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Lower Uterine Segment Thickness Measurement and Uterine Scar Integrity in Pregnant Women with Prior Cesarean Section Using Two-Dimensional Transabdominal Ultrasound

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Abstract

Background: The number of repeated C.S. is steadily increasing, so the risks are suggested to increase. Measurement of the lower uterine thickness (LUS) close to term is an efficient method for prediction of the scar defect and avoiding uterine rupture.

Aim of Study: To determine the normal range of the LUS thickness in pregnant women without prior C.S. near term pregnancy. To evaluate the relationship between the LUS thickness in pregnant women near term with prior one or more C.S. and the occurrence of uterine rupture or scar dehiscence.

Patients and Methods: One hundred pregnant women close to term (36 weeks of gestation or more) with prior at least one C. S. (selected cases) and another one hundred women with prior one or more vaginal deliveries (control group) were enrolled in this prospective controlled and follow-up study in Damanhour General Hospital. All the cases were assessed for entire LUS thickness by two dimensional transabdominal ultrasound. The study was carried outduring the period from 6/2020 to 11/2021. The selected cases were followed-up for the scar condition during their deliveries by repeated C.S. After collection of the data in Exile sheets, they were tabulated andstatistically evaluated and analyzed.

Results: The LUS thickness for the controlled group was found 4.1 ± 1.0mm. with mode equal 4.0mm, while for the selected group it was found 3.2 ±0.897mm. with mode equal 3.5mm. The study had showed that the increased time since last C.S. in years is a significantly independent protective factor for scar dehiscence (p=0.038). The cut-off point for LUS thickness as a predictor for scar dehiscence was found <3.6mm (p=0.002) with sensitivity 80% and specificity 51% and 95% confidence interval (CI).

Conclusion: Pregnant women with prior C.S. whose LUS thickness was found <3.6mm had to avoid trial for vaginal delivery (VBAC) and to arrange for delivery at shorter gestational age.

Recommendations: Are to advise to prolong the time elapsed since the last C.S. as the increased time since last C.S. had been found significantly an independent protective factor for scar dehiscence.

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Key Words: *Cesarean section (C.S.) – Rupture uterus – Dehiscent scar – Lower uterine segment (LUS) – Transabdominal sonography (T.A. U/S).*

Introduction

CESAREAN section (C.S.) is the most common and well established obstetrical operation worldwide. The adoption of continuous fetal monitoring in the early 1970s contributed to increase in the C.S. rate, resulting in non-progressive labor and suspected fetal distress to become the most common indications for C.S., [1], also there is an increase in number of C.S. on demand and the repeated C.S. [2] reported that there is a significant relationship between the transabdominal sonographic measurement of the entire LUS thickness in pregnant women near term who had previous C.S. and the risk of uterine rupture or scar dehiscence. They also considered the LUS thickness an appropriate predictor of dehiscent scars and shorter gestational age in pregnant women with previous C.S. in subsequent pregnancies. The normal LUS appears as a two-layer structure; a hyperechoic layer representing the bladder wall and a less echogenic layer representing the myometrium, [2]. The present study was designed to improve the experience of the staff to detect the optimumtime to perform the repeated C.S. according to LUS thickness measurement by two-dimensional transabdominal ultrasound in the third trimester of pregnancy.

Patients and Methods

Study design:

One hundred pregnant women close to term (36 weeks of gestation or more) with prior at least one C.S. (selected group) and another one hundred women with prior one or more vaginal deliveries (control group) were enrolled in a prospective controlled follow-up study in Damanhour general Hospital during the period from 6/2020 to 11/2021.

