterine dehiscence most often occurs at time of the repeat cesarean section in an asymptomatic manner. Considering that abnormal LUS thinning (paper-thin LUS) and uterine dehiscence represent risk factors of symptomatic uterine rupture ***(Pollio et al., 2006).***

Routine surveillance of cesarean section scars by ultrasonography during pregnancy has been proposed by some authors, in an attempt to identify silent asymptomatic scar dehiscence ***(Armstrong et al., 2003).***

Aim of the work

The objective of the study is to assess the value of ultrasonographic assessment of the cesarean section scar defect during pregnancy starting from first trimester till term hoping to reach cut off value for prediction of the scar dehiscence by measuring the niche parameters and the scar thickness.

Patients and Methods

This prospective study was carried out on a number of 100 pregnant women with a previous low transverse cesarean section, during the period from June 2015 to August 2016 from those attending the outpatient clinic for antenatal care at AL-Azhar University Hospital (Damietta) & EL-Mahalla General Hospital.

Inclusion criteria:

- Pregnant women with previous cesarean section scar defect seen in early pregnancy.
- Single fetus pregnancy.

Exclusion criteria:

- Previous surgery on the uterus other than cesarean section.
- Multiple pregnancy and fetal congenital anomalies.

Ultrasound Examination:

❖ **Transvaginal Ultrasound examination was performed during first trimester**

Transvaginal ultrasound examination is a highly accurate method for detecting cesarean scar defect***(Armstrong et al., 2003).***

Cesarean section scar defect defined as a triangular hypoechoic filling defect at least 1mm in the anterior wall of the uterus***(Monteagudo et al., 2001).***

A sagittal plane of the lower uterine segment and the cervix was used in order to demonstrate the previous cesarean scar. Maternal bladder was mildly filled. The previous cesarean scar site was defined as a small hypo- echoic line in the anterior wall of the uterus.

Identification of internal os was performed using the following criteria:

1. At the level where there is slight narrowing in the lower uterine segment, between the uterine corpus and the cervix at the lower boundary of the urinarybladder ***(Vikhareva Osser et al., 2009).***
2. The endocervical mucosa can be used to define the cervical canal. The level of internal os appears as a V-shaped notch at the top of the canal, before reaching the thickened lower uterine segment ***(Naji et al., 2012a).***
3. The uterovesical fold (UV fold) should be clearly visible as a hyperechoic line between the bladder interface and the endocervical canal.

The internal os is generally at the level of the uterine arteries***(Naji et al., 2012a)***.

Applying the above methods, the CS scar should be well delineated as a hypoechoic indentation at the anterior wall of lower uterine segment lies between the uterovesical fold and the internal cervical os ***(Naji et al., 2012a).***

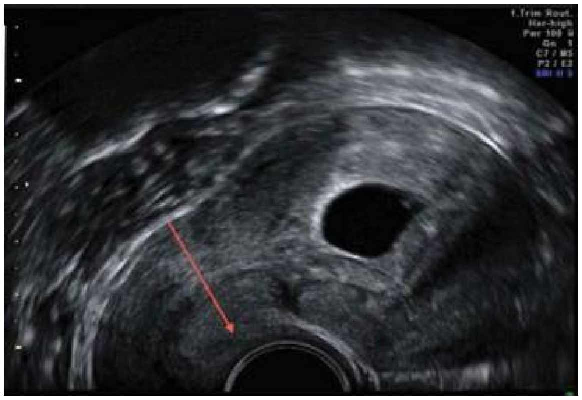

Figure (4): LSCS scar above the internal os***(Naji et al., 2012a)***

Transabdominal ultrasound examination was repeated every 4 weeks during pregnancy till term and the minimum measurements of the niche parameters was recorded for each trimester and also for the LUS thickness.

Abdominal ultrasound was done for full obstetric assessment to confirm gestational age, fetal lie, presentation and placental position stressing on its relation to previous scar and also to evaluate the LUS thickness between 20-36 weeks of gestation with full bladder.

The depth (D) and width (W) of the niche and residual myometrial thickness (RMT) were also measured at 11-16, 20-28and 32-36 weeks of gestation.

On ultrasound, the lower uterine segment appeared as three layered structure: the chorioamnioitic membrane with a decidualized endometrium, middle layer of myometrium and the uterovesical peritoneal reflection juxtaposed to the muscularis and the mucosa of the bladder ***(Martins et al., 2009).***

The definition of the niche used in this study was "any indentation representing myometrial discontinuity at the site of the scar***(Bij de Vaate et al., 2014).***

The scar was identified in the sagittal transection of the uterus. The residual myometrial thickness (RMT) was defined as the distance between the tip of the hypoechoic triangle and the surface of the anterior uterine wall. Thus, RMT represents the thickness of the myometrial layer at the site of hysterotomy ***(Pomorski et al., 2014).***

