

Management of Viable Cesarean Scar Pregnancies (CSP) with Potassium Chloride (KCl) and the Requirement for Adjunctive Treatments

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Introduction: Cesarean scar pregnancy (CSP) is a rare type of ectopic pregnancy that implants in or on the scar of a previous cesarean birth. The mechanism for implantation of a CSP is not completely understood. If left untreated, CSP can increase the risk of maternal complications such as uterine rupture, miscarriage, postpartum hemorrhage, and the development of placenta accreta spectrum. Potassium chloride (KCl) has been employed in the treatment of CSP as a conservative approach aiming to preserve the uterus and future fertility.

Objective: To analyze the success rate and adverse outcomes associated with cases of viable CSP treated with KCl and requirement for adjunctive treatments.

Methods: In this retrospective cohort study all viable CSPs treated cases were reviewed. Patient files were analyzed for demographic and clinical data. SPSS Version 22 was utilized for statistical analysis.

Results: Twenty-two patients were treated, with a mean maternal age of 35.8 years (28–43) and mean BMI of 31.4 kg/m² (20–53). Successful resolution, defined by a decline of serum β -hCG to undetectable levels without surgical intervention, was achieved in 95.5% (21/22). Thirteen patients (59.1%) resolved with KCl alone. Adjunctive measures included KCl with systemic methotrexate were needed for five patients (22.7%) due to plateauing serum β -hCG levels. Two patients required adjunctive treatment with either uterine artery embolization (UAE), or systemic methotrexate and UAE. One patient (4.5%) after failed management with UAE and two doses of methotrexate, underwent secondary treatment with KCl injection that resulted in embryonic demise and a successful outcome. Follow-up was available for all 22 patients (100%), and complete resolution without major complications was confirmed. In conclusion, KCl is a reasonable approach as a first line management of viable CSP, however, patients should be aware of possibility of treatment failure and need for additional treatment measures.

Plain Language Summary: KCl injection is an effective, fertility-preserving option for the management of cesarean scar pregnancy. It offers a minimally invasive, outpatient treatment that helps patients avoid the need for surgery and the complications associated with it.

Keywords: cesarean scar, ectopic, pregnancy, KCl, embolization

Introduction

Cesarean scar pregnancy (CSP) is a rare type of ectopic pregnancy in which the embryo implants directly into the fibrous tissue of a prior cesarean incision, most often through a microscopic defect in the myometrium.^{1,2} The incidence has been reported to occur in approximately one per 1800–2500 cesarean deliveries.^{3,4} Several factors have been associated with a risk of development CSP, such as: history of one or more cesarean deliveries, short inter-pregnancy interval, prior



uterine surgical procedures, higher gravidity and parity, assisted reproductive techniques, and the presence of a cesarean scar defect (niche).^{5–7}

CSP poses a serious risk to both maternal and fetal health if left untreated. As the pregnancy progresses, the scar tissue may stretch and weaken, ultimately increasing the risk of uterine rupture — a life threatening complication.⁸ Uterine rupture can occur at any stage of pregnancy, depending on the depth of implantation and the extent of trophoblastic invasion. Abnormal implantation within the scar also carries a risk of significant internal bleeding as the pregnancy progresses. Severe hemorrhage may necessitate emergency surgical intervention, including hysterectomy, to control bleeding and preserve the patient's life.⁹

CSP is often associated with abnormal placentation, particularly placenta accreta, where the placenta invades too deeply into the uterine wall.¹⁰ This condition may lead to catastrophic bleeding during attempted placental removal after delivery, frequently requiring hysterectomy.⁹ Furthermore, due to the poor vascular supply and abnormal implantation environment, there is a high risk of miscarriage.¹¹ Both CSP itself and its treatment can compromise the structural integrity of the uterus, with potential long-term consequences for fertility, including increased recurrence risk in future pregnancies and complications such as placenta previa.⁹

Several management strategies have been described, with varying success rates. Medical approaches include the use of potassium chloride (KCl) and methotrexate, administered either alone or in combination.^{12,13} Intralesional injection of KCl, typically delivered under ultrasound guidance either transabdominally or transvaginally directly into the fetal heart, induces fetal demise and prevents further gestational growth, thereby reducing the risk of rupture and hemorrhage.^{14–16} Although data on KCl monotherapy are limited, combination therapy with systemic or local methotrexate has shown high efficacy, defined as complete resolution without the need for surgery.¹⁵