All the women were assessed for the entire LUS thickness by two-dimensional transabdominal ultrasound by the same Radiologist in Radiology Department of the hospital. The selected group was followed-up for the scar condition during their deliveries by repeated C.S. Inclusion criteria of the selected group included: One hundred women having single fetus, at 36 weeks of gestation or more, cephalic presentation, with prior one or more C.S. were enrolled in the study. Another one hundred women having single fetus and has no history of C.S. before were recruited as a control group. The study has been approved by the Department of Ethical Committee of the Hospital and Informed consent was fulfilled for every woman participated in the study. Criteria of exclusion were: Multiple pregnancies, placenta anterior and low lying, Diabetic women and those having fetus >4kg. Also, women with placenta accreta and those with history of rupture uterus were excluded. Women who had history of vertical C.S. and those who refused to share in the study were of course excluded. Ultrasound evaluation and follow-up: Transabdominal ultrasonography was performed in the supine position and the woman having moderately filled bladder using two-dimensional ultrasound with convex transducer of frequency 3-5 MHZ in the Radiology Department of the hospital. The examination was done by the same Radiologist for all women. The entire LUS thickness was measured in sagittal section under magnification to localize the thinnest zone. Measurements were obtained at the bladder wall-myometrium interface. The entire LUS thickness was measured as the distance from the posterior bladder wall interface to the uterine amniotic fluid-wall interface (the entire LUS thickness) [3]. The selected women with prior C.S. were followed-up during delivery by repeated C.S. for the scar condition.

Statistical analysis: The data were collected in Exile sheets. The data were tabulated and statistically analyzed by an IBM compatible personal computer with SPSS Statistical Package Version 26.

Two types of statistics were used: (A) Descriptive statistics: Mean and standarddeviation (SD) and modefor quantitative data. (B) Analytic statistics:

1- Student"s *t*-test (*t*); is a test of significance used for comparison of quantitative variables between two groups of normally distributed data, while Mann-Whitney's test (U) for comparison of quantitative variables between two groups of not normally distributed data.
2- Kruskal-Wallistest (non-parametric test); was used for comparison between more than two groups not normally distributed having quantitative variables.
3- Tamhane test is used for Post Hoc analysis. For Probability of error: p-value <0.05 was considered significant.
4- Receiver Operator Characteristic (ROC) curves with the Area Under the CURVE (AUC); was used to determine the optimal cut-off for LUS thickness as a predictor of scar dehiscence.
5- Sensitivity: Is the ability of the test to correctly identify those who have the disease.
6- Specificity: Is the ability of the test to correctly identify those who do not have the disease.
7- Multivariate Logistic regression model; was used to detect predictors of scar dehiscence.

Results

For the selected group; the age in years was 29.55±5.2 years; most of them were around 30 years. The parity was of mean 2.32±1.27, the mode was 1 and 2 (bimodal). The gestational age in weeks was 37.5±1.35 and mode was 38 weeks. The estimated fetal weight in grams was 3142 ± 462.9, with mode of 3500 grams. The time elapsed since last C.S. in years was 4±2.23, with mode 4 years. The lower segment thickness in millimeter (mm) was 3.2±0.897 and mode 3.5mm for the selected group (Table 1). As for the control group: the mean age in years was 31.38±5.6 years, with mode 32 years. The parity was 2.83±1.34 with mode 2. The gestational age in weeks was 38.28 ±2.03, with mode 40 weeks. The estimated fetal weight in grams was 3215.5±546.2 with mode 3000 grams. The time elapsed since last delivery in years was 4.5±2.4 and mode 3 and 5 (bimodal). The lower segment thickness in millimeter (mm) for the control group was 4.1±1 and mode 4mm. (Table 1).

Correlation between L US thickness and multiple variants:

The study has showed that there was a significant negative relationship between LUS thickness and the risk of uterine scar dehiscence in all the studied groups (p<0.001 - Table 2). As regard to the maternal age in years, we found a significant negative relationship with LUS thickness at age group 20-25 years (p=0.04 - Table 3). We found a significant positive relationship between the gestational age (G.A.) in weeks and the risk of dehiscence of uterine scar in group 39-40 weeks (p=0.044 - Table 4). As regard the parity, we have found positive significant association between the

number of deliveries and the risk of dehiscent uterine scar at the group of two deliveries (p=0.036 Table 5). As for the time elapsed since the last delivery in years, we have found insignificant increase in the risk of scar dehiscence when the time elapsed was <1 year (p=0.844) and in group of >4 years (p=0.062), but significant increase in the riskwas found in the group 1.1-2.0 years (p= 0.006) andin group 3.1-4 years (p=0.094 - Table 6). As regard the amniotic fluid volume (AFV), there was a significant positive association between LUS thickness and average amniotic fluid volume group (p=0.001) and no case of dehiscent scar was reported with oligohydramnios (Table 7). As regard the estimated fetal weight in grams (EFW), we have found a significant increased risk of scar dehiscence in group 3001-3500 grams (p=0.014). There was also an insignificant increase in the risk in the group of 3501-4000 grams (p=0.211) and there was no risk in the group of >4000 grams (Table 8). The study has showed that the increased time elapsed since the last C.S. in years was an independent protective factor for scar dehiscence (p=0.038, confidence interval (CI) = 0.444-0.978 and Odd ratio = 0.659 (Table 10). The cut-off value for LUS thickness as a predictor of scar dehiscence was found <3.6mm. (p=0.002) with sensitivity 80% and specificity 51% and 95% CI (Table 9).