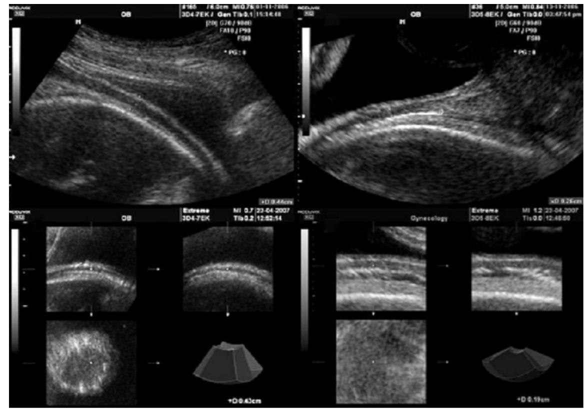

Figure (5): Images demonstrating measurement of the entire thickness of the lower uterine segment (LUS) by transabdominal two-dimensional (a) and three-dimensional (c) ultrasound, and of the muscular layer of the LUS by tranvaginal two-dimensional (b) and three-dimensional (d) ultrasound ***(Martins et al., 2009).***

The depth of the hypoechoic triangle (D) was defined as the distance between the surfaces of the endometrial/endocervical layer of the anterior uterine wall to the tip of the hypoechoic triangle. The width (W) was defined as the distance between the proximal and distal parts of the myometrium of the anterior uterine wall measured at the surface of the endometrium/endocervix of the posterior uterine wall ***(Pomorski et al., 2014)***.

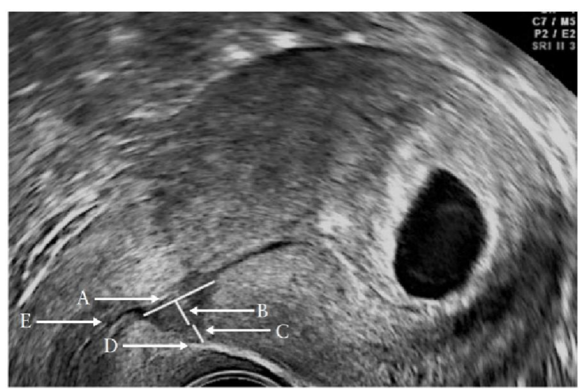

Figure (6): Sagittal ultrasound image showing anatomical location of features measured to quantify size of component parts of a Cesarean section scar using transvaginalsonography in first trimester of pregnancy. A, width of hypoechoic part; B, depth of hypoechoic part; C, residual myometrial thickness; D, uterovesical fold; E, internal cervical os ***(Naji et al., 2013).***

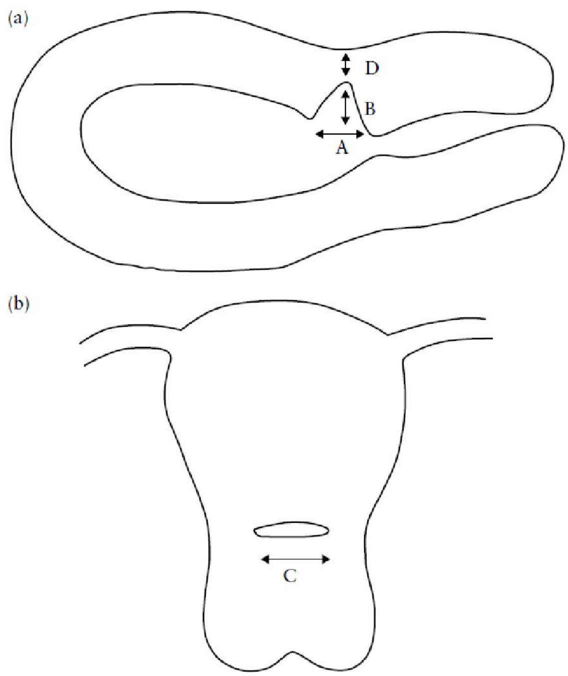

Figure (7): Schematic diagram showing Cesarean scar dimensions in sagittal (a) and transverse (b) planes. A, width of hypoechoic part of scar (apparent 'defect') in sagittal plane; B, depth of hypoechoic part of scar (apparent 'defect') in sagittal plane; C, length of hypoechoic part of scar (apparent 'defect') in transverse plane; D, residual myometrial thickness in sagittal plane ***(Naji et al.,2012a).***

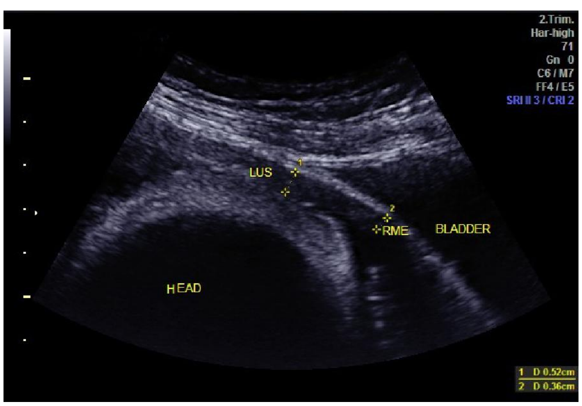

Figure (8): LUS thickness and RMT at 38 week of gestation.

