




# The Cesarean Scar of Pregnancy: Ultrasound Findings and Expectant Management Outcomes

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## Abstract

**Objective** The nomenclature has evolved from low implantation to cesarean scar pregnancy (CSP) and criteria are recommended for identification and management. Management guidelines include pregnancy termination due to life-threatening complications. This article applies ultrasound (US) parameters recommended by the Society for Maternal Fetal Medicine (SMFM) in women who were expectantly managed.

**Study Design** Pregnancies were identified between March 1, 2013 and December 31, 2020. Inclusion criteria were women with CSP or low implantation identified on US. Studies were reviewed for niche, smallest myometrial thickness (SMT), and location of basalis blinded to clinical data. Clinical outcomes, pregnancy outcome, need for intervention, hysterectomy, transfusion, pathologic findings, and morbidities were obtained by chart review.

**Results** Of 101 pregnancies with low implantation, 43 met the SMFM criteria at < 10 weeks and 28 at 10 to 14 weeks. At < 10 weeks, SMFM criteria identified 45 out of 76 women; of these 13 required hysterectomy; there were 6 who required hysterectomy but did not meet the SMFM criteria. At 10 to < 14 weeks, SMFM criteria identified 28 out of 42 women; of these 15 required hysterectomy. US parameters yielded significant differences in women requiring hysterectomy, at < 10 weeks and 10 to < 14 weeks' gestational age epochs, but the sensitivity, specificity, positive (PPV), and negative predictive values (NPV) of these US parameters have limitations in identifying invasion to determine management. Of the 101 pregnancies, 46 (46%) failed < 20 weeks, 16 (35%) required medical/surgical management including 6 hysterectomies, and 30 (65%) required no intervention. There were 55 pregnancies (55%) that progressed beyond 20 weeks. Of these, 16 required hysterectomy (29%) while 39 (71%) did not. In the overall cohort of 101, 22 (21.8%) required hysterectomy and an additional 16 (15.8%) required some type of intervention, while 66.7% required no intervention.

**Conclusion** SMFM US criteria for CSP have limitations for discerning clinical management due to lack of discriminatory threshold.

## Keywords

- ▶ cesarean scar pregnancy
- ▶ low implantation
- ▶ peripartum hysterectomy ultrasound

received

January 6, 2023

accepted

January 26, 2023

accepted manuscript online

February 21, 2023

DOI <https://doi.org/10.1055/a-2040-1458>.  
ISSN 0735-1631.

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### Key Points

- The SMFM US criteria for CSP at <10 or <14 weeks have limitations for clinical management.
- The sensitivity and specificity of the ultrasound findings limit the utility for management
- The SMT of <1 mm is more discriminating than <3 mm for hysterectomy.

Cesarean scar pregnancy (CSP) has had several designations, including cesarean scar ectopic pregnancy, low implantation placenta, early placenta accreta, morbidly adherent placenta, and trophoblastic cesarean implantation. CSP is currently defined as an embryo whose basalis implants in the scar tissue from a previous cesarean hysterotomy. This condition is reported to be associated with a high rate of severe maternal morbidity and mortality.<sup>1–5</sup> Although rare, the incidence of CSP has been steadily increasing along with the rate of cesarean deliveries, reaching an estimated incidence between 1 case per 1,800 and 2,656 pregnancies in the United States.<sup>1–5</sup>

The prerequisite for the development of CSP is at least one previous cesarean delivery. However, it is unclear whether the number of previous cesarean deliveries further increases the risk, and current literature indicates that 52% occur in patients with only one prior cesarean.<sup>1</sup> The CSP is a relatively new term to describe those low implantations of the basalis in the first trimester that are near the cesarean scar and have ultrasound (US) characteristics that are associated with increased morbidity due to placental accreta spectrum (PAS).<sup>1–17</sup> The Society for Maternal Fetal Medicine (SMFM) issued guidelines focusing on the US parameters of presence of the niche or ovoid appearance near the scar, smallest myometrial thickness (SMT), and evidence of increased vascularity of the basalis in the lower uterine segment near the scar.<sup>1</sup> Symptoms of CSP in the first trimester are variable, the most common of which is vaginal bleeding.<sup>1–17</sup>

