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MODERN DIAGNOSTIC CAPABILITIES FOR UTERINE SCAR INTEGRITY (LITERATURE REVIEW)

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ABSTRACT

One of the important tasks of obstetrics is to reduce maternal and perinatal mortality. Over the past 30 years, there has been a clear trend towards a significant increase in the frequency of CS in order to reduce perinatal losses [1]. Every year, 1.5 million CS are performed worldwide [2]. It should be noted that due to the expansion of indications for CS, the number of women of childbearing age with postoperative RUI is steadily increasing [3]. Incomplete healing of RUI has become one of the recognized complications associated with this type of surgery. The exact cause and mechanism of the occurrence of the so-called niche - a deepening of the myometrium on the endometrial side of at least 2 mm - are still not entirely clear [4]. In recent decades, many researchers have proposed the use of various other terms to denote the phenomenon of local thinning of the scar area, calling this condition a diverticulum, a sac, a scar leak, a scar dehiscence, an isthmocele, etc. [8-10]. Keywords: uterine scar, cesarean section, scar integrity, diagnosis, incompetent scar.

STUDY OBJECTIVE

To systematically analyze current Russian and international literature on modern diagnostic methods for uterine scar incompetence.

MATERIAL AND METHODS

The study included data from Russian and international literature published over the past 10 years.

RESULTS

Inadequate scar healing and subsequent development of uterine scar tissue incompetence after a cesarean section is a common complication. Numerous studies have been published over the past few years demonstrating that the risk of bleeding, placenta previa, and placenta accreta increases with uterine scar defects [3]. A previous cesarean section is also a risk factor for uterine rupture, which is associated with adverse maternal and perinatal outcomes [4, 5]. Despite the fact that cesarean section is a safe procedure, clinicians have been faced with an increasing number of complications over the past two decades [2, 6]. The first suggestion that these symptoms might be related to a uterine scar after CS was made by Thurmond et al. [7]. In a later prospective cohort study by van der Voet et al., the prevalence of a failed uterine scar after the first CS in a group of 263 women was shown to be 49.6% when assessed by transvaginal ultrasound and 64.5% when assessed by sonohysterography at 6–12 weeks [8]. Despite a large number of studies on the scar defect after CS, an internationally accepted definition was only agreed upon in 2019 by the European Community, which defined a failed uterine scar defect after CS as an anatomical defect on the anterior wall of the uterine body in the area of the scar with myometrial thinning of at least 2 mm [12].

CONCLUSION

In our opinion, when diagnosing a pregnancy in a cesarean section scar, the term "ectopic pregnancy" should be used. It reflects the nature of the pathological location of the fertilized egg and determines the management strategy for this patient. Perhaps, it is worth considering introducing an additional subcategory into the classification of ectopic pregnancy due to the high risk of complications and the specific treatment tactics for this location of the fertilized egg. When diagnosing a pregnancy in a cesarean section scar, taking into account international experience, the most effective treatment method with the fewest complications should be used: local administration of methotrexate (possibly in combination with systemic administration). Monitoring of patients after methotrexate administration, in addition to monitoring for a decrease in serum β-hCG levels, should include ultrasound to determine the volume of the fertilized egg and the degree of its vascularization for the timely diagnosis of possible complications. When patients are discharged from the maternity hospital after a CS, early ultrasound (at 6-7 weeks) should be recommended for subsequent pregnancies to ensure timely diagnosis of possible ectopic nidation of the fertilized egg in the scar area.

RELEVANCE OF THE PROBLEM

One of the important goals of obstetrics is to reduce maternal and perinatal mortality. Over the past 30 years, there has been a clear trend toward a significant increase in the frequency of CS with the goal of reducing perinatal losses [1]. 1.5 million CS are performed annually worldwide [2]. It should be noted that, due to the expansion of indications for CS, the number of women of childbearing age with postoperative myometrial incomplete healing is steadily increasing [3]. Incomplete healing of myometrial incomplete healing has become one of the recognized complications associated with this type of surgery. The exact cause and mechanism of the so-called niche—a deepening of the myometrium on the endometrial side of at least 2 mm—is still not fully understood [4]. In recent decades, many researchers have proposed various other terms to describe the phenomenon of localized thinning of the scar area, calling this condition a diverticulum, a sac, a scar leak, a scar dehiscence, an isthmocele, etc. [8–10]. In 2019, a group of authors published a study aimed at summarizing the available data regarding the definitions, measurements, and classification of localized myometrial thinning [11]. Twenty leading experts participated in the study. As a result, consensus was reached on 79 controversial issues. The majority (83%) of the experts agreed with the term "niche," deciding that a niche should be defined as a depression at the site of a CS scar with a depth of at least 2 mm. Thus, to date, there are numerous terms describing changes in scar structure in the form of localized thinning. Due to the limited possibilities of using various methods for studying the condition of the scar during pregnancy, in recent decades, studies have appeared devoted to the study of morphological changes in the RM after CS in non-pregnant women. Many authors [11] draw attention to significant differences in the methods for measuring the RM during and outside of pregnancy.