Statistical analysis

Data were analyzed with **SPSS** version 21. The normality of data was first tested with one-sample Kolmogorov-Smirnov test.

Qualitative data were described using number and percent. Association between categorical variables was tested using Chi-square test.

Continuous variables were presented as mean ± SD (standard deviation). The two groups were compared with Student ***t*** test.

Pearson correlation used to correlate continuous data. Sensitivity and specificity at different cut off point tested by ROC curve.

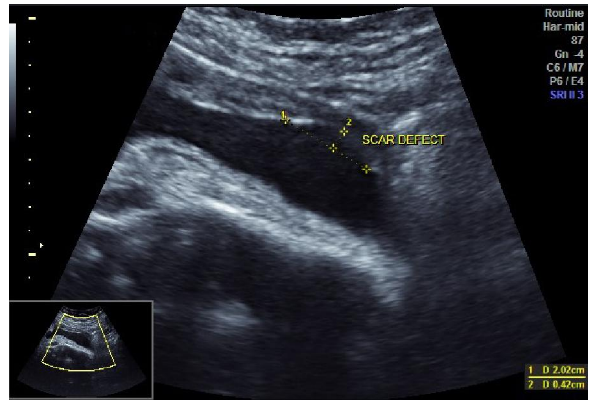

Figure (9): Cesarean section scar defect depth and width at 36 week of gestation.

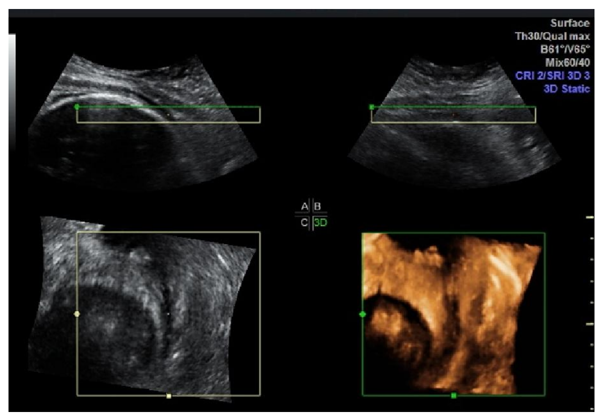

Figure (10): Dehiscent scar at 37 week of gestation.

Level of significance:

For all above mentioned statistical tests done, the threshold of significance is fixed at 5% level (p-value).

The results was considered:

- Non-significant when the probability of error is more than 5% (P > 0.05).
- Significant when the probability of error is less than 5% (P ≤ 0.05).
- Highly significant when the probability of error is less than 0.1% (P≤ 0.001).

The smaller the P-value obtained, the more significant are the results.

Results

Mean maternal age was 28 years, mean gravidity was 3, mean parity was 2 and mean number of CS was 2.

The mean depth of CS scar defect in 1st, 2nd and 3rd trimester was (3.3, 1.9 and.88mm) respectively, the mean RMT in 1st, 2nd and 3rd trimester was (4.3, 3.3 and 2.4mm) respectively, the mean LUS thickness in 2ndand 3rd trimester was (5.1and 3.2mm) respectively and the mean width of CS scar defect in 1st, 2nd and 3rd trimester was (3.8, 4.7and 5.7mm) respectively.

Table 1): Changes in niche dimensions and LUS thickness measured during pregnancy.

Items	1st trimester	2nd trimester	3rdtrimester	Paired t-test	p-value
Depth	3.33 ±.68	1.99 ±.51	0.88 ±.40	t1=33.8t2=37.4t3=26.8	P1≤.001**P2≤.001**P3≤.001**
width	3.81 ±.44	4.79 ± 0.50	5.77 ±.51	t1=56.8t2= 74.5t3=45.1	P1≤.001**P2≤.001**P3≤.001**
LUS	-	5.14 ± 1.06	3.28 ±.72	t=25.7	P3≤.001**
RMT	4.39±.93	3.38±.91	2.45±.77	t1=50.2t2=52.1t3=26.6	P1≤.001**P2≤.001**P3≤.001**

P1comparison between 1st trimester and 2nd trimester
P2comparison between 1st trimester and 3rd trimester
P3 comparison between 2nd trimester and 3rd trimester

