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CESAREAN SCAR PREGNANCY: A COMPREHENSIVE REVIEW ON DIAGNOSIS AND MANAGEMENT

Obstetrics & Gynaecology

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ABSTRACT

Background: Cesarean scar pregnancy (CSP) is a rare but rising ectopic pregnancy where a blastocyst implants in fibrous tissue of a previous cesarean scar. Increasing cesarean rates make CSP more common, with risks of uterine rupture, severe bleeding, placenta accreta spectrum (PAS), and fertility loss. It occurs when a blastocyst implants through a tiny myometrial defect, causing abnormal placental invasion. Early diagnosis by transvaginal ultrasound is key; typical signs are an empty uterine cavity, low anterior sac, thin myometrium, and increased scar vascularity. Management depends on gestational age, residual myometrial thickness (RMT), cardiac activity, and fertility goals. Options include monitoring, methotrexate (MTX), uterine artery embolization (UAE), or minimally invasive surgery. If RMT is ≤ 3 mm, surgical repair is advised to reduce recurrence. Multidisciplinary care in specialized centers ensures the best outcomes. **Conclusion:** CSP requires high clinical suspicion, early diagnosis, and tailored treatment to minimize morbidity and preserve reproductive potential.

KEYWORDS

Cesarean scar pregnancy, ultrasound diagnosis, residual myometrial thickness, hysteroscopy.

INTRODUCTION

Cesarean scar pregnancy is a rare but serious type of ectopic pregnancy in which the embryo implants within the fibrous tissue of a prior cesarean scar (Cali et al., 2018). Reported incidences range from 1 in 1000 to 1 in 2500 pregnancies and are projected to increase globally in parallel with rising cesarean delivery rates (Morlando et al., 2020). By 2030, cesareans could account for nearly one-third of all deliveries worldwide (Morlando et al., 2020).

Key risk factors for CSP include multiple prior cesareans, a retroverted uterus, history of curettage or abortion, multiparity, poorly healed uterine scars, and vaginal bleeding in early pregnancy (Timor-Tritsch et al., 2012). Missed or delayed diagnosis can result in catastrophic outcomes, including uterine rupture, life-threatening hemorrhage, disseminated intravascular coagulation, emergent hysterectomy, or permanent fertility loss (Abbott, 2020). Moreover, CSP is considered a precursor for PAS disorders, especially when placenta previa or extensive scar tissue is present (Zhang et al., 2017).

PATHOGENESIS AND ETIOLOGY

The exact mechanism behind CSP is not fully understood but is believed to involve blastocyst implantation through a microscopic tract in the cesarean scar, possibly due to incomplete healing or a niche formation in the myometrium (Wang et al., 2022). The risk increases with a lower incision placement, suboptimal closure techniques, uterine retroversion, and intra-abdominal adhesions (Antoine et al., 2021).

Studies show that the average myometrial thickness at the isthmus progressively declines with each additional cesarean. For instance, after a vaginal birth, the isthmic myometrium averages about 11 mm in thickness; after one cesarean, it drops to around 8 mm, after two cesareans to 6 mm, and after three or more, it may fall below 5 mm (Wang et al., 2022). Notably, a residual myometrial thickness of ≤ 3 mm is strongly associated with a higher risk of uterine rupture, massive bleeding, and recurrent CSP (Timor-Tritsch et al., 2016).

NATURAL HISTORY

CSP rarely continues to term. Most cases are diagnosed in the first trimester. If undetected or untreated, they can progress into the second or third trimester, often manifesting as PAS disorders like placenta accreta, increta, or percreta (Morlando et al., 2020). Expectant management carries high hysterectomy rates-reported between 50% and 100%-due to catastrophic bleeding or uterine rupture (Cali et al., 2018). Many PAS cases diagnosed late may have originated as undetected CSPs that progressed with abnormal placentation.

