Origin of a Post–Cesarean Delivery Niche: Diagnosis, Pathophysiologic Characteristics, and Video Documentation

The incidence of cesarean delivery (CD) has increased in recent years.[1] Concurrently, complications in future pregnancies from CD scars, including placenta accreta spectrum (PAS), uterine dehiscence, uterine rupture, and cesarean scar pregnancy (CSP), are also on the rise. A uterine scar defect has been identified as the underlying factor.[2,3]

A "niche," also termed "cesarean scar dehiscense," "isthmocele," and "cesarean scar defect," was defined by Monteagudo et al[4] in 2001 as a sonographic presence of a hypoechoic area within the myometrium of the lower uterine segment, reflecting a discontinuation of the myometrium that may occur at the site of a previous CD. A niche and other morphologic abnormalities in the cesarean scar can be visualized by using transvaginal ultrasound or saline infusion sonohysterography (SIS).[5] Its prevalence in patients with previous CD ranges from 19% to 84%.[6] The clinical importance of a niche remains unclear. However, it has been associated with both obstetric and gynecologic conditions, such as CSP, PAS, abnormal uterine bleeding, infertility, and pelvic pain. These conditions contribute to substantial morbidities, including hemorrhage, hysterectomy, intensive care, and a need for laparoscopic, hysteroscopic, and robotic interventions.[5] If a fertilized ovum implants in such a niche, it gives rise to a CSP with the potential to result in a pathologic invasion in PAS and its far-reaching consequences.[7]

The origin and etiology of niche formation are poorly understood. Several hypotheses have been proposed, including the involvement of the cervix at the location of the uterine incision, incomplete uterine incision healing, intra-abdominal adhesions,

Figure 2. Endometrial cavity after a transverse uterine cut. The anterior portion of the uterus through the incision is on the left, and the posterior portion is on the right. The yellow arrows and broken lines point to the niche. The white broken lines indicate the uterine fundus, and the white arrow points to the cervix.

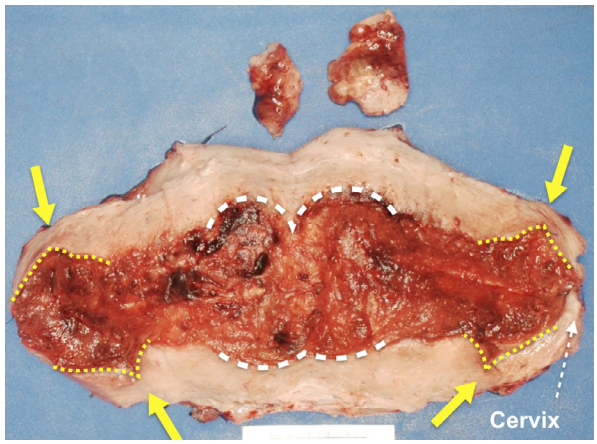
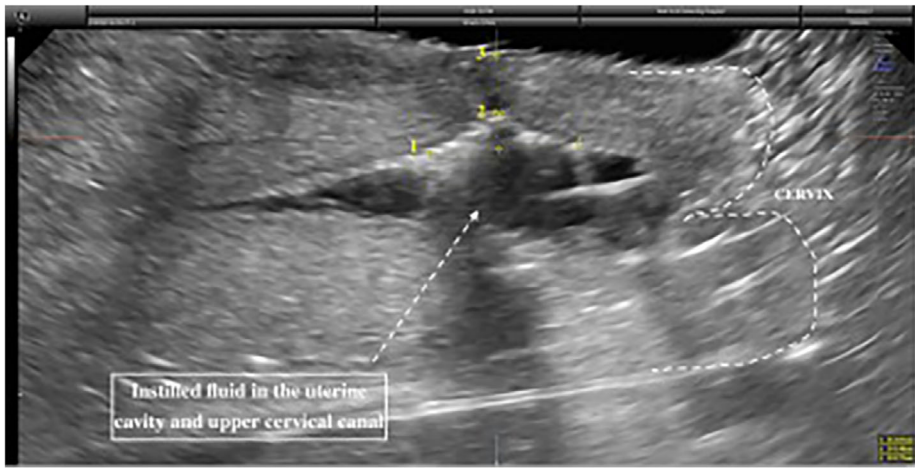
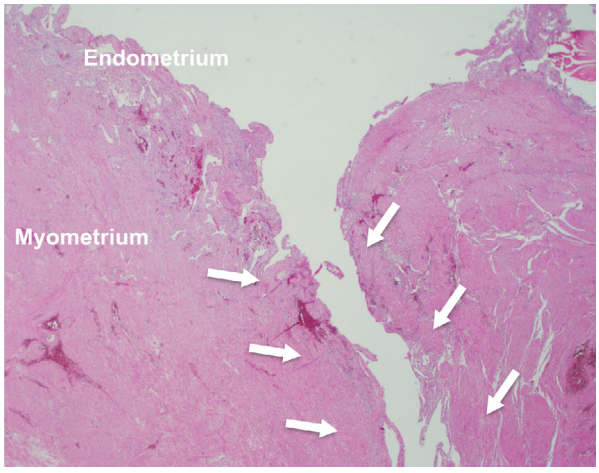


Figure 1. Saline infusion sonohysterography of the removed uterus. The dimensions of the niche and residual myometrial thickness are indicated.



inherent maternal conditions affecting the healing process,[8] and suturing techniques. These hypotheses suggest that the formation of a niche happens at some time during the healing phase of the uterine incision. There is some evidence that a closure technique with 1 or 2 layers offers no particular advantage over another.[9] However, a specific endometrium-free uterine closure technique[10] may reduce scarring, niche formation, and subsequent PAS-related complications.