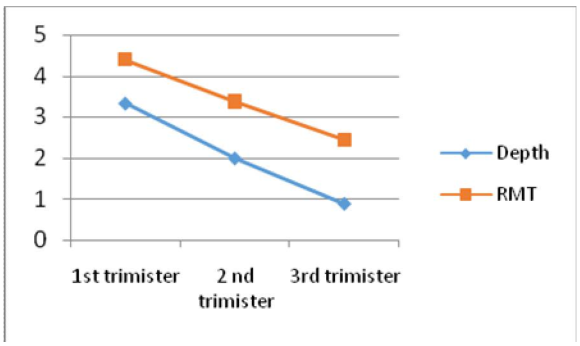

Figure (11): Changes in mean depth of the niche and RMT during pregnancy

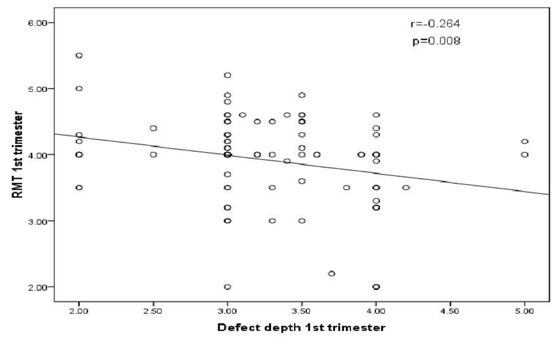

Figure (14): Correlation between depth of the niche and RMT in 1st trimester.

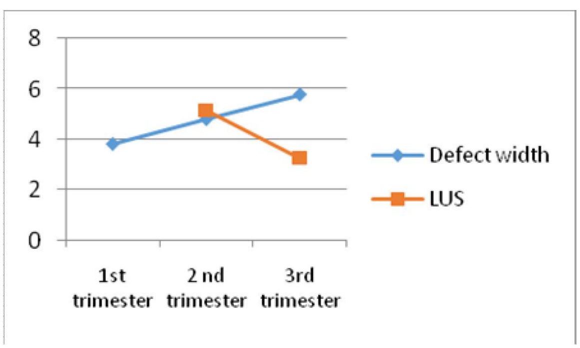

Figure (12): Change in mean width of the niche and LUS thickness during pregnancy.

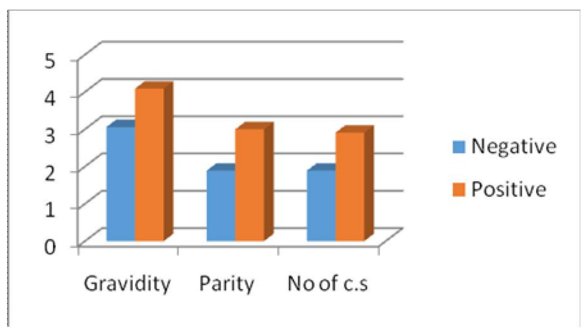

Figure (15): Relation between CS scar dehiscence and obstetric data.

Table (3): Correlation between depth of the niche and RMT in each trimester.

RMT	Depth					
	1st		2nd		3rd	
	r	P	r	P	r	P
1st trimester	-0.264	0.008*	-	-	-	-
2nd trimester	-	-	-0.197	0.05*	-	-
3rd trimester	-	-	-	-	-0.308	0.002*

Table (4): Correlation between number of CS and other parameters

	No of CS	
	r	**P**
Depth	0.181	0.002*
RMT	-0.296	<0.001**
LUS	-0.171	0.015*
width	0.315	<0.001**

Table (5): Correlation between parity and other parameters

	Parity	
	r	**P**
Depth	0.173	<0.001**
RMT	-0.30	<0.001**
LUS	-0.178	0.012*
width	0.312	<0.001**

**: Highly significant at P<0.001*statistically significant at P ≤ 0.05

Table (6): Relation between CS scar dehiscence and obstetric data

Items	Dehiscence		t	P
	Negative (N=89)	**Positive (N=11)**		
Age	27.94 ± 2.26	29.00 ± 1.18	2.457	0.023*
Gravidity	3.06 ± 0.86	4.09 ± 0.70	3.841	<0.001**
Parity	1.89 ± 0.75	3.00 ± 0.77	4.651	<0.001**
No of CS	1.89 ± 0.75	2.91 ± 0.70	4.314	<0.001**

Data expressed as Mean ± SD t: Student ***t*** test*: Statistically significant at P ≤ 0.05**: Highly significant at P < 0.001

Table (7): Relation between CS scar dehiscence and depth of the niche measured in 3rd trimester.

Items	Dehiscence		t	P
	Negative (N=89)	**Positive (N=11)**		
Depth 3rd	0.86 ± 0.42	1.02 ± 0.20	2.045	0.053

Data expressed as Mean ± SD t: Student ***t*** test*statistically significant at P ≤ 0.05

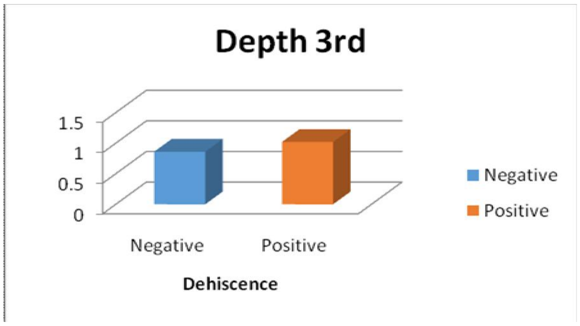

Figure (16): Relation between depth of the niche measured in 3rd trimester and CS scar dehiscence.

