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How to . . . .
Practical advice on imaging-based techniques and investigations

How to perform standardized sonographic examination of uterine niche in non-pregnant women

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BACKGROUND

A 'niche' is defined by the European Niche Taskforce as an indentation of the uterine myometrium at the site of the Cesarean section (CS) scar with a depth of at least 2 mm and is preferably assessed by transvaginal ultrasonography (TVS) using gel or saline[1]. The prevalence of a uterine niche after CS as assessed by sonohysterography ranges from 56% to 84%[2–4]. A niche is associated with gynecological complaints, such as spotting and dysmenorrhea. Recently, it has also been identified as a possible risk factor for secondary infertility and complications in subsequent pregnancies[5–12]. It has been acknowledged that niche characteristics, such as size and thickness of the residual myometrium, are associated with the severity of postmenstrual spotting and the risk of uterine rupture in a subsequent pregnancy[13,14]. Moreover, niche characteristics may influence the management of related symptoms. Therefore, uniform and accurate description and measurement of a niche are important for clinical assessment of symptoms, planning of surgical interventions and for research purposes. For this reason, a practical guideline for detailed uterine niche evaluation in non-pregnant women was developed by international gynecological experts through a Delphi procedure[15]. The experts also proposed a classification system which, however, is solely descriptive and its clinical relevance needs to be evaluated in future studies. To facilitate implementation of the uniform measurements described in this guideline, we created a step-by-step tutorial on how to perform a standardized sonographic evaluation of the uterine niche in non-pregnant women.

PRACTICAL POINTS

The best way to evaluate a uterine niche is by TVS in the sagittal and transverse planes. In the absence of intrauterine fluid, it has been proven that relevant niches can be missed if only unenhanced ultrasound is performed; therefore, in such cases, the use of saline contrast sonohysterography (SCSH) or gel infusion sonohysterography (GIS) may be of additional value if there is suspicion of a niche[16,17]. For example, Bij de Vaate *et al.*[18] showed that, in women with a history of CS, TVS missed more than half of the niches detected by GIS. Five basic rules should be kept in mind when evaluating a uterine niche:

1. In a woman with a previous CS undergoing ultrasound assessment because of gynecological symptoms, high suspicion of a niche or infertility, if a niche cannot be identified in the absence of intrauterine fluid, the use of SCSH or GIS is advocated.
2. The endometrium should be excluded from the niche measurements.
3. The length, depth and width of the niche should each be measured in the plane in which it is largest; this is not always the midsagittal or midtransverse plane.

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4. The residual myometrial thickness (RMT) should be measured at its thinnest part in the plane in which the RMT is thinnest; this may be different from the plane in which the niche is the largest.
5. The transverse plane should be used only for measuring the width of the niche and to identify branches.

We propose a four-step roadmap for the evaluation and measurement of uterine niches. We also provide practical tips and suggest additional measurements that can be used in research settings.

Before commencing the evaluation of a niche, it is of great importance to optimize the ultrasound machine settings. To optimize resolution, adjust the sector angle to obtain an optimal view of the entire uterus. Adjust the depth until you see the entire uterus and set the focal depth at the level of the niche. If there is too much shadowing due to scar tissue at the anterior part of the uterus, try to position the transvaginal probe in the posterior fornix and see if the image improves. To obtain an optimal view and to exclude uterine pathology before concentrating on the niche and carrying out any measurements, start by scanning and assessing the entire uterus in two directions: the sagittal plane from right to left and the transverse plane from the cervix to the fundus.

Step 1: Measuring length, depth and width of niche

Find the image in which the main niche has the largest depth and length. This is not always the midsagittal plane but could be more lateral. Zoom in on the region of interest and adjust the focus. First, measure the length of the niche in a straight line parallel to the uterine cavity/cervical canal. Then, measure the depth of the niche as the vertical distance from the base of the defect to the myometrium at the apex of the niche (Figure 1). As mentioned above, the endometrium should be excluded from niche measurements. Subsequently, measure the width of the niche in the transverse plane, at its largest point; this could be at the base or the apex of the defect. Again, the endometrium should be excluded from the measurement (Figure 2).