Factors Leading to the Development of Uterine Scar Failure

According to the literature, factors leading to the development of uterine scar failure are divided into four main groups [12]: factors related to suturing technique; factors related to

changes in the lower uterine segment (gestational age, period of delivery) or the level of uterine incision;

a surgical technique that can induce the formation of adhesions between the uterine scar and the abdominal wall and, being opposite to the tissue direction in the scar itself, cause a deterioration in wound healing; factors with a potential negative impact (maternal-related factors - age, maternal body mass index, number of pregnancies, number of vaginal deliveries, number of C-sections, placenta previa, preeclampsia, diabetes, steroid use during pregnancy; fetal-related factors - birth weight; surgery-related factors and the course of the postoperative period - anesthesia method, time of surgery, intraoperative blood loss, postpartum infection).

Uterine Scar Diagnosis

Currently, surgical methods for restoring myometrial integrity in the uterine incision area are considered the most important factor leading to the development of a defect or niche [13]. Thus, it seems clear that areas of ischemic necrosis in the area of myometrial integrity restoration best explain the formation of adhesions and scar defects. Moreover, not only the technique of myometrial wound suturing is important, but also the technique of tissue dissection [4]. For example, our study showed that, all other things being equal, the most gentle tissue dissection method when using an USE is one with an output frequency of 36 kHz and a periodic operation mode of 3 sec on/30 sec on/off with its transverse feed at an angle of 90° to the blade. With the widespread introduction of TVUS into medical practice in recent decades, studies have appeared devoted to the study of morphological changes in the myometrium after CS in non-pregnant women [8, 15–20]. In all studies, the authors only indicated the detection of a hypoechoic area in the myometrium of the lower uterine segment at the site of the previous CS during ultrasound [8], and the frequency of detection of uterine scar defects ranged from 6.9 to 69%. Despite the fact that the authors used similar methods of radiographic imaging, these studies employed different methods for classifying these abnormal scars, therefore the actual prevalence of various morphological defects of the uterine scar is unknown. In recent years, one of the most pressing issues in modern obstetric and gynecological practice remains the issue of preserving reproductive function in women of childbearing age with uterine fibroids. While uterine fibroids were previously considered a condition predominantly affecting women in their late twenties and early forties, they are now increasingly being diagnosed in younger women [2, 4, 7-9]. Furthermore, a clear trend toward postponing childbearing has recently emerged. It is now considered common to plan the birth of a first child between the ages of 30 and 35. An analysis of the data from the Department of Operative Gynecology at the Moscow Regional Research Institute of Obstetrics and Gynecology (MRRIOG) confirms the general global trend toward an increasing number of women of reproductive age with uterine fibroids who wish to preserve their fertility. Taking all of the above into account, it is clear that the woman's desire to fully preserve her reproductive function is fundamental when choosing preconception preparation and treatment methods for fibroids. Treatment for women with uterine fibroids planning pregnancy should be as organ-preserving as possible. As the number of women with uterine fibroids and pregnancy, or women with uterine fibroids planning pregnancy, increases, obstetricians and gynecologists are increasingly faced with the need to refine their management strategies for patients with uterine fibroids both during and outside of pregnancy. Childbirth in pregnant women following uterine surgery requires a

differentiated approach from the obstetrician. A healthy uterine scar is essential for a successful completion of pregnancy and vaginal delivery. Current methods for assessing uterine scar condition after organ-preserving surgery remain controversial, which serves as the basis for this study.

Signs of partial uterine scar failure include visualization of niches and deformations in the scar projection with myometrial thinning to 4-5 mm or less. These defects often have an irregular slit-like shape and can be located both centrally and eccentrically. Sometimes, niches and defects extending into the parametrium can be visualized. The absence of convincing vascularization in the myometrium during energy mapping also suggests partial uterine scar failure. If partial scar failure is suspected, office hysteroscopy and hydrosonography are recommended [10, 13]. It should be noted that the criteria for assessing scar integrity are absolutely identical after any uterine surgery (cesarean section, myomectomy outside and during pregnancy, metroplasty, and after plastic surgery on the uterus for developmental anomalies). We consider the following signs as criteria for the viability of the uterine scar in the early postoperative period (6-7 days) (Fig. 2): - absence of deformations, niches, areas of retraction on the part of the outer covering and uterine cavity; - the thickness of the myometrium in the area of the postoperative scar is equal to the thickness of the intact myometrium; - absence of hematomas in the structure of the scar, connective tissue inclusions, fluid structures; - visualization of well-structured ligatures in the myometrium; - adequate blood flow: scanty on days 2-3 and increased on days 4-7 (reparative processes in the myometrium); - the thickness of the vesicouterine fold of the peritoneum is less than 5 mm, the absence of hematomas or fluid contents under this fold [10, 11]. The ultrasound signs of a healthy scar after myomectomy in the late period (6 months after surgery) include: - smoothness and clarity of the contours of the uterus; - an ideal scar - determination of the localization is not possible; - the thickness of the myometrium in the projection of the scar is equal to that of the unchanged myometrium; - the absence of niches and deformations of the uterine walls; - the absence of ligatures in the myometrium or single ligatures; - good vascularization of the scar according to Doppler ultrasound (a moderate number of vascular loci, comparable to the intact myometrium) (Fig. 3) [10, 12, 13]. In 7 (5%) patients of the 1st group, in the postoperative period, the uterine scar was visualized as single hyperechoic (connective tissue) inclusions against the background of unchanged myometrium, and in 9 (6%) patients - as a deformation of the external contour or cavity of the uterus and in the scar area. At the same time, among patients with active vascularization in the area of the bed of the removed nodes on the 5th-7th day of the postoperative period, it was possible to visualize the uterine scar after 6 months only in 4 (3%) patients. Evaluation of the viability of the scar 6 months after metroplasty (Fig. 4): - the position of the scar corresponds to the incision on the uterus during the operation; - no deformations, niches, areas of retraction on the side of the outer cover and uterine cavity; - the thickness of the myometrium in the area of the lower uterine segment is equal to the thickness of the anterior wall of the uterus; — absence of organized hematomas in the scar structure, connective tissue inclusions; — adequate blood flow (the amount of increase in loci is equal to that in the intact myometrium); — the condition of the vesicouterine fold, Douglas pouch, parametria — without edema, hematomas and free fluid [10]. In some cases, hydrosonography and hysteroscopy were used to confirm the