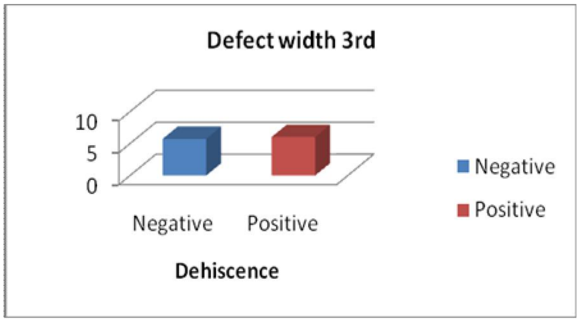

Figure (17): Relation between CS scar dehiscence and width of the niche measured in 3rd trimester.

Table (8): Relation between CS scar dehiscence and width of the niche measured in 3rd trimester.

Items	Dehiscence		t	P
	Negative (N=89)	**Positive (N=11)**		
Defect width 3rd	5.74±0.50	6.02±0.56	1.687	0.095

Table (9): Relation between CS scar dehiscence and RMT measured in 3rd trimester

Items	Dehiscence		t	P
	Negative (N=89)	Positive (N=11)		
RMT 3rd	2.67 ± 0.45	0.65 ± 0.18	28.076	<0.001**

Data expressed as Mean ± SD t: Student ***t*** test**: Highly significant at P < 0.001

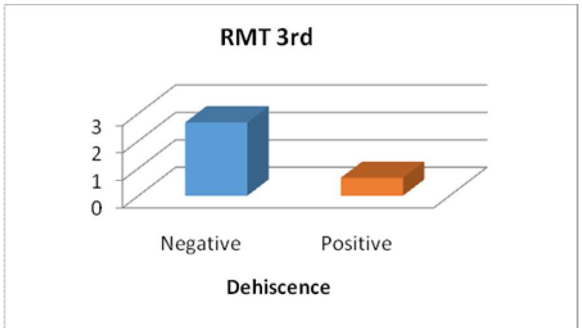

Figure (18): Relation between RMT measured in 3rd trimester and CS scar dehiscence.

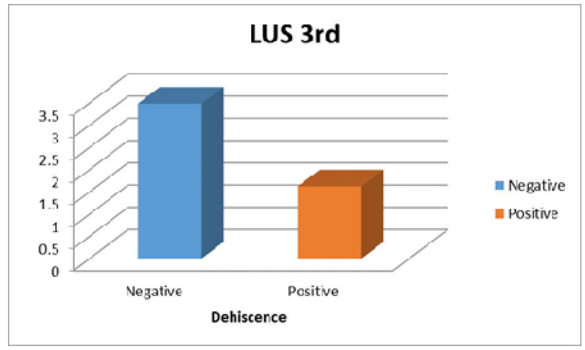

Figure (19): Relation between CS scar dehiscence and LUS thickness measured in 3rd trimester.

Table (10): Relation between CS scar dehiscence and LUS measured in 3rd trimester

Items	Dehiscence		t	P
	Negative (N=89)	Positive (N=11)		
LUS 3rd	3.48 ± 0.44	1.62 ± 0.28	13.640	<0.001**

Table (11): Relation between full LUS thickness/RMT ratio, Depth/ RMT ratio and CS scar dehiscence.

Items	Dehiscence		t	P
	Negative (N=89)	Positive (N=11)		
LUS/RMT Ratio 3rd	1.32 ± 0.19	2.59 ± 0.44	9.438	<0.001**
Depth/RMT Ratio3rd	0.34 ± 0.20	1.66 ± 0.51	8.550	<0.001**

Data expressed as Mean ± SD t: Student ***t*** test**: Highly significant at P < 0.001

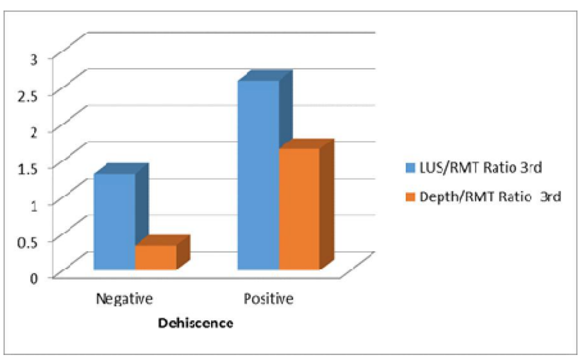

Figure (20): Relation between full LUS thickness/RMT ratio, Depth/RMT ratio and CS scar dehiscence.