Step 2: Classifying niche by identifying branches

The next step is to identify the presence of branches in the sagittal and transverse planes. The best method is to screen the entire lower uterine segment from cervix to corpus. A branch is defined as a thinner part of the main niche which is directed towards the serosa, with a smaller width than that of the main niche visible in the sagittal or transverse plane (Figure 3). Depending on the presence of branches, a niche can be classified as follows: (1) simple niche (no branches); (2) simple niche with one branch; or (3) complex niche (more than one branch). If branches are visible, additional measurements of the depth and thinnest RMT of the branches are recommended.

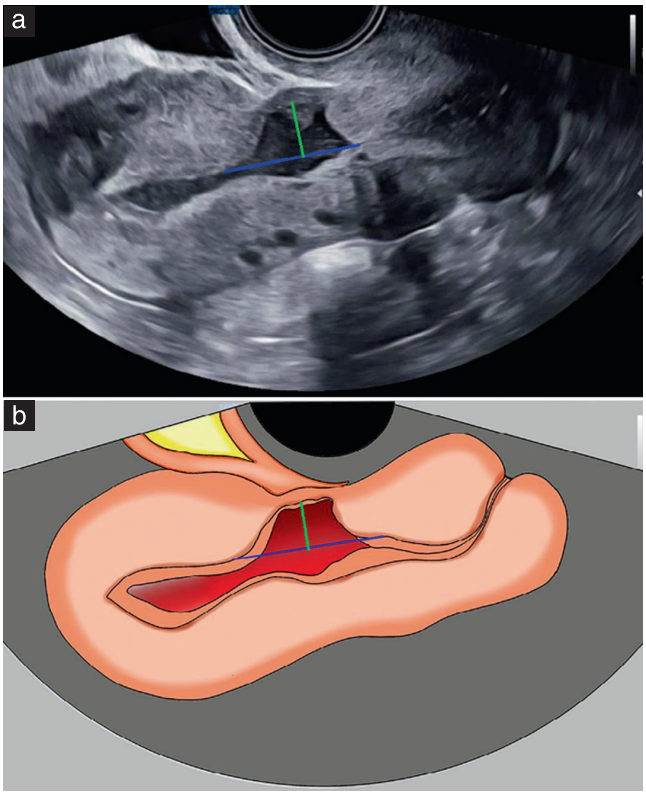

Figure 1 Transvaginal ultrasound image (a) and schematic diagram (b) showing measurement of length (blue line) and depth (green line) of uterine niche in the sagittal plane.

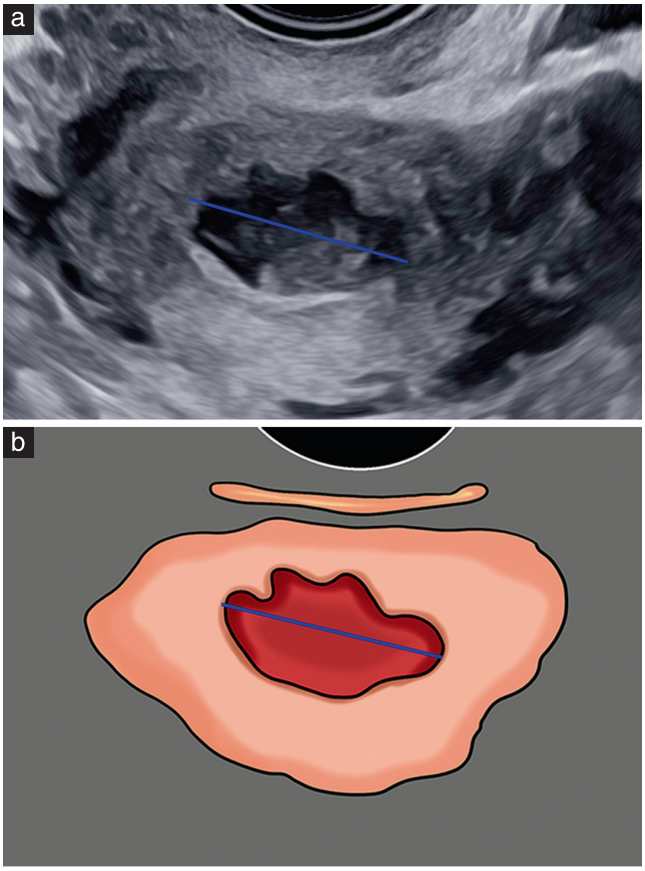

Figure 2 Transvaginal ultrasound image (a) and schematic diagram (b) showing measurement of width (blue line) of uterine niche in the transverse plane.