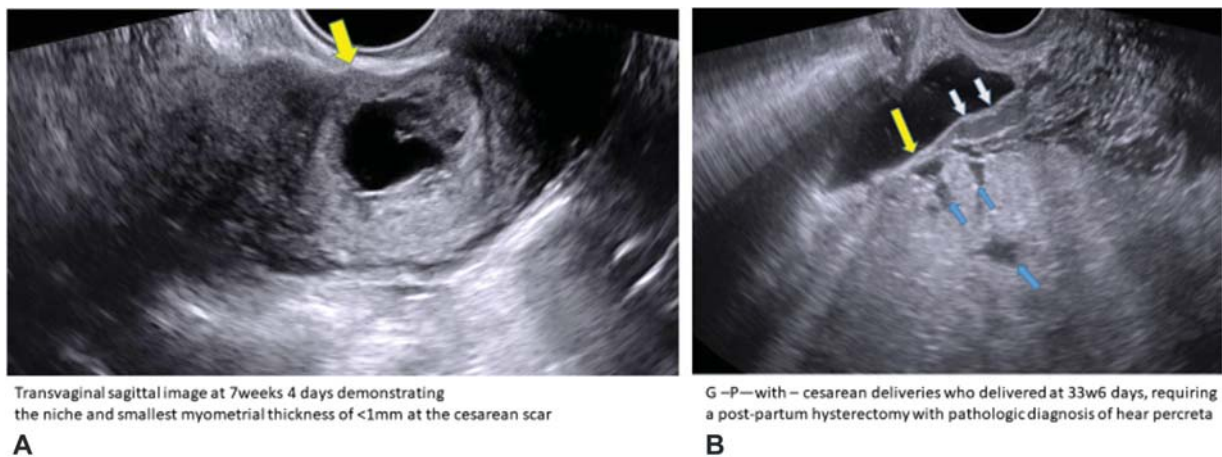
Due to its rarity, uncertainties exist on the natural history and optimal management of CSP. It has been observed that some cases continue to a viable gestational age, and those

that do are at high risk for severe obstetrical complications. In cases where CSPs have resulted in live births, they have been associated with PAS, peripartum hysterectomy, and hemorrhage at delivery.<sup>1–12</sup> The natural history and rate of complications has been described in some prospective series.<sup>5,6,12</sup> To further evaluate the natural history of CSP, we conducted a retrospective review to evaluate relevance of SMFM CSP US criteria and review outcomes in women who were expectantly managed.

### Materials and Methods

This study was approved by the Institutional Review Board and included only women with prior cesarean delivery. CSPs were identified searching for the diagnosis of “cesarean scar,” “low implantation,” and “cesarean ectopic” from a maintained obstetric U.S. database between March 1, 2013 and December 31, 2020. Transvaginal US images were reviewed blinded to clinical outcome for presence of a niche or ovoid appearance, SMT, and location of basalis (C.Y. and D.T.; **Fig. 1**). Transvaginal US studies included sagittal and transverse images and cine. Gestational age and clinical indications for the study were obtained separately from the US review.

Clinical outcomes including medical and surgical history, intrapartum characteristics, and pregnancy outcomes were obtained by chart review blinded to imaging findings (D.T., C. Y.). Maternal age at delivery, number of prior cesareans, and prior uterine surgery were recorded. Whether or not the pregnancy failed before 20 weeks and 0 days was documented. In the cases of failed pregnancy before 20 weeks,



**Fig. 1** G4 P3 with 3 previous cesarean deliveries who underwent cesarean hysterectomy with confirmed placenta percreta. (A) At 7<sup>3/7</sup> weeks, the niche is present (yellow arrow) with the smallest myometrial thickness of < 1 mm. (B) At 12<sup>4/7</sup> weeks, a niche is no longer present, with the smallest myometrial thickness of < 1 mm (yellow arrow). Also seen are placental lacunae (blue arrows) and bladder flap varices (white arrows).

interventions, including medical and surgical managements were obtained. Beyond 20 weeks, gestational age at delivery, mode of delivery, need for peripartum hysterectomy, and pathologic findings were obtained. Delivery data included estimated blood loss and transfusions. Subsequent pregnancy episodes and outcomes were obtained when available.