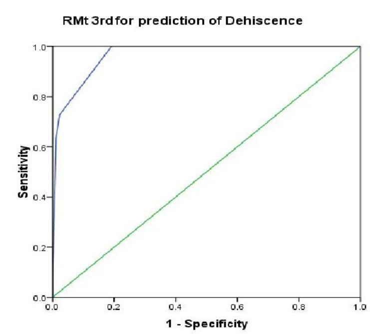

Figure (21): Receiver operating characteristic curve compares the sensitivity and specificity of RMT for prediction of CS scar dehiscence.

Table (12): RMT for prediction of CS scar dehiscence in 3rd trimester.

Item	AUC	P-value	Cutoff point	Sensitivity	Specificity	PPV	NPV	Accuracy
RMT	0.966	<0.001*	1.55	90.9%	86.5%	45.5%	98.7%	87%

*PPV= positive predictive value; * NPV= negative predictive value

Table (13): Full LUS thickness for prediction of CS scar dehiscence in 3rd trimester.

Item	AUC	P-value	Cutoff point	Sensitivity	Specificity	PPV	NPV	Accuracy
LUS	0.978	<0.001*	2.45	81.8%	93.3%	60%	97.6%	92%

*PPV= positive predictive value;*NPV= negative predictive value

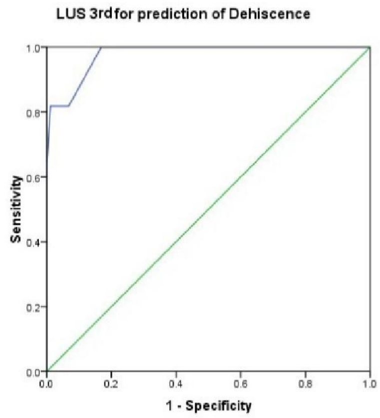

Figure (22): Receiver operating characteristic curve compares the sensitivity and specificity of full LUS thickness for prediction of CS scar dehiscence.

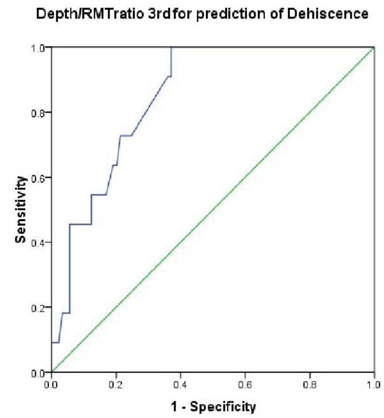

Figure (23): Receiver operating characteristic curve compares the sensitivity and specificity of depth /RMT ratio for prediction of CS scar dehiscence.

Table (14): Depth/RMT ratio for prediction of CS scar dehiscence in 3rd trimester.

Item	AUC	P-value	Cutoff point	Sensitivity	Specificity	PPV	NPV	Accuracy
Depth/ RMT ratio	.847	<0.001*	0.47	90.9%	63%	23%	98.2%	66%
			0.775	54.5%	87.5%	35.3%	94%	84%

*PPV= positive predictive value;*NPV= negative predictive value

4. Discussion

The increasing rate of CS and its complications has awakened an interest in CS scars. Cesarean scar defects (CSDs), was considered as deficient uterine scars or scar dehiscence following a cesarean section, involve myometrial discontinuity at the site of a previous cesarean section scar ***(Klemm et al., 2005).***

In the last several years, there has been an expansion of knowledge of long term complicationrelated to the presence of a CS scar in the uterus, such as a cesarean scar pregnancy, morbidly adherent placenta, and CS scar dehiscence or rupture***(Timor-Tritsch and Monteagudo, 2012; Valentin, 2013).***

The risk of occurrence of scar related complications seems to depend on the scar morphology and primarily on the presence of a niche in the CS scar***(van der Voet et al., 2013; Pomorski et al., 2014).***

It is not known whether defects in cesarean section scars that are visible at transvaginal ultrasound examination of nonpregnant women are associated with a higher risk of these complication than apparently intact scars ***(Fukuda et al., 1991).***

Thinning of lower uterine segment (LUS) is considered to be a result of stretching on a portion of LUS caused by the gestation itself, which does not occur in the scarred tissue. Scarred tissue is rigid and dose not stretch ***(Rozenberg et al., 1996).***

In a uterus with disturbed healing, the LUS may become extremely thin during gestation ***(Fukuda et al., 1991).*** Thus the quality and integrity of LUS can be evaluated by LUS thickness.

This study showed that there was significant decrease in mean depth of the niche from 3.33mm in 1st trimester to 0.88mm in 3rd trimester of pregnancy (P≤0.001) by average 2.3mm per trimester, while there was significant increase in mean width of the niche from 3.81mm in 1st trimester to 5.77 mm in 3rd trimester (P≤0.001) by average 1.96 mm and significant decrease in mean RMT from 4.39 mm in 1st trimester to 2.45 in 3rd trimester (P≤.001) by average 1.89mm per trimester.