Table (10) showed that the increased time since the last cesarean section (years) is an independent protective factor for scar dehiscence (Odds ratio =0.659, CI=0.444-0.978).

Table (1): Comparison of characters of control and selected groups.

Variables	Control	Cases	p-value
Age (years):			
Range	16-43	18-42	0.018
Mean ± SD	31.38±5.6	29.55± 5.2	
Mode	32	30	
Parity:			
Range	1-8	1-6	0.004
Mean ± SD	2.83±1.34	2.32±1.27	
Mode	2	1 and 2 (bimodal)	
Gestational age (weeks):			
Range	30-42	34-40	0.003
Mean ± SD	38.28-2.03	37.5±1.35	
Mode	40	38	
Estimated fetal weight (grams):			
Range	1400-4500	2100-4500	0.126
Mean ± SD	3215.5-546.2	3142±462.9	
Mode	3000	3500	
Lower segment thickness (mm):			
Range	2-8	0.8-5	<0.001
Mean ± SD	4.1± 1	3.2±0.897	
Mode	4	3.5	
Time elapsed since last delivery (years):			
Range	1-12	0.5-14	0.195
Mean ± SD	4.5±2.4	4±2.23	
Mode	3 and 5 (bimodal)	4	

Table (2): Comparison of lower uterine thickness mean ± SD (mm) in the studied groups.

LUS thickness	Dehiscent scar (n=15)	Intact scar (n=85)	Control group (n=100)	p-value
Mean ± SD	2.78±0.94	3.3±0.86	4.1±1	<0.001
Range	0.8-4	0.8-5	2-8	Tamhane test
				p_1=0.160
				p_2<0.001
				p_3<0.001

p1 between Dehiscent scar group and Intact scar group.
p2 between Dehiscent scar group and control group.
p3 between intact scar group and control group.

Table (3): Association between LUS thickness mean ± SD (mm) and maternal age (years) in the different studied groups.

Age (years)	Dehiscent scar (n=15)	Intact scar (n=85)	Control group (n=100)	*p*-value
<20	2±0	3.75±0.35	3.9±1.38	0.304
20-25	2.78±0.98	3.36±0.85	4.47±0.78	<0.002 Tamhane test p_1=0.623 p_2=0.04 p_3=0.003
26-30	2.25±1	3.26±0.78	3.87±1	0.015 Tamhane test p_1=0.458 p_2=0.117 p_3=0.047
31-35	3.55±0.07	3.22±1	4.24±1	0.016 Tamhane test p_1=0.489 p_2=0.006 p_3=0.007
36-40	3.1±1.3	3.01±1.3	3.99±1.1	0.103
>40	–	4±0.78	3.67±0.29	0.4

- $p1$ between Dehiscent scar group and Intact scar group. $p2$ between Dehiscent scar group and control group. $p3$ between intact scar group and control group.

Table (4): Association between LUS thickness (mm) and G.A. (weeks) in the different studied groups.

Gestational Age (G.A.) (weeks)	Dehiscent scar (n=15)	Intact scar (n=85)	Control group (n=100)	*p*-value
30-36	2.45±1.36	3.2±0.87	4.2±1.1	0.014 Tamhane test p_1=0.731 p_2=0.209 p_3=0.014
37-38	3.1±0.87	3.35±0.83	4±0.9	0.018 Tamhane test p_1=0.788 p_2=0.064 p_3=0.015
39-40	2.4±0.5	3.3±0.96	4±1.1	0.006 Tamhane test p_1=0.203 p_2=0.044 p_1=0.024

- $p1$ between Dehiscent scar group and Intact scar group. $p2$ between Dehiscent scar group and control group. $p3$ between intact scar group and control group.