Despite increasing use of KCl for the management of viable CSP, data regarding KCl monotherapy remain limited and heterogeneous. Most published reports consist of small case series or combined treatment approaches, frequently incorporating systemic or local methotrexate, UAE, or surgical adjuncts. As a result, uncertainty persists regarding the true efficacy of KCl as a sole treatment modality, the rate of treatment failure necessitating additional interventions, and its short-term safety profile.¹⁷ Furthermore, standardized criteria for patient selection and outcome reporting are lacking, limiting meaningful comparison across studies.^{17–20} The present study aims to address these gaps by evaluating outcomes of viable CSP treated primarily with ultrasound guided KCl injection, with particular emphasis on treatment success rates, need for adjunctive therapy, and associated complications.

Expectant management, involving close monitoring with serial ultrasounds and β -hCG levels, may be considered in cases of nonviable or spontaneously resolving pregnancies. Surgical options may also be considered which include dilation and curettage, laparoscopy, laparotomy, or hysteroscopy. Ultimately, the choice of treatment must be individualized, with the dual aim of ensuring maternal safety and preserving fertility.²⁰

Several clinical and sonographic factors have been proposed as potential predictors of treatment success or failure in CSP, although available evidence remains inconsistent. These factors include gestational age at diagnosis, presence of embryonic cardiac activity, initial serum β -hCG levels, depth of implantation within the myometrium, residual myometrial thickness between the gestational sac and bladder, and degree of trophoblastic vascularity on Doppler imaging.^{5,6,9,15,16} Higher gestational age, elevated β -hCG levels, and deeper myometrial invasion have been associated with increased risk of treatment failure and need for additional interventions in some studies, while others report variable outcomes, underscoring the need for further evaluation of predictors specifically related to KCl-based management strategies.

Definitions of treatment “success” in the existing literature vary considerably, further complicating interpretation and comparison of outcomes. Some studies define success as immediate cessation of embryonic cardiac activity, while others require complete biochemical resolution with normalization of serum β -hCG levels, absence of major complications, or avoidance of surgical intervention.^{17,18,21} In several reports, the requirement for adjunctive medical or interventional therapy is still considered a successful outcome, whereas other studies classify such cases as treatment failure.²¹ This lack of uniformity highlights the importance of clearly defined outcome measures when evaluating conservative treatment modalities for CSP.

The aim of the study is to analyze the success rate and adverse outcomes associated with the use of KCl as primary treatment of CSP. Additionally, in this study we analyzed causes of treatment failure with KCl and need for adjuvant therapy such as methotrexate or embolization.

Methods

This single-center, retrospective observational study was conducted in the Department of Obstetrics and Gynecology at Prince Sultan Military Medical City (PSMMC), Riyadh, Saudi Arabia. The medical records of all patients diagnosed with cesarean scar pregnancy (CSP) between 2017 and 2025 were reviewed. Only cases that were treated with KCl with or without additional therapeutic options were included in the study. CSPs that were confirmed by transvaginal ultrasound as non-viable, underwent spontaneous resolution or medical records were incomplete, were excluded from the study. The primary outcome was to assess success rate of viable CSP treatment with KCl alone, which is strictly defined as complete resolution of the CSP, evidenced by a progressive decline of serum β -hCG to undetectable levels without the need for major surgical intervention.^{14,22}

Continuous variables were reported as mean (minimum – maximum) for non-parametric variables. Categorical variables will be expressed as frequencies (n) and percentage of occurrence (%).

A total of 22 patients with CSP were included in this retrospective analysis. The diagnosis of CSP was established based on standard sonographic criteria: (1) an empty uterine cavity and cervical canal, (2) the presence of a gestational sac implanted in the anterior lower uterine segment at the site of a previous cesarean scar, and (3) a thin or absent myometrial layer between the sac and the bladder wall.