Step 3: Measuring adjacent myometrial thickness and residual myometrial thickness

The adjacent myometrial thickness is measured at the border of the niche base, perpendicular to the cervical canal, where the myometrium is thickest (Figure 4a). The RMT is measured where the myometrium is thinnest, from the top of the main niche to the serosa, perpendicular to the border with the serosa (Figure 4b). It is usually best to search for the thinnest RMT in the sagittal plane, although this may sometimes be located more laterally.

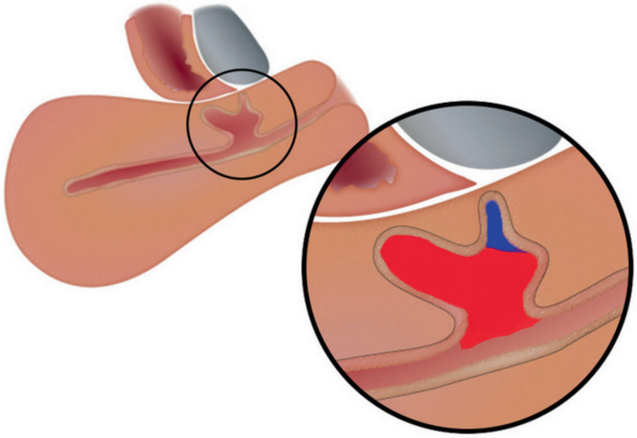

Figure 3 Schematic diagram showing a uterine niche (red area) with one branch (blue area).

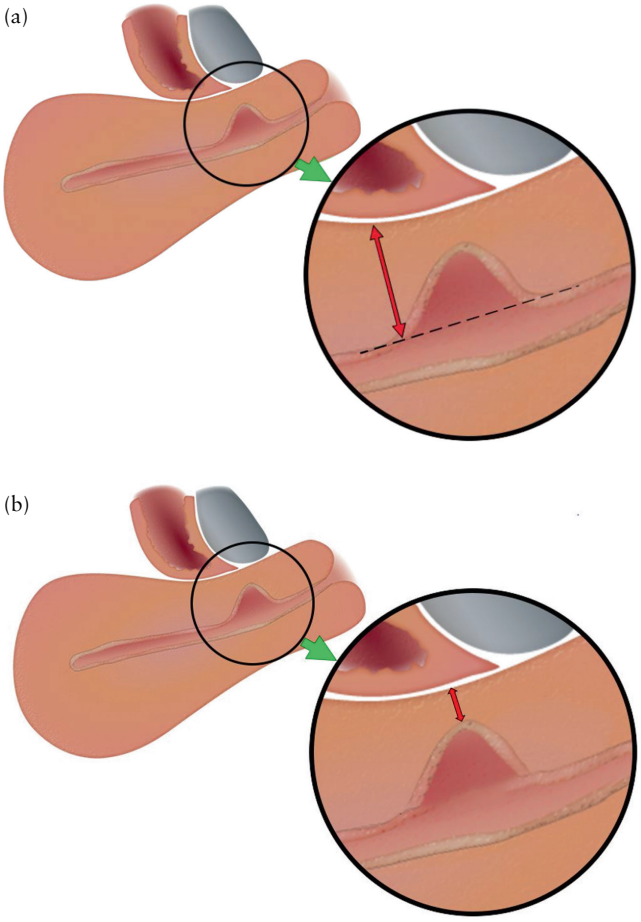

Figure 4 Schematic diagrams showing measurement of adjacent myometrial thickness (a) and of residual myometrial thickness (b) of uterine niche in the sagittal plane.