Table (5): Association between LUS thickness (mm) and number of deliveries or C.S. in the different studied groups (Parity).

Number of Deliveries (Parity)	Dehiscent scar (n=15)	Intact scar (n=85)	Control group (n=100)	*p*-value
1	3±0.58	3.3±0.77	4±0.65	<0.006 Tamhane test p_1=0.910 p_2=0.049 p_3=0.004
2	2.8±0.87	3.3±0.94	3.9±0.89	0.004 Tamhane test p_1=0.254 p_2=0.036 p_3=0.025
3	3±1.4	3.3±1	4.3±1.3	0.107
4	0.8	3.4±0.5	4.1±1.1	0.053
>4	3.5±0.07	3.5±1.2	4.1±1.05	0.647

- $p1$ between Dehiscent scar group and Intact scar group. $p2$ between Dehiscent scar group and control group. $p3$ between intact scar group and control group.

Table (6): Association between LUS thickness (mm) and the time elapsed science last delivery or CS (years) in the different studied groups.

Time Elapsed (years)	Dehiscent scar (n=15)	Intact scar (n=85)	Control group (n=100)	*p*-value
≤1	2.2±1.5	2.6±0.85	3.5±2.1	0.841
1.1-2	3.2±0.3	3.1±0.7	4.3±1.1	0.002 Tamhane test p_1=0.984 p_2=0.006 p_3<0.002
2.1-3	3±1.1	3±0.7	4±0.8	0.003 Tamhane test p_1=0.984 p_2=0.674 p_3<0.001
3.1-4	2.6±0.8	3.4±0.6	24±1.1	0.094
>4	2.7±1.1	3.6±0.98	4±1.1	0.062

- $p1$ between Dehiscent scar group and Intact scar group. $p2$ between Dehiscent scar group and control group. $p3$ between intact scar group and control group.

Table (7): Association between lower LUS thickness (mm) and amniotic fluid volume (AFV) in the different studied groups.

AFV	Dehiscent scar (n=15)	Intact scar (n=85)	Control group (n=100)	*p*-value
Average	2.7±0.95	3.3±0.87	4.1±1	<0.001 Tamhane test p_1=0.125 p_2=0.001 p_3=0.001
Oligohydramnios		3.3±0.89	3.9±1	0.129

- $p1$ between Dehiscent scar group and Intact scar group. $p2$ between Dehiscent scar group and control group. $p3$ between intact scar group and control group.

Table (8): Association between LUS thickness (mm) and the estimated fetal weight (EFW) (grams) in the different studied groups.

EFW (grams)	Dehiscent scar (n=15)	Intact scar (n=85)	Control group (n=100)	*p*-value
2000-2500	1.4±0.84	3.2±1	3.7±0.98	0.118
2501-3000	3.1±0.89	3.1±0.7	4.2±1	<0.003 Tamhane test p_1=0.999 p_2=0.296 p_3=0.001
3001-3500	2.9±0.82	3.3±0.95	4±1	0.006 Tamhane test p_1=0.545 p_2=0.014 p_3=0.01
3501-4000	3±0	3.6±0.54	4±1.2	0.211
>4000	4±0.5	4±0.6	4±0.57	1

- $p1$ between Dehiscent scar group and Intact scar group. $p2$ between Dehiscent scar group and control group. $p3$ between intact scar group and control group.

Table (9): Receiver Operator Characteristic (ROC) curve for LUS thickness as a predictor of scar dehiscence.

AUC	Cut-off point	*p*-value	Sensitivity	Specificity	95% CI	
					Lower	Upper
0.749	<3.6	0.002*	80%	51%	0.624	0.868

Table (10): Multivariate Logistic regression for predictors of scar dehiscence.

Predictors (Independent Variables)	Odds ratio	*p*-value	95% CI (lower-upper)
Patient Age (years)	0.978	0.745	0.854-1.120
Parity number	1.005	0.985	0.620-1.627
Time Elapsed since last cesarean section (years)	0.659	0.038*	0.444-0.978
Gestational age (weeks)	0.865	0.468	0.585-1.28
EFW (grams)	1	0.656	0.999-1.002

CI = Confidence interval.