DIAGNOSIS

Preferred Imaging and Features

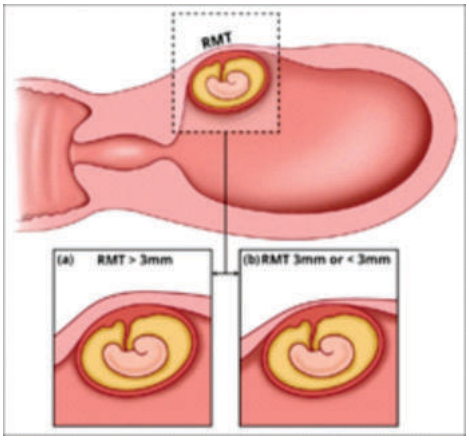
Transvaginal ultrasound (TVUS) remains the gold standard for diagnosing CSP (Timor-Tritsch et al., 2016). Typical ultrasound features include an empty uterine cavity and cervical canal, a gestational sac implanted low in the anterior uterine wall at the scar site, a thin or absent myometrial layer between the sac and bladder, and increased peritrophoblastic blood flow on color Doppler. Disruption of the myometrial–bladder interface may also be seen. Although MRI can assist in complex cases, it rarely adds value during first-trimester evaluation.

Early diagnosis, ideally before 9 weeks of gestation, is crucial. As the pregnancy advances, the gestational sac can appear to migrate toward the uterine fundus, creating a false sense of normalcy (Timor-Tritsch et al., 2012). However, the placenta remains anchored at the scar site, increasing the risk of morbidly adherent placenta later in pregnancy.

CLASSIFICATION

Zhang et al. (2017) classified cesarean scar pregnancy into three main types, based on how the gestational sac relates to the scar and its direction of growth. Type I, or endogenic CSP, grows inward toward the uterine cavity and generally carries a lower risk of rupture. In Type II, the sac grows outward into the myometrium or toward the serosal surface, increasing the chance of uterine rupture. Type III represents the deepest implantation, with significant myometrial invasion, posing the highest risk for rupture and associated placenta accreta spectrum disorders. Figure 1 illustrates these CSP types about residual myometrial thickness. Figure 1 illustrates CSP types according to RMT.

Figure 1. CSP according to RMT



Special Sonographic Markers: COS and Uterine Midpoint

In addition to typical ultrasound features, two useful markers help

refine CSP diagnosis and risk assessment. The Crossover Sign (COS) describes the gestational sac's position relative to the endometrial line on sagittal ultrasound. A COS-1 pattern, where at least two-thirds of the sac crosses above this line, indicates deeper implantation and predicts higher risks for severe bleeding and placenta accreta spectrum (D'Antonio et al., 2025).

Another practical tool is the Uterine Midpoint Rule, which compares the sac's distance from the cervix to the uterine midpoint. In CSP, the sac typically lies closer to the cervix than it would in a normal intrauterine pregnancy, with a sensitivity of about 93% and specificity near 99% (Timor-Tritsch et al., 2016). Both markers are useful for early risk stratification and help guide counseling and treatment planning.

DIFFERENTIAL DIAGNOSIS

Cesarean scar pregnancy must be carefully distinguished from other lower uterine or cervical implantations, particularly cervical pregnancy and miscarriage in progress. Cervical pregnancy, although extremely rare, usually occurs without a prior cesarean history and can be differentiated by its ultrasound features. A classic sign is the "sliding sign"—when gentle pressure with the transvaginal probe causes the gestational sac to move within the cervix, indicating that it is not anchored deeply in scar tissue. This mobility is not seen in CSP, where the sac is firmly implanted into the fibrous cesarean scar tissue.

In contrast, miscarriage in progress typically presents with an open cervical os and a non-viable gestational sac located within the endocervical canal. On ultrasound, there is usually an absence of fetal cardiac activity and no detectable peritrophoblastic blood flow on Doppler imaging, unlike the prominent vascularity seen with CSP (Timor-Tritsch et al., 2016). Recognizing these subtle but critical sonographic differences is essential to avoid misdiagnosis and to ensure appropriate, timely management.