Statistical analysis included chi-square for nominal data and analysis of variance for parametric data with  $p < 0.05$  considered significant. Sensitivity, specificity, positive, and negative predictive values were calculated for SMFM criteria.<sup>1</sup>

## Results

Using the search terms of low implantation, cesarean scar of pregnancy, or cesarean ectopic, we identified 109 cases. After review of the US 101 cases with adequate images of the lower uterine segment were included in the analysis. Of the 101 cases included, 46 failed prior to 20 weeks of gestation, and 55 progressed beyond 20 weeks. Sixty-nine (69%) required no intervention. Twenty-two (22%) required hysterectomy at delivery. Sixteen of the 46 that failed prior to 20 weeks required intervention, including 7 dilatation and curettages (D&Cs), 6 hysterectomies, 2 requiring medical therapies, and 1 classical cesarean (→Fig. 2).

Thirty-four (34%) did not have cardiac activity on their initial US study. Of these 24 (71%) required no intervention. Ten (29%) required an intervention, of these five required a D&C, two required medications (methergine, methotrexate), and there were three hysterectomies. Two of the three hysterectomies had documented invasion on pathology, and the third received mifepristone and misoprostol at an outside facility and presented with bleeding, requiring hysterectomy.

Of 67 (66%) with documented cardiac activity at initial presentation, 12 (18%) failed prior to 20 weeks. Of these 12 failed pregnancies, 6 (50%) required intervention (2 D&Cs, 3 hysterectomies, and 1 classical cesarean). Of the 55 who progressed beyond 20 weeks, 4 (7%) successfully had a vaginal birth after cesarean, 51 (92.7%) had a cesarean delivery, and 16 of the 51 (29%) required a hysterectomy at delivery. Of those requiring hysterectomy, 12 (75%) were anticipated and 4 (25%) were unanticipated.

Of the 101 pregnancies with confirmed CSP, 43 met the SMFM US criteria < 10 weeks and 28 at 10 to 14 weeks. Those resulting in hysterectomy were more likely to have a niche present at < 10 weeks and 10 to 14 weeks and a smaller myometrial thickness at 10 to 14 weeks (→Table 1). The sensitivity, specificity, positive, and negative predictive values for cesarean hysterectomy revealed that the presence of a