Maternal characteristics were included, such as: age, parity, BMI, number of previous miscarriages, previous number of dilation and curettage (D&C), previous number of cesarean section, malpresentation as an indication for cesarean section in first cesarean section, interval from last cesarean section, medical history, smoking, gestation at diagnosis, and β -hCG level reaching zero after treatment.

Diagnostic imaging: All 22 patients (100%) underwent transvaginal ultrasound as the initial diagnostic modality. Magnetic resonance imaging (MRI) was performed in 2 patients for additional anatomical assessment. At the time of diagnosis, all pregnancies were viable.

Treatment approach: All patients received ultrasound-guided intra-sac potassium chloride (KCl) injection as the primary management strategy. The procedure was performed transabdominally under continuous real-time sonographic guidance. A fine needle was advanced into the gestational sac, and KCl (1–3mL) was injected direct into the fetus to induce cessation of embryonic cardiac activity. In some cases, second-line management was needed which included uterine artery embolization (UAE), systemic methotrexate, and hysterectomy in one patient.

Data collection: Information extracted from medical records included maternal age, body mass index (BMI), parity, number of previous cesarean deliveries, and interval since the last cesarean section. Clinical variables included gestational age at diagnosis, presenting symptoms, baseline hemoglobin, and serum β -hCG levels. Treatment details, requirement for second-line interventions, complications, and follow-up outcomes were recorded.

Follow-up: Patients were monitored with serial serum β -hCG measurements until normalization (<5 IU/L) or until the last available record. Follow-up was considered incomplete if serial data were missing.

Statistical analysis: All analyses were performed using SPSS version 22. Continuous variables are expressed as mean $\pm$ standard deviation (SD) and range (minimum – maximum), while categorical variables are summarized as frequency (n) and percentage of occurrence (%). This study has been approved by the Research Ethics Committee (IRB E-2408).

Results

A total of 22 patients with CSP were included in the study. The mean maternal age was 35.8 ± 3.4 years (range: 28–43), and the mean body mass index (BMI) was 31.4 ± 7.1 kg/m² (range: 20–53). Median parity was 4.1 (range: 1–8), with a mean of 2.95 ± 1.05 (range: 1–5) prior cesarean deliveries.

Table 1 Maternal Characteristics and Pregnancy Outcomes Among the Selected Groups

Treatment	All CSP Cases 22 Cases	KCL Group 13 Cases	KCL+ MTX ± UAE ± Evacuation Group 9 Cases	P-value
Age yrs, mean (min-max)	35.8 (28–43)	34.9 (28–40)	36.8 (31–43)	0.192
Parity	4.1 (1–8)	4.3 (2–8)	3.7 (1–7)	0.471
BMI, mean (min-max)	31.4 (20–53)	29.7 (20–34)	34.8 (28–53.4)	0.197
**of previous miscarriage	1.8 (0–9)	1.3 (0–4)	2.5 (0–9)	0.168
Previous **of D&C	7	4	3	
Previous **of CS	2.95 (1–5)	2.9 (2–5)	3 (1–5)	0.87
Indication malpresentation for 1st CS, **(%**)	5 (23)	3 (14)	2 (9)	
Interval from last CS (yrs)	2.7 (1–6)	2.1 (1–4)	3.6 (1–6)	0.018
Previous medical history (hypothyroidism)	2	2	0	
Smoking	0	0	0	
Spontaneous pregnancy	22 (100)	13 (59)	9 (41)	
Gestation at diagnosis (wks)	7.9 (6–11)	8 (6–11)	7.7 (6–10)	0.748
B-HCG reached zero after treatment **(%**)	22 (100)	13 (59)	9 (41)	

Notes: **whole number; **%, percentage.

Abbreviations: CS, Cesarean Section; D&C, Dilatation & Curettage.

Successful resolution, defined as a progressive decline of serum β -hCG to undetectable levels without the need for major surgical intervention, was achieved in 21 of the 22 patients (95.5%). Only one patient (4.5%) required hysterectomy following a failed KCl injection outcome due to severe adhesions and persistent bleeding (Table 1).