MANAGEMENT

Expectant Management

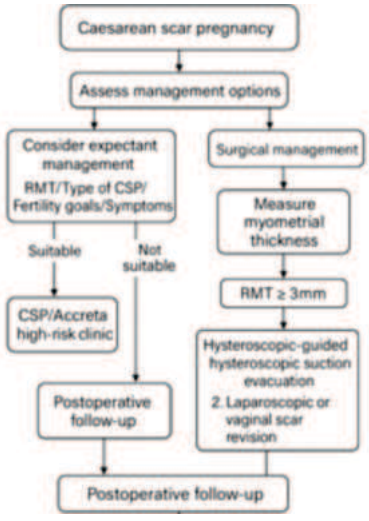
Expectant management is rarely recommended because of high complication risks. If cardiac activity is absent and spontaneous resolution occurs, close monitoring may be appropriate in select stable cases (Abbott, 2020).

MEDICAL MANAGEMENT

Medical management of CSP mainly involves methotrexate (MTX), uterine artery embolization (UAE), or both. MTX, a folate antagonist, may be given systemically (intramuscularly or intravenously) or locally by direct sac injection under ultrasound (Zheng et al., 2023). Systemic MTX works best for early, non-viable CSPs with low β-hCG but is less effective when β-hCG is high or cardiac activity is present; failure rates range from 22% to 48% (Zheng et al., 2023). Patients should be counseled about side effects like mucositis, nausea, alopecia, and bone marrow suppression, with serial β-hCG tests and ultrasound for monitoring. If MTX fails, UAE or surgery may be needed to control bleeding and remove residual tissue. Chemoembolization, which combines intra-arterial MTX with UAE, delivers high local doses while blocking blood flow (Zheng et al., 2023). Direct MTX or potassium chloride injection into the sac can help when cardiac activity is present but should be done only in centers with interventional radiology and surgical backup (Zhang et al., 2017). UAE is often combined with dilation and curettage (D&C) or hysteroscopic removal for better hemostasis and outcomes (Qiao et al., 2016). High-intensity focused ultrasound (HIFU) is another option for early CSP, usually paired with hysteroscopic suction (Diakosavvas et al., 2022). These minimally invasive options aim to preserve fertility and reduce surgical risk but require careful patient selection and expert teams.

SURGICAL MANAGEMENT

Surgical treatment remains central for cesarean scar pregnancies, especially when medical therapy fails, bleeding is severe, or the patient is unstable. The choice depends on residual myometrial thickness (RMT), CSP type, and available expertise. Hysteroscopic resection is preferred when RMT is over 3 mm, allowing safe sac removal with minimal risk (Diakosavvas et al., 2022). If RMT is borderline or removal incomplete, laparoscopy ensures full excision and scar repair. Laparoscopy is ideal for exogenic CSPs extending outward into the myometrium or serosa, enabling defect excision and layered closure to reinforce the scar and lower recurrence risk (OuYang et al., 2019). Vasopressin or electrosurgery can help control bleeding. Combining hysteroscopy and laparoscopy improves safety and fertility outcomes. A transvaginal hysterotomy suits select cases and is safe when done by skilled teams, allowing direct removal with layered closure for better scar strength (OuYang et al., 2019). Post-surgical follow-up with ultrasound at three to six months checks healing and any niche. Patients should wait 12–18 months before conceiving again to allow scar remodeling and reduce recurrence or rupture risk. Managed by a multidisciplinary team in a specialized center, modern surgical approaches-hysteroscopic, laparoscopic, or transvaginal-offer good success, low complications, and favorable fertility outcomes. Figure 2 shows a suggested surgical algorithm for CSP.



Recurrence and Prevention

Recurrence occurs in about 18% of cases. Uterine niche repair is mostly performed for symptomatic relief, and its role in CSP prevention remains unclear (Antoine et al., 2021). Suture techniques that avoid incorporating the endometrium may reduce niche formation, but robust trials are still needed.

CONCLUSION

Early diagnosis with high-resolution ultrasound and clear classification systems such as Types I–III, COS, and RMT guide safe, effective CSP management. Expectant management is rarely appropriate, while tailored medical and surgical combinations help preserve fertility and minimize risk. More large studies are needed to improve prevention and refine treatment pathways.

ABBREVIATIONS

- CSP: Cesarean Scar Pregnancy
- PAS: Placenta Accreta Spectrum
- RMT: Residual Myometrial Thickness
- COS: Crossover Sign
- MTX: Methotrexate
- UAE: Uterine Artery Embolization
- HIFU: High-Intensity Focused Ultrasound

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