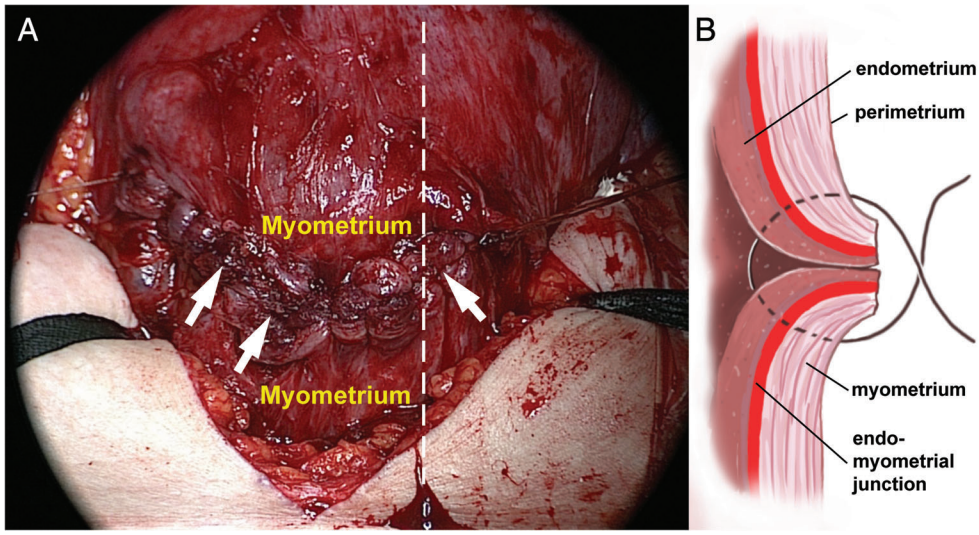
Figure 3. Microscopic view of the niche. The niche is lined by the endometrium, which is trapped within the myometrium (arrows; hematoxylin–eosin, original magnification ×200).



The objective of this pilot study was to investigate a correlation between a single-layer uterine closure technique and niche formation immediately after CD. We evaluated the anterior uterine wall after a video-recorded CD by immediate SIS of the removed uterine specimen as well as by a further histopathologic examination of the repair using the single-layer technique.

A 33-year-old woman, gravida 3, para 2, with 2 previous CDs, type 2B von Willebrand disease, and a history of subdural hematoma was admitted at 39 weeks for an elective tertiary CD and peripartum hysterectomy for sterilization and excessive menstrual bleeding requiring recurrent blood and clotting factor transfusion. Consent was obtained for the CD, video photography, peripartum hysterectomy, SIS of the uterus after removal, and general anesthesia, which was recommended by her neurologist and hematologist. A CD was performed. The uterus was exteriorized. The edges of the uterine incision were held with clamps. The uterine incision was than repaired with a No. 1 chromic suture in a continuous single-layer locked fashion (Video 1). A hysterectomy was then performed without incident, and the uterus was passed off the operating field for immediate SIS.

Figure 4. Continuous locked single-layer uterine closure with a superficial visible endometrium (white arrows) within the myometrium and illustration of a cross section (dashed line).



The uterus was contained in a receptacle and completely covered with ultrasound gel. An ultrasound scan was performed with a high-frequency (5–8 MHz) abdominal transducer and a LOGIQ 700 ultrasound system (GE Healthcare, Milwaukee, WI). Saline infusion sonohysterography was performed with an insemination catheter. The depth and length of the niche were measured, as well as the thickness of the residual myometrium. Saline infusion sonohysterography revealed a triangular uterine defect measuring 4.9 mm in depth and 20.1 mm in length. The thickness of the residual myometrium above the niche measured 7.7 mm (Figure 1).

Subsequently, the uterus was sent to pathology. The uterus was examined in a fresh state after coronally sectioning it into anterior and posterior portions. Representative sections were taken for a microscopic study. Formalin-fixed, paraffin-embedded tissue sections were stained with hematoxylin–eosin and examined under a BX53 microscope (Olympus Optical Co, Tokyo, Japan). An 8.7-cm-long recent CD incision was noted. The uterine cavity sounded to a depth of 13 cm. The cervix was 4.3 cm in length and 5.3 cm in width. Gross sagittal sections of the uterus confirmed the defect along the whole length of the incision and the myometrial thickness above the defect (Figure 2). Histopathologic sections revealed an endometrial lining along the defect extending into the myometrium (Figure 3).