Discussion

Most of the studies had used for measurement of LUS thickness transabdominal ultrasound (TA U/S) alone, transvaginal ultrasound (TV U/S) alone or both together. If TV U/S is not available or could not be applied, TA U/S with magnification could be used Abdel Baset et al., [4]. LUS muscular thickness assessment by TV U/S was found more reliable than the entire LUS thickness by TA U/S approach. Nonetheless,one should consider that the association between thin LUS muscular thickness measurement obtained by TV U/S and the risk of uterine rupture had only been suggested; as all patients evaluated by study in whom LUS was assessed by TV U/S approach and underwent C.S., only uterine dehiscence was observed Nicol et al., [5]. As our candidates were all Bedwen women; they were unhappy and mostly refused TV U/S approach and only accept TA U/S approach. We evaluated the entire LUS thickness of our candidate by TA U/S approach respecting their preferences. We have to remember also that the actual association between thin LUS measurement and uterine rupture had been assessed only using TA U/S approach Nicol et al., [5]. Several studies had evaluated the use of ultrasonography in the prediction of uterine rupture, but only few had evaluated the reliability of the method. Lack of reliability in a test may be due to different readings of the same measurement when it is made by the same observer a second time or by a second observer.Unsuitable tests may put patients at risk and entails a waste of resources. In the present study the LUS thickness measurements of all the recruited women were done by the same Radiologist in Radiology Department of the hospital to attain the optimal reliability of the test.

The current study had showed that LUS thickness measured in millimeter is highly significant thinner in women delivered by C.S. than that in women delivered by normal vaginal delivery.This result was consistent with French study that found

that the thinness of LUS was highly correlated with the dehiscent uterine scar and preterm labor Ginsberg et al., [6]. In Iraq, Samar and Kadem, [7] reported that LUS assessment was a simple test that can be used to predict the uterine scar defect, but their study had revealed no reliable cut-off value in this regard. The present study had showed that the LUS thickness measurement in pregnant women with prior C.S. could be used as a predictor of scar dehiscence with a cut-off value <3.6mm. with sensitivity 80% and specificity 51% and 95% Confidence Interval. This result was consistent with that of others who reported that the LUS thinning in pregnant women with previous C.S. could be used to predict shorter gestational age and delivery complications with a cut-off value of 3.5-4mm. with 79% sensitivity and 84% specificity Mohammed et al., [8] and Naji et al., [9]. The present study has showed that the increased time elapsed since the last C.S. in years is significantly an independent protective factor for scar dehiscence. This result was consistent with other previous studies. Ulfat et al., [2] had found that the shortduration since last C.S. was significantly correlated with the LUS thinning. It had been reported that the LUS of women delivered by C.S. was healed and become thicker with time Vervoot et al., [10]. An Indian data stated that women with a short interval between pregnancies had thinner LUS Balachandran et al., [11]. Also the results of Basic et al., [12] supported our finding, as they stated that the duration since last C.S.is correlated positively with the LUS thickness. The important points in our study were that we could find cut-off value for thickness of LUS in pregnant women with prior C.S. below which the risk for scar complication may be suspected which is <3.6mm. Also, we could clarify that increasing the time since last C.S. in years is an independent protective factor for scar dehiscence. The limitations of our study were the small number of the recruited women as our hospital is tertiary hospital and most cases were presented or referred as emergency cases, also we could not apply the TV U/S approach for social reasons as our participants are Bedwen women who were unhappy to have this approach.

Conclusion and Recommendations:

The current study had showed that LUS thickness becomes thinner in pregnant women with prior C.S. than in pregnant women who had never had C.S., butonly vaginal delivery. The cut-off value of the entire LUS thickness measured by TA U/S in pregnant women with previous C.S.at which we suspect scar problems was found <3.6mm. in our study.

Depending on the results of the present study, we could recommend to avoid trial for vaginal delivery after C.S. (VBAC) for women whom LUS thickness is found <3.6mm. We also strongly advice to arrange to deliver those women at shorter gestational age to avoid fetal and maternal complications. Another important recommendation is to advice for increasing the time elapsed since last C.S. as it was found that increasing this time is significantly an independent protective factor for scar dehiscence.

