Ultrasound Examination of the Uterine Scar after Cesarean Section: Isthmocele, Scar Pregnancy, Niche of Myometrium, and Low Uterine Segment Thickness

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Abstract

The article is concerned with a review of contemporary concepts of the possibilities of ultrasound (US) evaluation of the uterine scar after the cesarean section (USCS) and provides clinical examples illustrated with US images. The possibilities of ultrasonographic evaluation of USCS abnormalities in nonpregnant patients as well as in the early stages of pregnancy are considered. The images of rare USCS abnormalities such as symptomatic isthmocele, scar pregnancy, and uterovesical fistula are presented. The possibilities of US for diagnostics of scar abnormalities in later pregnancy terms for prediction of successful vaginal delivery have been analyzed.

Keywords: Isthmocele, Scar pregnancy, Ultrasound, Uterine scar after cesarean section, Vaginal birth trial.

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INTRODUCTION

The relevance of the subject matter is beyond dispute and increases with every passing year. Two components cause the growth of interest. On the one hand, due to increase in the frequency of operative deliveries in recent decades, a significant subpopulation of women with a postoperative scar (or several scars) of the uterus has formed around the world.^{1–3} On the other hand, today there is almost 100% coverage of the entire population of pregnant women with routine ultrasound (US) examinations.

It causes the request of obstetrician-gynecologists to obtain adequate information not only about the condition of the fetus or placenta but also about the state of the uterine scar after the cesarean section (USCS). Obstetricians are perplexed after normal US scan results when performing abdominal delivery and revealing incompetent scar sometimes representing a true "hole" in the uterine wall. "Why did they not see this during the US study?"—obstetricians ask. The next time they ask or even demand "to assess the condition of the scar."

Thus, what are the possibilities of US diagnostics of the USCS abnormalities?

USCS abnormalities are as follows:

- Symptomatic isthmocele in the nonpregnant state
- Localization of the gestational sac within USCS at an early stage
 of the first trimester of pregnancy
- Incompetence (dehiscence) of the scar, which is not extended to the visceral peritoneum, with insignificant bleeding from the wound edges at any pregnancy term
- Uterine rupture along the scar (disruption of continuity of all layers causing post-traumatic bleeding) at any pregnancy term.

It should also be mentioned a particular problem of scar abnormalities after gynecological surgical interventions and their complications such as myomectomy, perforation of the uterine wall, and others. A number of cases of fundal or sidewall uterine rupture after such operations are described. However, an US assessment of these types of scars is even more difficult and is not considered in this publication. Department of Radiology, Kharkiv Medical Academy of Postgraduate Education, Kharkiv, Ukraine

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The condition of USCS during pregnancy is one of the important problems of obstetrics, as it is associated with complications that are potentially hazardous and life-threatening for the mother.

Ultrasound imaging of USCS in the nonpregnant state is different from US assessment during pregnancy.

SCAR AND ISTHMOCELE IN THE NONPREGNANT STATE

Imaging of USCS in the Nonpregnant State

- In the early postoperative period, the scar contours and the rows of ligatures of the surgical suture of the postpartum uterus are clearly visible (Fig. 1).
- In the late postoperative period with transvaginal US examination, the scar area is also visible (Fig. 2).

Niche (Isthmocele) of USCS in Nonpregnant Women

- Isthmocele or niche is a pocket-like defect of the myometrium of the CS region.
- Niches can have various shapes: triangular, rounded, semicircular, rectangular, etc, (Figs 2 and 3).

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- The frequency of isthmocele imaging with US in both pregnant and nonpregnant patients has been increased recently with the growth of a subpopulation of USCS women.^{2,3}
- It is more often asymptomatic (clinically insignificant).
- Clinical symptoms of significant niches show abnormal uterine bleeding (mainly spotting postmenstrual), pain, and secondary infertility.⁴
- Symptomatic niches (Fig. 3) are indications for surgical correction.
- The defect sizes as criteria for choosing the approach are contradictory.
- The best imaging of a niche in the nonpregnant state is achieved using liquid sonohysterography.
- The thickness of the residual myometrium represents a criterion for choosing the approach.

