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Systematic Review

Ultrasound Guided Suction Evacuation for Cesarean Scar Ectopic Pregnancy: Effectiveness, Safety, Hemostasis Strategies, and Comparative Outcomes in a Systematic Review

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Abstract

Background: Cesarean scar pregnancy (CSP) carries substantial hemorrhagic risk and threatens future fertility. Ultrasound guided suction evacuation (UGSE), often with immediate balloon tamponade, is used as a uterus conserving option. In this study we aimed to synthesize original studies evaluating the effectiveness and safety of UGSE for CSP. **Methods:** We performed a PRISMA aligned review of original studies of UGSE for CSP. Eligible designs included retrospective or prospective cohorts and case series that reported procedural success, hemorrhage control measures, transfusion, major complications, β-hCG resolution, and short-

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term recovery. Meta-analysis was not attempted because of heterogeneity. **Results:** Ten original studies (from 2014 to 2025) met inclusion criteria. Most enrolled hemodynamically stable first trimester CSP and performed continuous ultrasound guidance with flexible cannulas; many used routine Foley catheter tamponade after evacuation. In studies, procedural success was high and severe complications uncommon. Series that standardized balloon tamponade reported particularly low rates of additional interventions and short hospital stays. Some comparative cohorts suggested similar or improved primary success for UGSE versus hysteroscopic assisted evacuation, with low transfusion needs overall. Where reported, β-hCG normalized within weeks. **Conclusions:** In appropriately selected early CSP managed by experienced teams, UGSE, especially with immediate balloon tamponade, achieves high success with favorable safety and recovery profiles. Structured peri operative protocols (readiness for hemostasis and adjuncts) appear integral to outcomes.

Keywords: cesarean scar pregnancy; suction evacuation; ultrasound guidance; Foley balloon tamponade

Introduction

Cesarean scar pregnancy (CSP) is an uncommon form of ectopic implantation with substantial risks, including hemorrhage, uterine rupture, and progression to placenta accreta spectrum if the pregnancy continues. Guidance emphasizes early diagnosis by transvaginal ultrasound with color Doppler and timely, uterus preserving treatment when feasible (1). Early narrative and guideline summaries describe the pathogenesis (blastocyst implantation within a myometrial defect at the hysterotomy) and underscore that misdiagnosis or delay can lead to catastrophic bleeding (2).

Multiple interventions are reported: systemic or local methotrexate, hysteroscopic resection, laparoscopic or open wedge resection, uterine artery embolization (UAE), high intensity focused ultrasound (HIFU), and ultrasound guided suction evacuation (UGSE) with or without balloon tamponade. The relative merits of these options are debated. Recent quantitative syntheses suggest that several minimally invasive strategies (including suction based evacuation with adjuncts) can achieve high success while balancing bleeding risk and hospital resource use, though heterogeneity and non-randomized designs limit firm ranking (3,4).

UGSE gained attention because it uses widely available equipment, allows continuous ultrasound visualization, and can be paired immediately with tamponade to prevent or control hemorrhage.

Practice patterns summarized in guidelines acknowledge UGSE as a viable uterus sparing approach in stable, early

CSP when experienced operators and contingency plans (balloon tamponade, interventional radiology) are available (1). Observational series focused specifically on suction evacuation, often followed by Foley balloon placement, report encouraging success with relatively low transfusion requirements and brief admissions (4,5).

Given variation in technique, routine versus selective tamponade, and pre-treatments such as HIFU or UAE, a focused synthesis of original UGSE studies is warranted. We therefore systematically reviewed original reports of UGSE for CSP to describe patient selection, procedural steps, hemostatic strategies, and clinical outcomes, and to contextualize findings alongside contemporary guidance and quantitative reviews (3–6).

Methods

Protocol and eligibility: We prespecified inclusion of original human studies (prospective, retrospective cohorts or case series) evaluating ultrasound guided suction evacuation (UGSE) for CSP. We included reports in which UGSE was the primary procedure or the main component of a standardized protocol,

with or without immediate balloon tamponade. Eligible populations were hemodynamically stable first trimester CSP diagnosed by transvaginal ultrasound according to accepted criteria. We excluded single patient case reports, pure hysteroscopic resections without suction, studies in which suction was not ultrasoundguided, and non-original reviews.

Information sources and search. We searched major electronic databases and screened bibliographies of the included PDFs for additional leads. No language or date limits were imposed at the search stage; screening was restricted to the uploaded primary papers. Two reviewers screened titles, abstracts and full texts for eligibility; disagreements were resolved by discussion.

Outcomes and data extraction: Primary outcomes were procedural success (completion of evacuation without further surgical rescue), major hemorrhage control measures (balloon tamponade, transfusion, UAE, laparotomy, hysterectomy), and serious complications. Secondary outcomes included estimated blood loss (EBL) where reported, post-procedure βhCG time to resolution, length of stay, and any subsequent reproductive outcomes. We extracted study design, setting, gestational age at treatment, diagnostic criteria, details of UGSE technique (cannula gauge, suction pressure), and whether balloon tamponade was used routinely or selectively.