Step 4: Useful measurements for research purposes

The vesicovaginal fold (VV fold) is an artificial triangular fold between the bladder, the vagina and the cervix, which is visualized by placing the transvaginal probe in the anterior vaginal fornix (Figure 5). The distance between the VV fold and the apex of the niche is reported

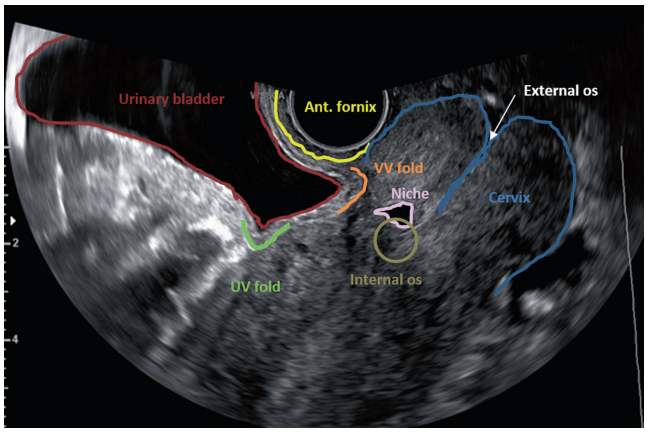

Figure 5 Transvaginal ultrasound image showing plica vesicouterina or uterovesical fold (UV fold) (green line) and vesicovaginal fold (VV fold) (orange line). Ant., anterior.

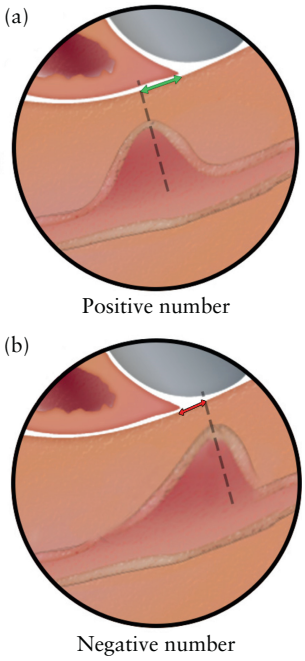

Figure 6 Schematic diagrams showing measurement of distance between vesicovaginal fold and apex of uterine niche in the sagittal plane: (a) positive value (green double-headed arrow); (b) negative value (red double-headed arrow).