Evaluation of USCS in the First Trimester of Pregnancy

Ultrasound examination of the USCS area in the early stages of pregnancy is a crucial aspect for obstetric-gynecologists. In the first trimester, the pregnancy localization over the scar, and, especially, in the niche of the scar, is associated with an extremely high risk of complications. The correlation between scar localization of pregnancy in the early first trimester with subsequent formation



Fig. 1: Day 20 after CS, rows of ligatures (arrows)

of anomalous invasion of the placenta (AIP) has been convincingly proven in series with a significant number of cases. $^{\rm 5}$

USCS and Isthmocele Risks during Pregnancy

- Scar pregnancy (Fig. 4)
- Subsequent developing of AIP, including the risk of severe bleeding during pregnancy
- Formation of vesicouterine fistula⁶ (Fig. 5).

Experts believe that US scan with an assessment of pregnancy localization in relation to the scar area till 6–7 GW is extremely important for all the patients with USCS.⁵ When the pregnancy is located over the scar and particularly in the niche of the USCS, the patient should be informed about the risks of severe further complications.

Isthmocele and Residual Myometrium during Pregnancy

It was proposed to measure the thickness of the residual myometrium over the scar in the first trimester, and then measure the thickness of the low uterine segment in the third trimester, and to estimate the risk of incompetency or rupture of the scar on the basis of changes in time in this thickness.⁷⁸ To date, these approaches are still controversial and disputable.

Echograms of normal anterior uterine wall and the incompetency of the USCS are presented in Figure 6.

Possible US Signs of Incompetent Scar during Pregnancy and at Term

- Niche-like defect of myometrium (Fig. 6B).
- Scar dehiscence.
- The asymptomatic dehiscence of the scar is called a "silent rupture," which means that the patient has no manifest clinical symptoms.
- The amniotic membrane as well as parts of the fetus and placental tissue can prolapse into the defect.
- In the presence of deep niches, with complete incompetency of the muscular layer, only serosa can cover the uterus (Fig. 6C).
- Imaging of myometrial defect covered by visceral peritoneum is a difficult task for the sonologist, especially in late pregnancy.



Figs 2A and B: Long-term follow-up after the CS, a niche-like area of a triangular shape in the area of USCS. (A) A small, clinically nonsignificant defect; (B) Schematic diagram shows measurement of the niche depth (1) and the thickness of the residual myometrium over the defect (2)





Figs 3A to C: Symptomatic isthmocele of ovoid shape in a patient after two CSs. (A) Defect size is 1.5×2.5 cm; (B) Thinning of the residual myometrium over the defect is 1.1 mm; (C) Such a niche may require reparative surgery in the nonpregnant state, with the purpose of elimination of abnormal uterine bleeding

- Ultrasound diagnostics of the scar defect is most effective in cases of amniotic protrusion (herniation) into the defect.
- A rare case of the diagnosis of large USCS defect with gross amniocele containing fetal legs, using expectant management and prolongation of pregnancy till 30 GW, was described in 2016.⁹

Echograms of the low uterine segment (LUS) in women with USCS are presented in Figure 7.

A dehiscence is an incomplete separation of a uterine scar with an intact serosa layer.¹⁰ It should be noted that so far a number of reports have been published about the diagnosed defects of the USCS at pregnancy with expectant management and favorable perinatal and maternal outcomes.^{9,10}

Uterine Rupture along the Scar

Ultrasound imaging of a myometrium niche or amniocele makes the basis for diagnosing the USCS incompetency, while the rupture of the uterus along the scar is a clinical diagnosis that is confirmed in the operating room and has clinical signs as pain, bleeding, or fetal distress.