Naji et al. (2013)reported that scar changes over time showed an average increase of 1.8 mm in the width of hypoechoic part of the scar per trimester, depth of the hypoechoic part decreased over time with average decrease of 1.8mm per trimester and RMT decreased by average 1.1mm per trimester.

Fukuda et al. (2016) in their study showed that there is a strong inverse relationship between LUS thickness and gestational age at ultrasound (P>0.001). The mean thickness at 16 weeks' gestation was 5.2±1.6mm and at 40 weeks 'gestation was 2.3±0.6mm.

In this study there was significant decrease in mean LUS thickness from 5.14 mm in 2nd trimester to 3.28 mm in 3rd trimester (P≤0.001) on average decrease 1.43mm per trimester.

Scar dehiscence was defined as a separation of the muscular layer with an intact serosa ***(Asakura et al., 2000)***.

There was highly significant relation between mean gravidity, parity and number of CS and occurrence of CS scar dehiscence (P<0.001) positive dehiscence associated with higher values.

Pomorski et al. (2014) who done there study on 41non pregnant women with history of low transverse CS 6 weeks after CS, they noted that there was a very low level of correlation between the incidence of CS scar dehiscence and the number of CSs.

This study showed that the relation between mean depth of the niche measured in 3rd trimester and occurrence of CS scar dehiscence was not significant (P=0.053), although the mean depth of the niche was greater in positive dehiscence. While there was highly significant relation between mean RMT measured in 3rd trimester and occurrence of CS scar dehiscence (P<0.001), the positive dehiscence associated with smaller thickness than non-dehiscence, the mean RMT was 0.65mm in positive women and 2.67mm in negative women, with highly significant relation between mean LUS thickness measured in 3rd trimester and occurrence of CS scar dehiscence (P<0.001). Positive dehiscence associated with smaller thickness than non- dehiscence mean thickness of LUS in positive women was 1.62 mm while it was 3.4 mm in negative women.

Fukuda et al. (2016) they observed strong correlation between the LUS thickness evaluated using ultrasound before CS and the grade of uterine scar dehiscence, ranging from 2.2mm in women without scar dehiscence to1.0mm in women with scar dehiscence and they concluded that the myometrial thickness of less than 1.2mm would predict a high risk of scar dehiscence.

In study by ***Vikhareva Osser and Valentin (2011)*** of women who delivered by CS, uterine dehiscence was found significantly less often in women with a scar with a small defect (5.3%) compared to women with scars with a large defect (42.9%). The scar categorized as large or small based on thickness of RMT, in women who only underwent unenhanced ultrasound examination a scar defect was defined as large if the RMT was <2.2mm ***(Vikhareva Osser et al., 2009).***

In this study we calculated ratio between full LUS thickness and RMT (LUS/RMT) and there was highly significant relation between mean LUS/RMT ratio and occurrence of CS scar dehiscence (P<0.001), the mean LUS/RMT ratio was 2.59 in positive dehiscence while in negative was 1.32 it mean that the higher the ratio, the greater the risk of CS scar dehiscence, in other word the smaller was the RMT the greater the risk of CS scar dehiscence.

And also we calculated ratio between the depth of the niche and RMT (D/RMT) and we find that there was highly significant relation between mean D/RMT ratio in 3rd trimester and occurrence of CS scar dehiscence (P<0.001), the mean D/RMT ratio positive dehiscence was 1.66 and in negative was 0.34.

Pomorski et al. (2014) showed the correlation between the risk of dehiscence and CS scar defect parameters. There was a significant correlation (0.60) between occurrence of scar dehiscence and the D/RMT ratio with P- value 0.007. Thus, the higher the D/RMT ratio the greater the likelihood of CS scar dehiscence.

They concluded that the only parameter that is useful for prediction of scar dehiscence was D/RMT ratio. In other words, the bigger the depth of the niche (D) and the smaller the thickness of RMT, the greater the risk of CS scar dehiscence. And there is one possible explanation for the usefulness of D/RMT ratio is that only the D and RMT values together represent the entire thickness of the uterine wall at the site of the scar***(Pomorski et al., 2014).***

In this study there was significant negative correlation between mean RMT and mean depth of the niche measured in 1st,2nd and 3rd trimester (P=.008,.05 and.002) respectively, it mean that the greater was the depth of the niche the smaller was the RMT.

This study showed that there was significant positive correlation between mean width (P<0.001), mean depth of the niche (P=0.002) and number of CS, it mean that history of multiple CSs associated with increase in niche dimensions (depth and width). And significant negative correlation between mean RMT (P<0.001), LUS thickness (P=0.015) and number of CS. Women with history of multiple CSs associated with smaller RMT and LUS thickness.