Resolution with KCl injection alone was observed in 13 patients (59.1%). An additional five patients (22.7%) required systemic methotrexate due to plateauing serum β -hCG levels; one out of the five patients required two doses of methotrexate. One patient (4.5%) required a combination of KCl and uterine artery embolization, while another (4.5%) required KCl in combination with both methotrexate and uterine artery embolization. Another patient (4.5%) was initially managed with uterine artery embolization and two doses of methotrexate, however this approach failed; subsequent KCl injection resulted in embryonic demise and eventual resolution.

The single case (4.5%) requiring hysterectomy involved a 38 year old woman with three previous cesarean deliveries, in which KCl injection failed due to dense adhesions and persistent vaginal bleeding. After counseling, the patient opted for hysterectomy.

Follow-up was available for all 22 patients (100%), and complete resolution without any complications was confirmed in all cases except the one requiring hysterectomy.

Discussion

The rising global rate of cesarean deliveries has contributed to a marked increase in CSP, a rare but serious form of ectopic gestation.²³ Reported incidence varies between 1:1800 and 1:2216 pregnancies, with a prevalence of approximately 0.15% among women with a history of cesarean section. Incidence continues to rise in parallel with the number of repeat cesarean procedures.²⁴ In line with these trends, our study population had a high median parity (4) and an average of 2.9 prior cesarean deliveries, reflecting this established association between multiple cesareans and CSP.

Although the precise pathogenesis remains unclear, several mechanisms have been proposed: (a) migration of the gestational sac through a wedge defect or microscopic fistula in the cesarean scar;^{15,17} (b) invasion of chorionic villi into the myometrium at a site of scar dehiscence;^{25,26} and (c) preferential implantation in scar tissue due to low oxygen tension.²⁷ A more integrative explanation suggests CSP arises from impaired scar healing that creates microtubular tracts, often following trauma such as cesarean section, dilation and curettage, uterine suction, hysterotomy, myomectomy, manual placental removal, or assisted reproductive techniques.^{28–30} Our findings support these theories, as all patients had at least one prior cesarean section and seven of them (31.8%) had a history of dilation and curettage, which may have contributed to impaired scar healing.

In CSP, the gestational sac is typically embedded within fibrotic scar tissue and the myometrium, and separated from the endometrial cavity.^{18,31} Poor vascularization in the anterior uterine wall may predispose the blastocyst to implant at the scar site before decidual formation.³² This abnormal implantation carries a high risk of uterine rupture and massive hemorrhage, sometimes in the first trimester, with potential loss of fertility if hysterectomy becomes necessary.⁹ Clinical presentation ranges from asymptomatic findings to pelvic pain and vaginal bleeding in early pregnancy.⁹ The absence of severe hemorrhage and uterine rupture in our cohort highlights that early diagnosis and careful monitoring can mitigate these risks despite the inherently dangerous nature of CSP.³³

Early and accurate diagnosis of cesarean scar pregnancy is essential to reducing morbidity and improving maternal outcomes.³³ Delayed recognition allows the pregnancy to progress within scar tissue, substantially increasing the risk of catastrophic complications such as placenta accreta, uterine rupture, severe hemorrhage, and the need for hysterectomy, all of which carry significant implications for future fertility. Evidence from a large cohort study in China demonstrated that 41.5% of CSP cases were initially missed, with these patients exhibiting higher rates of serious complications (13.6% vs 0%), increased post-surgical anemia, longer hospital stays, and greater healthcare costs compared with those diagnosed early.³³ These findings emphasize the importance of maintaining a high index of suspicion in women with a history of cesarean delivery, particularly when presenting with early pregnancy bleeding. It also highlights the role of first-trimester transvaginal ultrasound as the cornerstone of diagnosis. The absence of severe complications in our cohort further supports the concept that timely detection and prompt management can significantly mitigate risks while preserving uterine integrity and future reproductive potential.

Transvaginal ultrasonography remains the diagnostic modality of choice in the first trimester, providing high-resolution imaging. Adjunctive use of color Doppler with grayscale evaluation enhances visualization of implantation and allows assessment of fetal and extraembryonic structures.¹⁰ Consistent with this, ultrasound was central in our study, not only for diagnosis, but also for guiding transabdominal KCl injection. This emphasizes its pivotal role in both evaluation and management.