Clinical Stages of Uterine Rupture along the Scar

- Threatening rupture
- The rupture occurred (Fig. 8)

Threatening and occurred rupture are usually accompanied by abdominal pain syndrome of varying severity, while the USCS incompetency is more often clinically asymptomatic.

Abnormalities of the USCS: Problems of US Diagnostics

Abnormalities of the USCS are very rare during pregnancy. Their frequency is about 22–74 cases per 10,000 labors according to different statistical reports.^{1,11}

In an obstetric center or a maternity hospital with a large number of deliveries, a few such cases can occur annually. In the same time during routine visits of a sonologist, such abnormalities can be observed extremely rarely, with a possibility tending to zero.

In addition, there is a probability for dehiscence or rupture of a scar at any pregnancy term, without labor, with latent labor, or with obvious contractions. What is the conclusion? The fact is that a scar can turn out to be abnormal within any period of time—in 5 minutes, 5 hours, days, or weeks after the unremarkable US scan. It means in terms of logics, a special US examination of a pregnant woman in order to "assess the structure and competence of the scar" has no practical value.

Besides, in many cases during both re-CS or US scan, the uterine scar area itself has the appearance of a normal myometrium and has no contours. It should be noted that even the obstetrician often does not distinguish the immediate area of the scar while



Figs 4A to C: Early pregnancy localized in the USCS area, two cases. (A) Pregnancy in the scar niche surrounded by myometrium, the thickness of the residual myometrium is 1 mm; (B) Laparoscopy image; (C) Pregnancy localized over the USCS area with the residual myometrium thickness

performing surgery, and also cannot determine the localization of pose the previous incision. was Thus, among the main problems of US diagnostics of abnormalities of uterine scar after the cesarean section, the

following ones are the most important:

Very low frequency of abnormal sonographic findings

4 mm (yellow arrow)

- The possibility of dehiscence or rupture of the scar at any term of pregnancy after an unremarkable scan
- Inability to determine accurately the type and location of the scar in most cases.

Risk Assessment of Vaginal Delivery in USCS

As was mentioned, rupture of the uterine scar is a rare complication, as evidenced by global statistics. In recent years, the concept of vaginal birth after cesarean section (VBAC) has become widespread. In recent decades, VBAC is being provided more often and successfully, and the concept is gaining great popularity among pregnant women and obstetricians around the world.¹² According to different centers, the frequency of successful VBAC reaches 75–82%.^{11,12} There is evidence that the risk of severe maternal complications with repeated CS is statistically higher than with VBAC.^{1,11}

In this sense, the role of US in pregnant women with USCS has increased, although it remains somewhat controversial. It was proposed to perform US examination of LUS to determine the

possibility of VBAC and to assess the risk of uterine rupture.¹² It was determined that the thinner LUS is, the higher the frequency of uterine rupture at a trial of VBAC.^{12,13}

In addition to the presence of obvious practical logic, metaanalysis also confirmed the relationship between the LUS thickness and the risk of uterine rupture.¹⁴ There was a viewpoint that the LUS thickness after 35 weeks is a predictor of successful or complicated VBAC.⁸

US Measurement of the Lower Uterine Segment in Prediction of Successful Trial of VBAC

- It is carried out in the third trimester, after 35 weeks, before the onset of labor.
- The sagittal section should be selected at the level above the internal os.
- Medium bladder filling is required.
- The image should be enlarged.

Two methods of measuring of LUS have been proposed such as measuring either only myometrium thickness or the thickness of the entire LUS.¹⁴

 Measurement of myometrium of LUS: The layer between the bladder wall/myometrium and the myometrium/chorioamniotic membrane (Figs 7A and B) is measured, while the bladder wall is not included in the measurement.