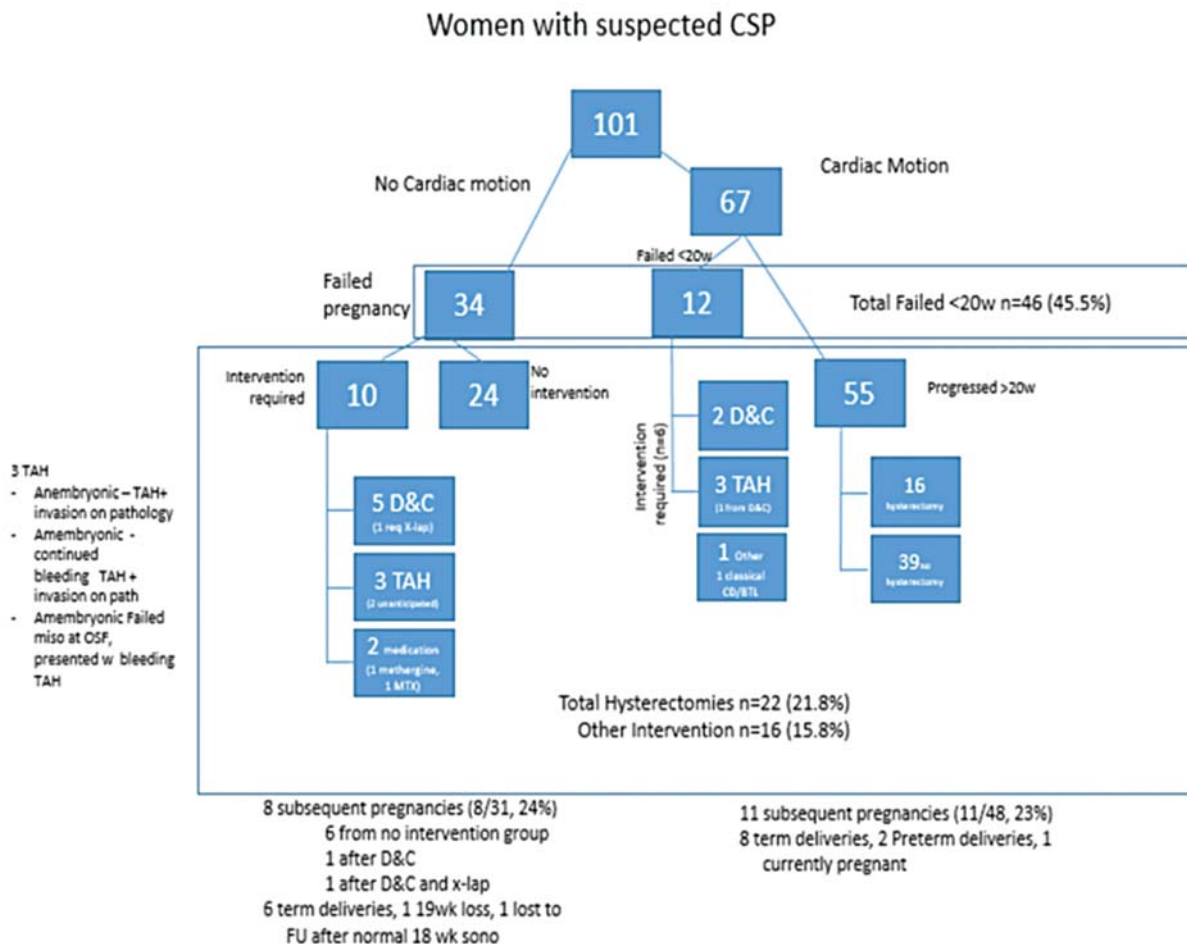


Fig. 2 Summary of findings in women with suspected cesarean scar pregnancy (CSP).

**Table 1** Cases meeting SMFM CSP criteria

US variables	Hyst	No Hyst	p-Value	Sens	Specif	PPV	NPV
< 10 wk niche +	13/13 (100%)	14/31 (45%)	0.0007	100%	55%	48%	100%
< 10 wk SMT ≤ 3 mm	11/13 (85%)	29/32 (91%)	0.561	85%	9%	28%	60%
< 10 wk SMT < 1 mm	9/13 (69%)	9/32 (28%)	0.011	69%	72%	100%	85%
10–14 wk niche +	8/15 (53%)	2/13 (15%)	0.037	53%	85%	80%	61%
10–14 wk SMT ≤ 3 mm	15/15 (100%)	13/13 (100%)	1	100%	0	26%	0
10–14 wk SMT < 1 mm	14/15 (93%)	4/13 (31%)	0.0006	93%	69%	78%	90%

Abbreviations: CSP, cesarean scar pregnancy; Hyst, hysterectomy; NPV, negative predictive value; PPV, positive predictive value; Sens, sensitivity; SMFM, Society for Maternal Fetal Medicine; SMT, smallest myometrial thickness; Specif, specificity; US, ultrasound.

niche was 100% sensitive but only 55% specific before 10 weeks and only 53% sensitive and 15% specific beyond 10 weeks. Also, the SMT of < 1 mm is more discriminating than < 3 mm in its association with hysterectomy and was the most significant parameter at 10 weeks and beyond. The SMT of < 1 mm showed better associations with postpartum hysterectomy than the ≤ 3 mm cut-off (→Fig. 3). At < 10 weeks, the SMFM criteria identified 45/76 women; of these 13 required hysterectomy and 32 did not; there were 6 who required hysterectomy who did not meet the SMFM criteria. At 10 to < 14 weeks, the SMFM criteria identified 28/42 women; of these 15 required hysterectomy. Of those pregnancies progressing beyond 20 weeks (n = 55), 39 (71%) did not require hysterectomy (→Table 2).