Taisser et al. (2012) defect depth and width showed statistical significant increase in patients with history of2 or more CS and RMT showed statistical significant increase among patients had one versus those had two or more previous CS (P=.02,.007,.04), respectively this study was done on non- pregnant women. Cases with history of multiple cesarean sections was associated with increased width and depth of cesarean section scar defect as repeated trauma to a wound can disrupt the normal healing process.

Zimmer et al. (2007) found that the RMT value were significantly smaller in women with a history of 3CSs, when compared to women with history of 1or 2CSs. Ultrasound scan was done on non -pregnant women.

Despite difference in the population and methodology, all of the aforementioned studies, including ours, found that a pre-existing CS scar may negatively influence the healing of a new cesarean uterine incision. This may be a result of decreased vascular perfusion and oxygenation in the scar tissue ***(Lofrumento et al., 2016)***.

This study showed that there was highly significant positive correlation between mean width, mean depth of the niche (P<0.001) and parity while there was significant negative correlation between mean RMT (P<0.001), LUS thickness (P=0.012) and parity, The increase in parity is associated with larger defects, this is in agreement with ***(Ofili-Yebovi et al., 2007)***.

In this study we reached critical cut-off point of RMT for prediction of CS scar dehiscence which was 1.55mm derived from the ROC curve with sensitivity, specificity, PPV, NPV of 90.9%, 86.5%, 45.5% and 98.7%, respectively. Accuracy of these method was 87%.

Fukuda et al. (2016) in their study they observed a cut-off value 1.2mm for LUS myometrial thickness could predict thin LUS and complete dehiscence without false positive results (both sensitivity and specificity was 100%), whereas a cut-off value 0.7mm could predict complete dehiscence without false positive results.

Kok et al. (2013) showed that a full LUS thickness cut-offs between 2.0 and 3.0mm with sensitivity and specificity of 0.61 and.91; cut-offs between 3.1and 5.1mm reached a sensitivity and specificity of 0.96 and 0.63 and had a strong negative predictive value for prediction of dehiscence and rupture. The sensitivity and specificity of myometrial LUS thickness for cut offs between 0.6and 2.0mm was 0.76 and 0.92; cut off between 2.1and 4.0mm reached a sensitivity and specificity of 0.94 and 0.64 which had strong positive predictive value for dehiscence.

This study showed that the critical cut-off point of full LUS thickness for prediction of CS scar dehiscence was 2.45mm derived from the ROC curve with sensitivity, specificity, PPV, NPV of 81.8%, 93.3%, 60%, and 97%, respectively. Accuracy of this method was 92%.

Uharček et al. (2015) found that 2.5mm was considered the critical cut off value of LUS thickness with sensitivity 90.9% specificity 84% and it is correlated with translucent LUS measured by trans-abdominal US between 38-40 weeks， ation between width, depth of the niche and maternal age.

Rozenberg et al. (1996) indicated that the risk of uterine rupture in the presence of a defective scar was related directly to the degree of thinning of the lower uterine segment as measured by transabdominal ultrasonography at or near 37 weeks gestation. In particular, they demonstrated that this risk increased significantly when the thickness was 3.5mm or less. The use of this cut-off value showed an excellent sensitivity 88.0%, with a negative predictive value of 99.3%.

In these study we reached a cut-off point of depth / RMT ratio for prediction of CS scardehiscence it was.47 derived from the ROC curve with sensitivity, specificity, PPV, NPV of 90.9%, 63%, 23%, 98.2%, respectively. Accuracy of this method was 66%. And with cut-off point.77 with sensitivity, specificity, PPV, NPV of 54.5%, 87.5%, 35.3%, 94%, respectively. Accuracy of this method was 84%.

Pomorski et al. (2014)shows that the threshold value for the D/RMT is 0.785. When the D/RMT ratio is greater than 0.785, there was dehiscence when the ratio was lower there was no dehiscence. With sensitivity 71% and specificity 94%. An increase in D/RMT ratio of.01 increase the chance of dehiscence by 30%. D/RMT value greater than 1.3035 indicates that the likelihood of dehiscence is greater than 50%. Therefore D/RMT value greater than 1.3035 can be consider the first diagnostic criterion for occurrence of CS scar dehiscence. The sensitivity of this method is 57%, and specificity is 97%.

The myometrial part of the scar can give us information about scar integrity only when we also assess the dimensions of the hypoechoic part of the scar. The proposed cut-off values indicating high risk of CS scar dehiscence are characterized by high specificity and sensitivity ***(Pomorski et al., 2014).***

Recommendations

We suggest performing a careful ultrasound scan for all women diagnosed to have CS scar defect, and measure its dimensions and lower uterine segment in order to detect which patient is at high risk during pregnancy. And we recommended further studies on CS scar defect with increase size of studied group to have more information about it.

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