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قياس سمُك الجزء الأسفل من الرحم وتقدير سلامة موضع القيصرية السابقة للسيدات الحوامل اللآتى سبق إجراء قيصرية لهن باستخدام الموجات فوق الصوتية عن طريق البطن

خلفية البحث : هناك زيادة مطردة فى معدل الولادات بعملية قيصرية مما يجعلنا نتوقع تزايد فى حدوث المضاعفات خصوصاً فى موضع جرح القيصرية السابقة. ويعتر قياس سمُك الجزء الأسفل للرحم مؤشراً كافياً لتو قع حدوث مشاكل فى موضع الجرح السابق.

الهدف من البحث : الوقوف على المعدل الطبيعى لسمُك الجزء الأسفل من الرحم للسيدات الحوامل اللآتى لم يسبق لهن الولادة بعملية قيصرية وذلك قرب نهاية الحمل. وكذلك تقييم العلاقة بين سمُك الجزء الأسفل للرحم للسيدات اللآتى سبق لهن الولادة بعملية قيصرية قرب نهاية الحمل وحدوث مضاعفات لموضع القيصرية السابقة، وقد حاولت دراسات عديدة سابقة استخدام قياس سمُك الجزء الأسفل من الرحم أثناء الحمل للسيدات اللآتى سبق لهن التعرض لعمية قيصرية كمؤشر لتوقع إمكانية حدوث مضاعفات فى موضع القيصرية السابقة.

ثم دراسة تحسين الخبرة فى هذا المجال ومحاولة تحديد الو قت المناسب لإجراء العملية القيصرية لمن سبق لهن الولادة بعملية قيصرية وذلك عن طريق قياس سمُك الجزء الأسفل للرحم أثناء متابعة الحمل بالموجات فوق الصوتية عن طريق البطن.

المريضات وطرق البحث : تم إجراء قياس لسمُك الجزء الأسفل للرحم بجهاز الموجات فوق الصوتية عن طريق البطن قرب نهاية الحمل لمجموعتين من السيدات كل منهما تبلغ ١٠٠ سيدة : مجموعة تشمل سيدات لم يسبق لهن الولادة بعملية قيصرية ولكن سبق لهن الولادة الطبيعية، والمجموعة الثانية تشمل سيدات سبق لهن الولادة بعملية قيصرية واحدة على الأقل. تم إجراء الدراسة خلال الفترة من ٢٠٢٠/٦/٢٧ إلى ٢٠٢١/١١/٣٠. كما تم متابعة حالة جرح القيصرية السابقة لمن سبق لهن الولادة بعملية قيصرية أثناء إجراء القيصرية التالية. بعد جمع البيانات لجميع السيدات تم عمل جداول ودراسات إحصائية تحليلية للبيانات.

نتائج البحث : بعد جمع وتحليل البيانات وجد أن سمُك الجزء الأسفل للرحم للسيدات اللآتى لم يسبق لهن الولادة بعملية قيصرية ولكن سبق لهن ولادة طبيعية واحدة على الأقل هو ٤.١±١.٠، بينما وجد أنها فيمن سبق لهن الولادة بعملية قيصرية تساوى ٣.٢±٠.٨٩٧. كما أظهرت الدراسة أن طول الفترة المنقضية بعد آخر عملية قيصرية بمثل عامل مستقل ومعتبر لحدوث مضاعفات فى موضع جرح القيصرية السابقة. كما تبين أن لحد الأدنى الآمن لسمُك الجزء الأسفل للرحم هو ٣.٦مم.

الإستنتاج والتوصيات :وقد خلصت الدراسة إلى أن الحد الأدنى الآمن لسمُك الجزء الأسفل للرحم أثناء الحمل لمن سبق لهن الولادة بعملية قيصرية هو ٣.٦ مليمتر. كما تبين أنه كلما زادت الفترة المنقضية بعد القيصرية السابقة كلما زادت الحماية من حدوث مضاعفات لجرح القيصرية السابقة. وعلى ذلك يوصى بمراعاة الحذر عند متابعة الحمل للسيدات اللآتى سبق لهن الولادة بعملية قيصرية إذا وجد أن سمُك الجزء الأسفل للرحم هو ٣.٦ مليمتر أو أقل، وكذلك يجب التفكير والتخطيط للتعجيل بإجراء العملية القيصرية للحمل الحالى لهن. وحسب نتائج الدراسة الحالية ينصح بإطالة الفترة بعد الولادة بعملية قيصرية قبل التفكير فى حمل جديد.