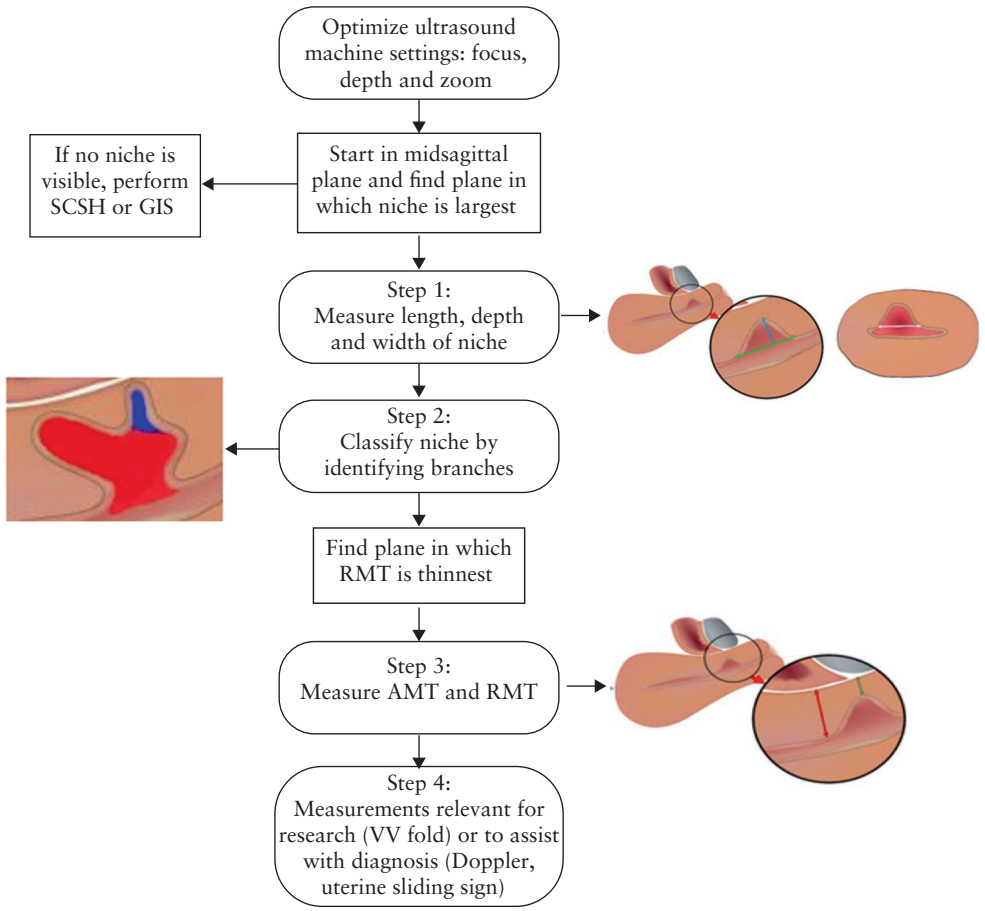

Figure 7 Step-by-step approach on how to measure a uterine niche in non-pregnant women. AMT, adjacent myometrial thickness; GIS, gel infusion sonohysterography; RMT, residual myometrial thickness; SCSH, saline contrast sonohysterography; VV, vesicovaginal.

as a positive number if the apex of the niche is situated cranial to the VV fold and as a negative number if the apex of the niche is situated caudal to the VV fold (Figure 6). This measurement may be useful if surgery is considered or for research purposes, but is not necessary for basic niche evaluation in clinical practice.

Other useful assessments for diagnosis

The use of Doppler imaging is not mandatory in standard niche measurements, but it may be useful to differentiate between a niche and other uterine abnormalities, such as hematomas, myomas or adenomyosis. Using Doppler may also help determine the relationship between the niche and the uterine artery in the transverse plane, which may be evaluated as part of the preoperative assessment for niche surgery. If you are in doubt whether there is a niche or the translucency is due to a Nabothian cyst, SCSH or GIS may provide additional information. As part of the preoperative workup, it is advised to assess the uterine sliding sign in order to determine the presence of adhesions between the niche and the abdominal wall and bladder, and between the uterus and the bowel[19]. This technique involves pushing gently towards the uterus with the vaginal probe.

CONCLUSIONS

A structured approach on how to evaluate a uterine niche in non-pregnant women in daily clinical practice is summarized in Figure 7. To facilitate the use of these uniform measurements, we have developed a free e-learning course for sonographers with an interest in this topic to practice their ultrasounds skills in an interactive way: http://nichelearning.online.