There were 19 subsequent pregnancies. Of those women who in their previous pregnancies presented with no evi-

dence of cardiac activity, 8 had subsequent pregnancies and 6 were in the no intervention group. Of the 8, there were 6 term deliveries, one 19-week pregnancy loss, and one lost to follow-up after a normal 18-week sonogram. Of the group of 11 women whose fetuses presented with cardiac activity, there were 8 term deliveries, 2 preterm deliveries, and 1 currently pregnant.

**Comment**

**Principle Findings**

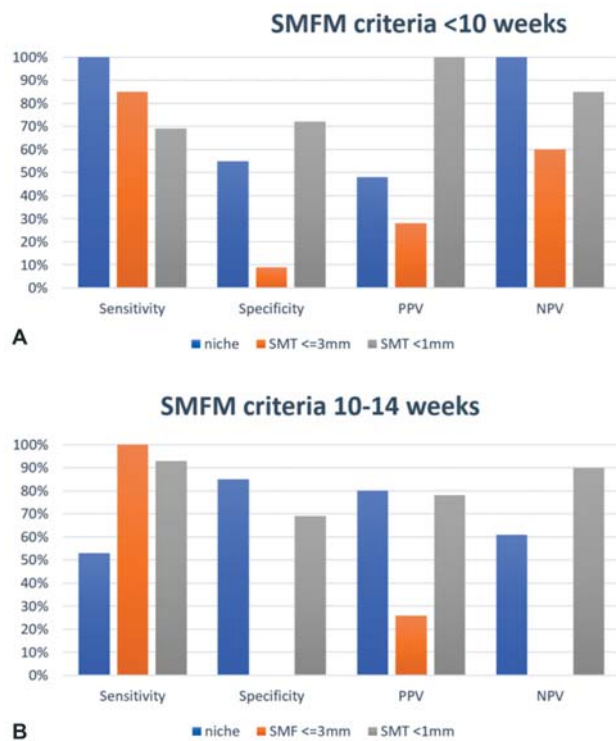
We found that the SMFM US criteria for CSP have limitations for discerning clinical management. Over two-thirds of cases of pregnancies require no intervention. Of pregnancies with cardiac activity who progressed beyond 20 weeks, one-third required hysterectomy at delivery.

**Results in the Context of What is Known**

Current consensus is that pregnancy termination is a consideration in the management of CSP. Due to the high rate of life-threatening complications associated with the condition, the SMFM strongly recommends against the expectant management of CSP unless there is a fetal demise or early pregnancy loss.<sup>1</sup> According to the SMFM guidelines, patients who choose expectant management should be advised of the potential complications of placental invasion and peripartum hysterectomy, a maternal-fetal medicine (MFM) specialist should closely monitor them, and they should deliver via cesarean between 34 weeks 0 day and 35 weeks 6 days gestation at a tertiary care center.<sup>1</sup> Our data suggest that expectant management can be associated with successful pregnancy outcomes and less morbidity than SMFM recommendations. Of those with cardiac activity, 82% continued past 20 weeks with 7% having a vaginal delivery, and only 29% requiring hysterectomy at delivery, with the remainder having a cesarean delivery without complications. Nonetheless, patients who choose expectant management should be advised of the potential complications of placental invasion and peripartum hysterectomy, with close monitoring by an MFM specialist.

**Clinical and Research Implications**

The impact of CSP on future fertility is poorly understood. Studies exploring the outcome of subsequent pregnancies



**Fig. 3** Prediction parameters of the Society for Maternal Fetal Medicine (SMFM) criteria at (A) less than 10 weeks and (B) 10 to 14 weeks.