diagnosis. Office hysteroscopy was performed 6 months after the surgery on the 4th or 5th day of the menstrual cycle, when the functional layer of the endometrium is completely rejected, and the underlying tissue is clearly visualized through the thin basal layer. In case of scar failure, retractions or thickenings are noted in the scar area. The whitish color of the scar tissue and the absence of vessels indicate a pronounced predominance of the connective tissue component, and retractions indicate thinning of the myometrium as a result of incomplete regeneration. In the absence of these signs, the scar is considered anatomically complete. However, despite its anatomical integrity, it may be morphologically defective with a predominance of connective tissue elements. The following hysteroscopic types of uterine scar condition are distinguished [6]: Type I: the uterine scar is practically not visualized; Type II: individual elements of poorly vascularized connective tissue are visible among the muscular elements; Type III: Wide connective tissue avascular scar. Information on the location of the nodes prior to myomectomy (a clear, informative description) is essential. A thorough examination of all uterine walls is performed at all stages of perinatal care. In the second and third trimesters, it is not always possible to determine the location of the scar, so assessing the thickness and structure of the myometrium in the myomectomy area is more appropriate. Transabdominal scanning is the primary examination method, but additional vaginal ultrasound is also necessary if the nodes are located at low elevations. It is advisable to begin examination of the pregnant uterus with a transabdominal transducer, which allows for a comprehensive overview of the anatomy of all uterine walls and detailed segmental scanning. Examination of the posterior uterine wall is particularly challenging, especially in the late second and third trimesters. Knowing the location of the removed nodes, the physician scans the suspected scar area (the "zone of interest") at high magnification. In favorable technical conditions (absence of massive subcutaneous fat, good tissue sound conductivity), it is advisable to use a linear high-frequency transducer. Its high resolution ensures differentiation of the layers of the anterior abdominal wall and the anterior uterine wall. When scanning from the level of the umbilicus to the pubic symphysis in transverse sections, then from the right to the left iliac bones in multiplanar sections, we evaluate the thickness of the myometrium in the "zone of interest", homogeneity, and the presence of inclusions. An unambiguous criterion for the anatomical solvency of the scar is considered to be a myometrial thickness of at least 0.3 cm. The odds ratio of developing an incompetent uterine scar in women with a history of CS is approximately 2.0, and the incidence of CS in the general population is approximately 35% [13]. In the study by Tang et al. Statistically significant factors influencing the development of incompetent uterine scars after CS were found in women with and without CS. These included the position of the uterus, age at the time of CS, duration of CS, stage of labor when CS was performed, suturing technique, and intraoperative blood loss (all $p < 0.01$). There were no significant differences between the two groups in age, number of CS, and anesthesia method ($p > 0.05$).

Bij de Vaate et al. identified 3 main groups of factors associated with the formation of incompetent uterine scars: those associated with the formation of the lower uterine segment/level of uterine incision; those associated with the technique of uterine suturing; and those associated with wound healing [6]. The authors also identified a fourth group of factors,

which includes other possible factors (somatic pathologies, smoking, age, BMI, parity, multiple pregnancies, timing of surgery, and a complicated obstetric and gynecological history).
In the study by Vervoort et al., they hypothesized that the factors influencing the development of a failed uterine scar can be divided not into four groups, but into only two: factors related to the surgical intervention and factors related to the patient [3].

CONCLUSIONS

Early diagnosis is essential for maintaining a woman's health and well-being, as well as for preventing complications in subsequent pregnancies, which emphasizes the importance of high-quality diagnosis and the development of adequate criteria for assessing uterine scar tissue after a CS, which, unfortunately, do not exist today. A structured approach to assessing uterine scar defects after a CS in everyday clinical practice can alleviate and prevent a number of complications and adjust the management tactics for patients with uterine scars.

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