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Figs 5A to D: A rare complication of USCS, a vesicouterine fistula. (A) 11 GW, nonviable fetus in the maternal bladder; (B) Placenta in the uterine cavity; (C and D) Images of vesicouterine fistula: sonogram (C) and cystoscopy (D)



Figs 6A to C: Normal LUS and the incompetency of the USCS. (A) Normal LUS, nulliparous patient; (B) 29 GW, USCS, myometrium niche; (C) Laparotomy, dehiscence of the scar, amniotic membrane is visible through the defective myometrium

• *Measurement of the entire LUS thickness*: The mucosa of the bladder and the uterine serous membrane are included in the measurement (Figs 7A and B).

Should LUS be Measured Transabdominally or Transvaginally?

The measurement results may vary when using different approaches. When measuring structures with such small sizes, some intraobservational and interobservational differences may occur in a way that the results of measurements taken by the same or different specialists do not coincide. In this case, the transvaginal approach seems more effective and reproducible.¹⁵ However, the higher the resolution of the US device, the less significant the difference between the measurement methods.

PRESENTATION OF **C**ASES

A series of echograms and other images (Figs 1 to 8) is presented to demonstrate normal and abnormal images of USCS in nonpregnant and pregnant patients.



Figs 7A to D: Ultrasound examination of LUS in two patients with USCS. Normal and magnified images (B and D magnified section of A and C). (A and B) Normal thickness of LUS/myometrium. Vaginal delivery at term; (C and D) Thin LUS with myometrium niche in TVS. CS at term



Fig. 8: Uterus with three scars after three previous CS. The uterine rupture occurred in 34 GW after insignificant result of US scan

DISCUSSION

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What should be Considered as LUS Thinning?

In recent years, a large number of publications have been devoted to the assessment of the threshold values of the LUS thickness as a predictor of the USCS incompetence.^{8,11-16}

A meta-analysis (2013) showed that the pooled sensitivity and specificity of myometrial LUS thickness for cutoffs between 0.6 and 2.0 mm was 0.76 (95% CI, 0.60–0.87) and 0.92 (95% CI, 0.82–0.97); cutoffs between 2.1 and 4.0 mm reached a sensitivity and specificity of 0.94 (95% CI, 0.81–0.98) and 0.64 (95% CI, 0.26–0.90). The pooled sensitivity and specificity of full LUS thickness for cutoffs between

2.0 and 3.0 mm was 0.61 (95% CI, 0.42–0.77) and 0.91 (95% CI, 0.80–0.96); cutoffs between 3.1 and 5.1 mm reached a sensitivity and specificity of 0.96 (95% CI, 0.89–0.98) and 0.63 (95% CI, 0.30–0.87).^{13}

For now, the ideal cut-off (lower threshold value of the LUS thickness) for prediction of a uterine rupture during a trial of labor in women with the previous cesarean section has not been accepted.

Besides, there are contradictions of the meta-analysis data on the advantages of methods for measuring the entire LUS or the thickness of the LUS myometrium. A cut-off of 2.5 mm for the thickness of the entire LUS was proposed, as a criterion of impossible VBAC.¹⁶

The final consensus on this issue has not been achieved. The publications and guidelines note that the research data are inconsistent, and the ideal LUS cut-off thickness cannot be recommended to predict a successful or unsuccessful attempt of VBAC.¹¹

It should be added that the role of the US of USCS during pregnancy in the prediction of scar "behavior" before and during delivery is not recognized by all authors and sonologists of all centers over the world. At present, multicenter studies of the diagnostic significance of ultrasonography in the management of patients with USCS are being performed.

Further researches are also required to focus on the correlations between the USCS localization, ultrasonography in the nonpregnant state and in first and second trimesters of pregnancy, and the thickness of LUS in the third trimester.

CONCLUSION

Ultrasound scan in pregnant women with a history of CS plays an important role and has significant opportunities; however, its value consists not only and not so much in direct imaging



and assessment of the scar condition but also in the prediction of severe maternal complications associated with the risks of vaginal delivery, abnormal placental invasion, and the formation of fistulas.

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