**Table 2** Demographics

	All	Hysterectomy (n = 22)	No hysterectomy (n = 79)	p-Value
Maternal age (y)		31.7 + 5.1	31.7 + 5.5	1
Race/ethnicity				0.225
Hispanic		13 5(9.1%)	58 (73.4%)	
White		2 (9.1%)	3 (3.8%)	
Black		6 (27.3%)	16 (20.3%)	
Other		1 (4.5%)	2 (2.5%)	
Prior cesareans	2 (1–5)	2 ± 0.9 (1–4)	2 ± 0.9 (1–5)	1
Prior D&C	0 (0–2)	0.2 ± 0.5 (0–2)	0.2 ± 0.5 (0–2)	1
Prior myomectomy	2 (0–2)	1/22	1/79	0.329
Failed pregnancy < 20 wk	46 (45%)	6/22 (27%)	40/79 (51%)	0.052
Gest age at delivery > 20 wk	259 (49–278)	33.6 ± 4.2 (21–38) [n = 16]	36.6 ± 3.6 (21–39) [n = 39]	0.001
Delivery method				<0.001
Resolved	30 (30%)	0	30 (38%)	
Cesarean delivery	52 (51%)	16 (73%)	36 (46%)	
TAH/TLH	5 (5%)	5 (23%)	0	
VBAC/SVD	5 (5%)	0	5 (6%)	
D&C	7 (7%)	1 (5%)	6 (8%)	
Other (methergine/MTX)	2 (2%)	0	2 (2%)	
Estimated blood loss	1,772 ± 2,081 (20–10,000)	3,529 ± 2,955 (50–10,000)	949 ± 498 (20–2,500)	<0.001
Blood transfusion	15 (15%)	18/22 (82%)	7/79 (9%)	<0.001
Clinical invasion	22 (22%)	21/22	1/46	<0.001
Pathologic invasion	21 (21%)	21/22	0	<0.001
Pregnancy after CSP	19 (19%)	0	19/79 (24%)	0.004

Abbreviations: CSP, cesarean scar pregnancy; D&C, dilatation and curettage; Gest age, gestational age; MTX, methotrexate; TAH/TLH, total abdominal hysterectomy/total laparoscopic hysterectomy; VBAC/SVD, vaginal birth after cesarean/spontaneous vaginal delivery.

after conservative management of CSP report a wide range of recurrence rates between 5 and 25%, and some reported an elevated risk of PAS.<sup>18,19</sup> However, a more precise rate of recurrence as well as the interval between the resolution of CSP and subsequent pregnancy is unknown. Our findings add to this data. To date, 20% of our patients had subsequent uncomplicated pregnancies.

**Strengths and Limitations**

Our study has both strengths and limitations. The SMFM criteria were retrospectively applied and did not include color Doppler mapping criteria. We along with others have found a positive association between color Doppler mapping, but again establishing a discriminatory quantification remains problematic.<sup>20</sup> Additionally, the definition of CSP was evolving during our study period, so our inclusion criteria were that of evidence of implantation of the basalis near the pressured location cesarean scar and within 5 cm of the external os.<sup>9–11,14–16</sup> Applying the SMFM US criteria yielded 43 women with positive findings but did not identify all high morbidity cases, nor did the positive findings offer an acceptable discriminatory assessment.

**Conclusion**

Our study evaluated the SMFM US criteria in the diagnosis of CSP. Important US findings include the presence of a niche, which was 100% sensitive but only 55% specific before 10 weeks and only 53% sensitive and 15% specific beyond 10 weeks. Also, the SMT of < 1 mm is more discriminating than < 3 mm in its association with hysterectomy and was the most significant parameter at 10 weeks and beyond. Our series of expectant management outcomes and subsequent pregnancy information, as well as the US parametric data of the SMT < 1 mm, may aid in counseling patients on management decisions. Future large multicenter prospective studies may provide more quantitative analysis and consistent discriminatory criteria.

**Conflict of Interest**

None declared.

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