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ORIGINAL ARTICLE

Ultrasonic assessment of cesarean section scar to vesicovaginal fold distance: an instrument to estimate pre-labor uterine rupture risk

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ABSTRACT

Background: The number of Cesarean sections (CS) is growing worldwide, intensifying the risk of complications in subsequent pregnancies and leading to increased maternal and fetal morbidity and mortality . In particular, the literature shows a higher risk of uterine rupture (UR) in subsequent pregnancy with trial of labor after cesarean section (TOLAC) Furthermore, there are few data about pre-labor UR in scarred uteri.

Objective: Since the key factor for management is timing, the aim of this study was to evaluate the accuracy of prenatal ultrasound (US) of scars in the early determining of pre-labor UR risk in women with a previous CS during their subsequent pregnancy

Methods: From April 2014 to November 2018 a retrospective analysis was performed in order to evaluate the scar to vesicovaginal fold (VVF) distance in three patients with pre-labor UR and in 60 cases of the control group.

Results: The periconceptional CS scar-VVF distance in the three UR cases resulted significantly increased compared to the controls (23.7 ± 3.5 mm vs 2.3 ± 2.7 mm, $p < 005$); moreover, a time interval of less than 18 months and a previous pre-labor preterm CS were found as known risk factors.

Conclusion: In this study, a higher uterine incision due to placenta previa or isthmic myoma seems to be correlated with a major risk of UR. Therefore, periconceptional US examination of CS-VVF distance, (which represents the level of the previous CS), seems to be a useful predictive factor of pre-labor UR in subsequent pregnancies.

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KEYWORDS
Uterine rupture; placenta previa; obstetric emergency; antenatal care visit

Introduction

Cesarean section (CS) increases the risk of complications in subsequent pregnancies, with increased maternal and fetal morbidity and mortality [1–5]. Complications include placenta previa, accreta, increta, percreta and dehiscence or uterine rupture (UR) [6]. UR represents an obstetric emergency, which has been reported in 0.16% of cases after CS and without trial of labor (TOLAC), and in 0.4–1% in patients who underwent TOLAC during a subsequent pregnancy [7]. UR is often characterized by an unclear clinical and ultrasound (US) picture, especially in primary stages [8]. Therefore, subsequent delayed diagnosis could be associated with an increase in maternal-fetal mortality and morbidity [9]. The accurate prediction of UR can be of significant value during the management of subsequent pregnancies after previous CS [10]. Several studies have been conducted using US measurement of the lower uterine segment (LUS) to evaluate the risk of uterine defects [11]. However, no clear cutoff value of scar thickness to predict uterine defects has been identified so far [12]. The aim of this study was to evaluate the accuracy of prenatal sonography scar exams in assessing the risk of UR in a subsequent pregnancy. In particular, scar-vesicovaginal fold (VVF) distance has been introduced as a new ultrasound (US) parameter; the VVF is a triangular-shaped fold between the bladder, the vagina and the cervix, obtained by placing a transvaginal probe in the anterior vaginal fornix (Figure 1(A)) with an almost empty bladder, which could represent the level of the previous CS [13]. Therefore, the results of this study would help clinicians with early detection in a subgroup of women with a high risk of UR in subsequent pregnancies, [14] and with the early identification of UR. Indeed, the immediate detection and management of UR could improve maternal-fetal outcome [15].

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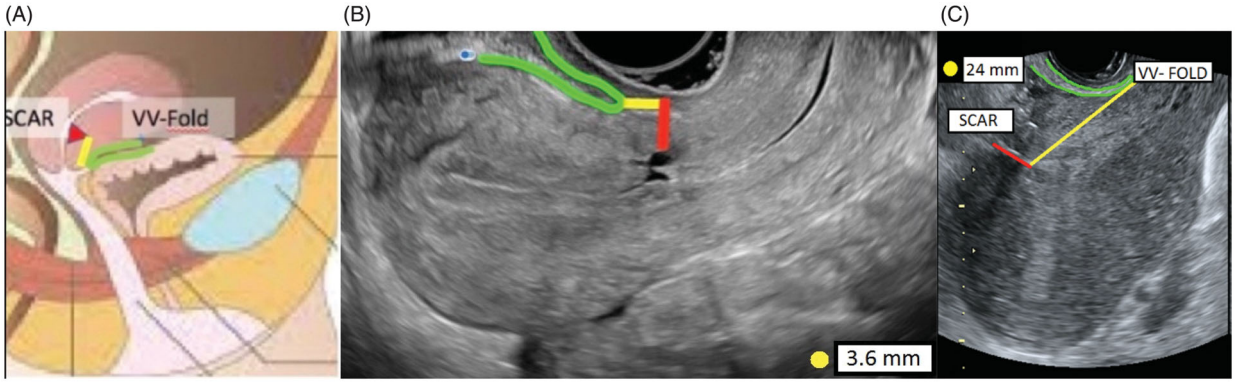