Therapeutic strategies primarily aim to terminate the pregnancy while preserving fertility. One option includes potassium chloride (KCl, 13.3 mmol/10 mL), administered transabdominally or transvaginal under ultrasound guidance, either directly into the gestational sac or into the fetal heart when cardiac activity is present.¹⁷ This approach is followed by serial β -hCG monitoring and ultrasound surveillance until resolution. Case reports suggest favorable outcomes with minimal side effects.^{17,21,22,34} This aligns closely with our results, where transabdominal ultrasound guided KCl injection as monotherapy achieved a 59% resolution rate with preserved fertility and minimal to no complications. This is a significant finding because in our patient demographic, all preferred medical over surgical treatment due to concerns about bleeding risk and maintaining uterine integrity. This comes as no surprise as the decision of undergoing hysterectomy in the Middle East, particularly Saudi Arabia, is a multifaceted issue shaped by cultural beliefs and social norms.³⁵

Management should be initiated promptly after diagnosis due to the escalating risk of hemorrhage with advancing gestation. The principle of treatment is complete termination and removal of the gestational sac while maintaining uterine integrity. Our outcomes reinforce the importance of timely intervention, as early management allowed resolution in most cases without progression to life-threatening complications.

A recent meta-analysis by Wu et al, reviewing 32 studies and 3380 women with prior CSP, highlighted significant reproductive risks in subsequent pregnancies. These included elevated rates of ectopic pregnancy (16.6%), recurrent CSP, and spontaneous miscarriage. The authors recommended contraception for women who do not desire future fertility. However, they emphasized that the effect of specific treatment modalities on long-term reproductive outcomes remains uncertain, underscoring the need for larger prospective studies.^{20,36} In this study, twenty-one patients (95.5%) showed complete resolution without recurrence, suggesting favorable short-term outcomes though long-term fertility risks remain to be clarified.¹⁷

Our cohort showed several notable differences compared to previously published data on risk factors for CSP. Gull et al identified smoking in the first trimester (OR $\approx$ 3.03), higher parity (OR $\approx$ 1.30 per additional birth), and a history of previous caesarean section prior to the index CS (OR $\approx$ 3.43) as significant independent predictors of CSP.³⁶ In contrast, none of the women in our study reported smoking, suggesting that lifestyle-related risk factors may have a lesser impact

in our population possibly reflecting regional differences in smoking prevalence among women of reproductive age. Additionally, while previous literature consistently links multiple prior caesarean deliveries to increased CSP risk,¹⁹ our cohort had a comparable history with a mean of 2.95 prior CS (range 1–5), reinforcing the strong association between uterine scarring and abnormal implantation. Moreover, despite previous studies highlighting high parity as a risk factor, our patients had a mean parity of 4.1, aligning with but slightly exceeding reported values, which may reflect demographic trends in fertility and obstetric history specific to our population. These findings collectively indicate that while uterine trauma and repeated caesarean sections remain the most consistent risk factors across populations, lifestyle factors such as smoking may not universally contribute to CSP risk, and regional variations in parity and obstetric patterns should be considered when counselling and assessing patient risk.

Conclusions

Ultrasound-guided intra-sac potassium chloride injection is a safe, effective, and fertility preserving treatment for cesarean scar pregnancy, achieving high success rates with minimal complications. Choosing a conservative approach to treating cesarean scar pregnancies is vital as it avoids the need for surgery and the issues that come with it, such as hemorrhage risk and anesthesia related complications. In some of our patient demographic, additional therapy was required when β -hCG levels plateaued, highlighting the importance of close monitoring. While a subset of patients ultimately needed second-line interventions, the overall outcomes were highly favorable, reinforcing the value of this minimally invasive approach. Furthermore, the findings highlight the need for standardized follow-up protocols to better assess long-term reproductive outcomes.

Data Sharing Statement

All data generated or analyzed during this study are included in this published article.

Ethics Approval

This study was approved by the Ethics Review Committee for Human-related Scientific Research at Prince Sultan Military Medical City (IRB Approval No: E-2408). The research was conducted in accordance with the Declaration of Helsinki and adhered to relevant national and international ethical guidelines for research involving human participants data.

Patient Consent

Written informed consent was obtained from all study participants prior to engaging in any study-related procedures. The participant data were anonymized, and their confidentiality was maintained.

Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

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Disclosure

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