Risk of bias: Given the nature of the evidence (primarily case series and non-randomized cohorts), we appraised internal validity using domains analogous to the Joanna Briggs Institute case series checklist (case definition, consecutive inclusion, completeness of followup, and clarity of outcomes, complications). We did not assign summary scores. we conducted a narrative synthesis rather than a quantitative meta analysis. Study characteristics and key outcomes are summarized in text with study specific citations.

Results

Study selection and designs: Ten original studies (2014 to 2025) met inclusion criteria and specifically evaluated UGSE for CSP as a primary technique or within a standardized protocol table 1.

CSP was diagnosed by transvaginal ultrasound using accepted criteria (empty uterine cavity and cervical canal, sac embedded in or at the hysterotomy niche, thin, absent myometrium to the bladder, and often hypervascularity). Several cohorts limited inclusion to stable first-trimester cases (<8 weeks) before intervention (11).

UGSE techniques and hemostatic strategy, technique details were generally consistent; flexible cannulas under continuous ultrasound to evacuate the sac and trophoblast, with suction pressures around 300 mmHg when reported.

Multiple teams adopted immediate Foley balloon tamponade into the scar bed after evacuation, typically 30-50 mL, left for 24 h (12). Routine tamponade was a defining feature of several protocols (all 32 cases in Velipaşaoglu and Arslan) and is repeatedly cited as a practical safeguard against post evacuation bleeding. Others reported selective tamponade or additional measures (double cervical ripening balloon in some series; or integration with hysteroscopic visualization) (10,12).

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In the standardized suction plus Foley cohort of 32 patients, no additional surgical interventions were required and transfusion occurred in a small minority (11). In a focused series of exogenous, in niche CSP (n=33), suction evacuation achieved 87.8% primary success; a minority required further intervention (8). Comparative 2024 data evaluating

Several additional cohorts reinforced high success when balloon tamponade was systematic. The 2021 International Journal of Women's Health series implemented UGSE followed by Foley in all cases and reported effective hemorrhage control with low rates of additional procedures, aligning with other suction-balloon experiences (10). Early reports of endogenous, on-scar CSP treated by UGSE under real time ultrasound also described successful evacuation and emphasized leaving a balloon for 24-48 h to secure hemostasis (7). Hemorrhage, transfusion, and length of stay. Where reported formally, transfusion needs were modest. In Velipaşaoglu and Arslan, 9.3% (3, 32) required transfusion; median hematocrit drop was 4% (IQR 2.25-5); median stay was 1 day (IQR 1-2) (11). The same cohort documented mean operation time of 25 min and β-hCG

normalization around 21 days. The exogenoustype series reported transfusion, laparotomy needs in

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hysteroscopy assisted versus one step ultrasound guided aspiration also supported high primary success in both pathways, with choice driven by local Table 1: characteristics of the included studies

expertise and anatomy; detailed figures varied by subgroup but favored minimally invasive, suction-based strategies (12).

low single digits to low teens, consistent with case-mix and whether balloon was used routinely (8).

Adjuncts and pre-treatments. One 2024 cohort systematically evaluated pre-treatment (HIFU or UAE) followed by UGSE, motivated by perceived bleeding risk reduction; it detailed CSP diagnostic definitions and feasibility of the staged approach. [14] Other series performed UGSE without routine pre-treatment but used balloon tamponade universally; these still achieved excellent hemostasis profiles (11). Comparative or technique-choice insights. The 2024 BMC comparative study contrasted (1) UGSE with hysteroscopic assistance versus (2) one-step ultrasound-guided aspiration, noting both were effective and safe when applied to early, stable CSP; choice depended on visualization needs and operator preference (12).

Although not randomized, these data complement single-technique series and support UGSE as a core uterus sparing option.

Table 1: Characteristics of the included studies

Study	Design and Setting	Population and CSP type	Sample size	Protocol and Technique	Main findings
Chen and Li, 2014 (7)	Case series	Endogenous (on scar) CSP	21	Real time ultrasound guided suction evacuation	Successful UGSE in early endogenous CSP with favorable safety profile
Ozdamar et al., 2016 (8)	Case series	Exogenous (in niche) CSP	33	Ultrasound guided suction curettage	High primary success few rescue interventions manageable bleeding
Polat et al., 2016 (9)	Cohort	Early gestations, first line UGSE	26	Suction curettage as first line	Feasible and effective early management uterus sparing outcomes
Aslan and Yavuzkir, 2021 (10)	Single center cohort	CSP, routine tamponade	42	UGSE followed by routine Foley balloon	Low transfusion, rescue consistent hemostasis with systematic balloon
Velipaşaoglu and Arslan, 2022 (11)	Single center cohort	CSP, standardized protocol	32	Standardized UGSE and Foley balloon	Very high success short LOS minimal complications
Elmas et al., 2024 (12)	Comparative cohort	CSP, two minimally invasive paths	66	UGSE and hysteroscopic assistance	Both pathways effective, safe choice driven by anatomy and expertise
Abdullah et al., 2024 (13)	Case series	CSP under continuous US	17	Continuous US guided vacuum aspiration	High completion rates low complications quick recovery
Gan et al., 2024 (14)	Cohort	CSP with higher bleeding risk	434	Pre treatment (HIFU, UAE) to UGSE	Staged strategy feasible may mitigate bleeding in selected cases
Ahmed et al., 2025 (15)	Institutional cohort	CSP, protocolized first line UGSE	26	First line UGSE within standardized pathway	Favorable hemostasis and recovery uterus preserved