Figure 1. (A) Triangle= niche/scar; left curve line= vesico-vaginal fold; center straight line indicates "Scar-Vesicovaginal fold" distance; (B) TV US sagittal plane of anteverted uterus (fundus located in the right): left straight line indicates top of niche/scar; right curved line=vesicovaginal fold and center straight line=scar-vesicovaginal fold distance;(C) TV US sagittal scan of uterus in case 1 with subsequent uterine rupturein pregnancy:center straight lineis scar-VV fold distance equal to 24mm.

Patient and methods

The comprehensive perinatal computerized database of the Department of Biomedical Sciences and Human Oncology, Unit of Obstetrics and Gynecology was consulted from April 2014 to November 2018, in order to perform a retrospective observational study. Pregnant women with previous CS and a subsequent single delivery complicated by pre-labor full thickness UR after 22 weeks' gestation were selected. Furthermore, 60 pregnant women (matched for gravity, parity and single pregnancy following each reported case of UR) with previous CS without UR complication were enrolled from the same period. The distance between the CS scar or top of niche and the VVF (scar-VVF distance) was measured (Figure 1(B)) in each patient by expert sonographer which was blinded to the events surround the first CS delivery. Before being placed on the list, women were given an explanation of the study and were formally invited to participate. The patients who agreed to participate in the study signed an informed consent form. All procedures performed in this study were in accordance with the Declaration of Helsinki, as revised in 2013. In addition, the patients were also informed that the data collected for this study are protected by the Privacy Act; the data were thus collected and used after each patient had signed a further informed consent form to authorize the use of personal data for scientific purposes only. In the two groups, the recent ultrasound (US) parameter scar-VVF distance, expression of the level of the previous CS incision, was evaluated in the preconception period and at least 6 months after the previous CS. The US examination was performed by both GE Voluson E6 and Voluson E10; all images were stored and reusable for measurements. CS scar marker was considered a hypoechogenic or hyperechogenic line or niche in the low uterine segment (LUS) in a sagittal US transvaginal plane of the uterus, visualizing at the same time the endometrial cavity and cervical canal; the VVF was identified in the same plane as a triangular-shaped fold between the bladder, the vagina and the cervix.

Statistical analysis

The Mann–Whitney *U*-test was used to compare continuous variables. The level of statistical significance was set to p-value $< .005$.

Results

In the study period, we found three UR before labor in which previous CS had been performed, in 2 cases due to placenta previa and in one case due to isthmic myoma. In the same period, we observed 60 case-control pregnancies with a physiological pregnancy course. In all cases, US evaluation of the scar was always available and was performed before pregnancy and at least after 6 months from the previous CS. In case 1, an elective CS at 39 weeks of gestation due to an anterior placenta previa was performed with a transversal hysterotomy above the LUS. An ultrasound assessment executed 6 months after the CS and before the next pregnancy showed a higher CS scar location, with scar-VVF distance equal to 24 mm (Figure 1(C)). In case 2, the previous pregnancy (December 2017) terminated with an emergency CS due to a central placenta previa abruption at 32 weeks of gestation; a placental flap was extending anteriorly over the LUS for 3 cm and a transverse hysterotomy was performed more cranially than usual. Evaluation of the preconception US image of the uterine scar allowed to

Table 1. Preconception US CS scar-VVF distance in pre-labor uterine rupture cases (3) and controls (60 pregnancies without uterine rupture and with at least 1 previous CS).

	Cases (3 pre-labor Uterine Ruptures)	Controls (60 pregnancies)	*p*
Preconception US CS scar-VVF* distance (M ± SD)	23.7 ± 3.5 mm	2.3 ± 2.7 mm	.001

*Vesicovaginal fold.

Table 2. Risk factors in 3 pre-labor uterine rupture cases.

Age >35 years	1/3
N. of previous CS ≥2	No
Vertical incision in previous CS	no
Previous preterm/ pre-labor CS	2/3
Previous CS in full dilatation	No
Previous myomectomy	No
Grand multipara (≥5)	No
Overextended uterus (in twin gestation or macrosomia or polyhydramnios)	No
Short time interval from previous CS (at less than 18 months)	1/3
Previous Non LTCS* for low lying placenta or other causes	3/3
Breech extraction	No
Instrumental delivery	No
congenital uterine anomalies	No
postpartum complications such as hemorrhage and infection	No

*Low segment transverse cesarean section.