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REFERENCES

1. Jordans IPM, de Leeuw RL, Stegwee SI, Amso NN, Barri Soldevila PN, van den Bosch T, Bourne T, Brolmann HAM, Donnez O, Dueholm M, Hehenkamp WJK, Jastrow N, Jurkovic D, Mashiach R, Naji O, Streuli I, Timmerman D, van der Voet LF, Huirne JAF. Niche definition and guidance for detailed niche evaluation. *Acta Obstet Gynecol Scand* 2019; **98**: 1351–1352.
2. Bij de Vaate AJ, van der Voet LF, Naji O, Witmer M, Veersema S, Brölmann HA, Bourne T, Huirne JAF. Prevalence, potential risk factors for development and symptoms related to the presence of uterine niches following Cesarean section: systematic review. *Ultrasound Obstet Gynecol* 2014; **43**: 372–382.
3. Stegwee SI, van der Voet LF, Ben AJ, de Leeuw RA, van de Ven PM, Duijnhoven RG, Bongers MY, Lambalk CB, de Groot C, Huirne J. Effect of single- versus double-layer uterine closure during caesarean section on postmenstrual spotting (2Close): multicentre, double-blind, randomised controlled superiority trial. *BJOG* 2021; **128**: 866–878.
4. Tulandi T, Cohen A. Emerging Manifestations of Cesarean Scar Defect in Reproductive-aged Women. *J Minim Invasive Gynecol* 2016; **23**: 893–902.
5. Wang YQ, Yin TL, Xu WM, Qi QR, Wang XC, Yang J. Reproductive outcomes in women with prior cesarean section undergoing in vitro fertilization: A retrospective case-control study. *J Huazhong Univ Sci Technolog Med Sci* 2017; **37**: 922–927.
6. Vissers J, Sluckin TC, van Driel-Delprat CCR, Schats R, Groot DJM, Lambalk CB, Twisk JWR, Huirne JAF. Reduced pregnancy and live birth rates after in vitro fertilization in women with previous Caesarean section: a retrospective cohort study. *Hum Reprod* 2020; **35**: 595–604.
7. Vissers J, Hehenkamp W, Lambalk CB, Huirne JA. Post-Caesarean section niche-related impaired fertility: hypothetical mechanisms. *Hum Reprod* 2020; **35**: 1484–1494.
8. Tower AM, Frishman GN. Cesarean scar defects: an underrecognized cause of abnormal uterine bleeding and other gynecologic complications. *J Minim Invasive Gynecol* 2013; **20**: 562–572.
9. Stegwee SI, Jordans I, van der Voet LF, van de Ven PM, Ket J, Lambalk CB, de Groot C, Hehenkamp W, Huirne J. Uterine caesarean closure techniques affect ultrasound findings and maternal outcomes: a systematic review and meta-analysis. *BJOG* 2018; **125**: 1097–1108.
10. Naji O, Wynants L, Smith A, Abdallah Y, Saso S, Stalder C, Van Huffel S, Ghaem-Maghami S, Van Calster B, Timmerman D, Bourne T. Does the presence of a Caesarean section scar affect implantation site and early pregnancy outcome in women attending an early pregnancy assessment unit? *Hum Reprod* 2013; **28**: 1489–1496.
11. Morlando M, Buca D, Timor-Tritsch I, Cali G, Palacios-Jaraquemada J, Monteagudo A, Khalil A, Cennamo C, La Manna V, Liberati M, D'Amico A, Nappi L, Colacurci N, D'Antonio F. Reproductive outcome after cesarean scar pregnancy: A systematic review and meta-analysis. *Acta Obstet Gynecol Scand* 2020; **99**: 1278–1289.
12. Gurol-Urganci I, Bou-Antoun S, Lim CP, Cromwell DA, Mahmood TA, Templeton A, van der Meulen JH. Impact of Caesarean section on subsequent fertility: a systematic review and meta-analysis. *Hum Reprod* 2013; **28**: 1943–1952.
13. van der Voet LF, Bij de Vaate AM, Veersema S, Brolmann HA, Huirne JA. Long-term complications of caesarean section. The niche in the scar: a prospective cohort study on niche prevalence and its relation to abnormal uterine bleeding. *BJOG* 2014; **121**: 236–244.
14. Pomorski M, Fuchs T, Zimmer M. Prediction of uterine dehiscence using ultrasonographic parameters of cesarean section scar in the nonpregnant uterus: a prospective observational study. *BMC Pregnancy Childbirth* 2014; **14**: 365.
15. Jordans IPM, de Leeuw RA, Stegwee SI, Amso NN, Barri-Soldevila PN, van den Bosch T, Bourne T, Brölmann HAM, Donnez O, Dueholm M, Hehenkamp WJK, Jastrow N, Jurkovic D, Mashiach R, Naji O, Streuli I, Timmerman D, van der Voet LF, Huirne JAF. Sonographic examination of uterine niche in non-pregnant women: a modified Delphi procedure. *Ultrasound Obstet Gynecol* 2019; **53**: 107–115.
16. Osser OV, Jokubkiene L, Valentin L. Cesarean section scar defects: agreement between transvaginal sonographic findings with and without saline contrast enhancement. *Ultrasound Obstet Gynecol* 2010; **35**: 75–83.
17. Bij de Vaate AJ, Brölmann HA, van der Slikke JW, Emanuel MH, Huirne JAF. Gel instillation sonohysterography (GIS) and saline contrast sonohysterography (SCSH): comparison of two diagnostic techniques. *Ultrasound Obstet Gynecol* 2010; **35**: 486–489.
18. Bij de Vaate AJ, Brölmann HA, van der Voet LF, van der Slikke JW, Veersema S, Huirne JAF. Ultrasound evaluation of the Cesarean scar: relation between a niche and postmenstrual spotting. *Ultrasound Obstet Gynecol* 2011; **37**: 93–99.
19. Moro F, Mavrelos D, Pateman K, Holland T, Hoo WL, Jurkovic D. Prevalence of pelvic adhesions on ultrasound examination in women with a history of Cesarean section. *Ultrasound Obstet Gynecol* 2015; **45**: 223–228.