A single-layer uterine closure technique does not guarantee layer-to-layer approximation.[5] In our case, the uterine closure was routine (Video 1), with the sutures capturing the full thickness of the uterine wall to achieve quick hemostasis. This resulted in inclusion of the endometrium in the closure, which can be partially seen at the superficial level of the incision. Suturing the so-created triangular defect begins to shape the form of a niche and the thickness of the myometrium along and above the uterine incision (Figure 4). Theoretically, the entrapped endometrium may not allow for proper approximation of myometrial margins during the healing process and may explain the eventual reduction of myometrial thickness at the site of the future uterine scar. Interestingly, studies comparing single- and double-layer closures have shown no differences in the incidence of niche formation.[9] We offer our explanation that in both of these conventional techniques, niche creation likely began with neglect of layer-to-layer approximation of the uterine wall and entrapment of the endometrium within the myometrium, secured by poor approximation of the opposing myometrium. To our knowledge, this was the first study to investigate a video-documented, present-day technique with SIS and a histopathologic examination immediately after hysterectomy. Further studies are needed to compare the uterine cavity findings of approved closure techniques, with and without layer approximation, and evaluate their relevance to niche formation and its origin. In this respect, video documentation may help address the associated challenges of confounding variables related to a lack of standardization of cesarean surgical techniques, diversity, and physician autonomy.

In conclusion, our work clearly demonstrated niche formation immediately after repair following a single-locked, full-thickness uterine closure. This novel finding, although not clinically significant, represents a plausible explanation for the origin of niche formation after a specific closure technique. Its final shape is most likely influenced by other intervening factors, including involution, and is achieved over the course of healing. Further investigations of contemporaneous methods and techniques are needed to solve these factors to better understand the pathogenesis of niche formation from its origin and to assess its clinical significance.

Clarel Antoine, MD, Ricardo N. Pimentel, MD, Ilan E. Timor-Tritsch, MD, Khush Mittal, MD, Terri-Ann Bennett, MD and Filipe M. Bourroul, MD

Department of Obstetrics and Gynecology; Department of Pathology, New York University School of Medicine, New York, New York, USA; and Compassionate Ob/Gyn Care PLLC, New York, New York, USA

doi:10.1002/jum.15368

References

1. Gibbons, L, Belizán, J, A Lauer, J, Betrán, A, Merialdi, M. *The Global Numbers and Costs of Additionally Needed and Unnecessary Caesarean Sections Performed per Year: Overuse as a Barrier to Universal Coverage.* Geneva, Switzerland: World Health Organization; 2010.
2. Timor-Tritsch, IE, Monteagudo, A. Unforeseen consequences of the increasing rate of cesarean deliveries: early placenta accreta and cesarean scar pregnancy—a review. *Am J Obstet Gynecol* 2012; 207:14–29.
3. Jauniaux, E, Jurkovic, D. Placenta accreta: pathogenesis of a 20th century iatrogenic uterine disease. *Placenta* 2012; 33:244–251.

4. Monteagudo, A, Carreno, C, Timor-Tritsch, IE. Saline infusion sonohysterography in nonpregnant women with previous cesarean delivery: the "niche" in the scar. *J Ultrasound Med* 2001; 20:1105–1115.
5. Bij de Vaate, AJ, Brolmann, HA, van der Voet, LF, van der Slikke, JW, Veersema, S, Huirne, JA. Ultrasound evaluation of the cesarean scar: relation between a niche and postmenstrual spotting. *Ultrasound Obstet Gynecol* 2011; 37:93–99.
6. Setubal, A, Alves, J, Osorio, F, et al. Treatment for uterine isthmocele, a pouchlike defect at the site of a cesarean section scar. *J Minim Invasive Gynecol* 2018; 25:38–46.
7. Timor-Tritsch, IE, Monteagudo, A, Cali, G, et al. Cesarean scar pregnancy and early placenta accreta share common histology: placental histology in CSP and EPA. *Ultrasound Obstet Gynecol* 2014; 43:383–395.
8. Vervoort, AJ, Uittenbogaard, LB, Hehenkamp, WJ, Brolmann, HA, Mol, BW, Huirne, JA. Why do niches develop in Caesarean uterine scars? Hypotheses on the aetiology of niche development. *Hum Reprod* 2015; 30:2695–2702.
9. Di Spiezio Sardo, A, Saccone, G, McCurdy, R, Bujold, E, Bifulco, G, Berghella, V. Risk of cesarean scar defect following single- vs double-layer uterine closure: systematic review and meta-analysis of randomized controlled trials. *Ultrasound Obstet Gynecol* 2017; 50:578–583.
10. Antoine, C, Pimentel, RN, Reece, EA, Oh, C. Endometrium-free uterine closure technique and abnormal placental implantation in subsequent pregnancies [published online ahead of print October 3, 2019.] *J Matern Fetal Neonatal Med.* https://doi.org/10.1080/14767058.2019.1670158