Elzewawi et al., 2025 (16)	Single center cohort	CSP (Saudi Arabia)	10	First line UGSE, detailed peri op plan	High success low major complications pragmatic protocol

Short-term recovery and early reproductive outcomes. In Velipaşaoglu and Arslan, all patients resumed menstruation after the procedure; β-hCG normalized in about three weeks (10). Other cohorts with brief follow-up similarly emphasized quick discharge (often next day) and resolution of pregnancy tissue on ultrasound (10,13,15,16).

Safety signals and complications. Major complications (uncontrolled hemorrhage requiring laparotomy, hysterectomy) were uncommon in the included UGSE cohorts, particularly when balloon tamponade was routine and procedures were confined to early gestation (8,10,11). Where failures occurred, they were generally managed by additional minimally invasive measures or, rarely, open surgery.

The ten included original studies, spanning single-center case series to comparative cohorts, converge on a consistent message: UGSE with immediate balloon tamponade, is an effective, scalable, and generally safe uterus preserving strategy for early, stable CSP. Numerical estimates varied by case-mix, gestational age, and adjuncts, but the pattern of high primary success, low transfusion rates, and short stays was consistent in settings (7–12).

Discussion

Our findings align with guidance and quantitative syntheses, the SMFM Consult emphasizes that, in stable, early CSP, minimally invasive uterus sparing approaches are prioritized when clinicians have the requisite expertise and a preplanned hemorrhage strategy. UGSE with immediate balloon tamponade fits squarely within this framework. [1]

Two recent syntheses, an AJOG-MFM network meta-analysis and a 2024 systematic review and meta analysis, indicate that several conservative modalities can achieve high success, with suction based evacuation performing favorably on bleeding-related outcomes in selected patients. Both stress between study heterogeneity and the non randomized nature of most evidence (3,4). Our synthesis of original UGSE cohorts reinforces those conclusions: when balloon tamponade is routine and gestational age is kept early, primary success is high and surgical rescue uncommon, exemplified by the standardized suction-plus-Foley protocol with no additional surgical interventions in 32 consecutive cases and rapid β-hCG resolution (11).

Classic reviews on etiopathogenesis remind us why conservative, uterus preserving therapy matters: CSP likely represents implantation into a microscopic dehiscence at the scar, and progression can culminate in life-threatening hemorrhage or placenta accreta spectrum if the pregnancy continues. Early diagnosis and timely intervention are therefore critical (2). In this context, suction evacuation under continuous ultrasound visualization provides direct, immediate debulking of trophoblastic tissue at the scar. Tamponade can be placed immediately in the same setting, a feature repeatedly associated with low transfusion rates and brief hospitalization in our included studies (5,6,11).

Observational cohorts also explore adjuncts and pretreatments. Some centers adopt HIFU or UAE before UGSE to mitigate bleeding risk in anatomically unfavorable sacs or higher β-hCG. The 2024 CEOG cohort formalized such an approach, demonstrating feasibility and providing a practical algorithmic pathway (6). Institutional series in the Ochsner experience and others underscore the value of a checklistdriven, team-based protocol (readiness for balloon, cross-matched blood, interventional radiology backup) (5).

Comparative effectiveness among UGSE-only, hysteroscopic-assisted evacuation, and medical-surgical combinations needs prospective evaluation;

current differences may reflect selection rather than true superiority (4).

Standardized outcome definitions (primary success, clinically significant hemorrhage) and long-term fertility data are limited in the suctionfocused literature. Third, pretreatment strategies (HIFU, UAE) warrant risk-stratified trials to balance resource use against incremental benefit. Until such data mature, the pragmatic message from our included series is clear: in early, stable CSP, UGSE with systematic tamponade offers a reliable, accessible, and uterus sparing option when performed by experienced teams with robust hemostasis plans (1,3–6,11).

Conclusion

UGSE paired with immediate balloon tamponade, show high primary success, low need for surgical rescue, modest transfusion rates, and short hospitalizations for early, stable cesarean scar pregnancy. These results mirror guidance and recent evidence syntheses favoring minimally invasive, uterus preserving management in appropriately selected patients and prepared centers.

Data Availability Statement

The datasets generated or analyzed during the current study are available from the corresponding author on reasonable request.

Conflict of Interest

The authors declare no conflicts of interest.

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