measure the CS scar-VVF distance equal to 21 mm (Figure 1(A–C)). The third case was a 37-year-old woman at 38 weeks of gestation, with a previous CS performed 3 years earlier at 36 weeks due to preeclampsia, which probably needed a higher incision on the LUS due to the presence of an anterior isthmic myoma of 35 mm in diameter. Evaluation of the preconception US image of the uterine scar allowed to measure the CS scar-VVF distance equal to 26 mm. In conclusion, the preconception US exam of CS-SVV distance in the three reported cases resulted significantly increased compared to controls (23.7 ± 3.5 mm vs 2.3 ± 2.7 mm; $p = .0167$, $z = 2.393$, Table 1). Moreover, the other known risk factors are a time interval between the 2 CS of less than 18 months, found in 1 reported case, and a previous preterm and prelabor CS in another two cases (Table 2).

Discussion

To the best of our knowledge, this is the first study to show an association between a higher preconception US CS scar-VVF distance and pre-labor UR in subsequent pregnancy; this US parameter well represents the higher transverse incision above the LUS of the previous CS, performed due to a low lying placenta in 2 cases and to isthmic myoma in the other. In the three reported cases of UR we performed an US examination, measuring the level of the previous CS scar-VV fold distance. This measurement resulted greater than in the control group, and as these cases reported, it could represent a predisposing factor of pre-labor UR. On the other hand, in the 60 cases of control, the same US parameter was evaluated and a significant difference (23.7 ± 3.5 mm vs 2.3 ± 2.7 mm, $p < .001$) was found. Indeed, in these women the majority of scars were located close to the vesical-vaginal fold, corresponding approximately to the internal uterine orifice. Moreover, in two reported cases other anamnestic risk factors were reported, such as the previous preterm CS performed and the interval between the 2 CS being less than 18 months. Indeed, the literature shows other predisposing factors of UR such as: number of previous CS, type of uterine incision (vertical or horizontal), previous non-low segment transverse cesarean section, single layer uterine suture, previous CS in full dilatation, no prior vaginal birth, induction/augmentation of labor, overextended uterus (in twin gestation or macrosomia or polyhydramnios), breech extractions, instrumental deliveries, other previous uterine operations (myomectomy, curettage), congenital uterine anomalies, and postpartum complications such as hemorrhage and infection [16,17]. According to a recent publication, [18] a "low lying placenta" as an indication for previous CS does not seem to be a risk factor for UR in the subsequent pregnancy for women attempting TOLAC. On the other hand, Gonzalez and Tulandi [19] described a possible higher risk of UR in labor after previous "no low uterine segment" transverse CS. As per the results of our study, in the case of previous CS with high uterus incision, we recommend careful antenatal and intrapartum surveillance, especially in the presence of multiple risk factors. It is also important to keep a registry of such cases in order to better understand circumstances and risk factors for developing such rare cases. In fact, we must consider that UR is an extremely rare event with very limited data, so future studies are

certainly needed. Essentially, the limitations of the study are represented by the sample size (which was not large) which may affect partially the robustness of the conclusion, and the retrospective study design, which may not include all details relating to the study. Furthermore, ultrasound measurement of VVF -scar distance cannot be used alone as a predictor of uterine scar defects.

Conclusion

To our knowledge, this is the first study to show an association between previous CS due to a low lying placenta and pre-labor UR. Moreover, the main strength of the present research is to employ an innovative US parameter for the measurement of the level of the corporal scar (scar-VVF distance) in order to identify patients with an increased risk of UR. Therefore, an early scan at 6-7 weeks' gestation could be useful to evaluate the characteristics of the scar and to evaluate the need for periodic follow-up [11].In fact, this is a reproducible US tool, which could be considered during the clinical work-up of patients with prior CS. In our experience, a higher incision on the LUS in the previous CS was related to a low-lying placenta (two cases) and isthmic myoma (1 case), which could represent a risk factor in subsequent pregnancy. Therefore, in these cases special attention should be paid in the periconceptional period together with the evaluation of other UR risk factors that should been collected during the medical history. Additionally, future developments of this research could lead to the validation of a specific US tool, in order to identify early "UR risk patients". Indeed, the early screening of potentially at-risk pregnancies would allow to plan a periodic follow-up of these patients and the rapid detection of UR symptomatology. This could be extremally important, since a preventive diagnosis and timely intervention may significantly improve maternal and fetal outcome [20]. Larger studies are needed to validate if this approach could possibly decrease the risk of UR and other complications in subsequent pregnancy. Consequently, this experience could represent a cornerstone for further discussion on this topic, also considering the absence of prior similar reference experience in literature. Finally, it may also provide useful recommendations for national and international gynecological-obstetric societies.

Disclosure statement

No potential conflict of interest was reported by the author(s).

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