ISSN 0973-2063 (online) 0973-8894 (print)

Bioinformation 22(10): 6852-6859 (2026)

©Biomedical Informatics (2026)

BIOINFORMATION
Discovery at the interface of physical and biological sciences

BIOMEDICAL INFORMATICS

www.bioinformation.net

Volume 22(10)

Research Article

Received October 1, 2026; Revised October 31, 2026; Accepted October 31, 2026, Published October 31, 2026

DOI: 10.6026/973206300226852

SJIF 2026 (Scientific Journal Impact Factor for 2026) = 8.478
2022 Impact Factor (2023 Clarivate Inc. release) is 1.9

Declaration on Publication Ethics:
The author's state that they adhere with COPE guidelines on publishing ethics as described elsewhere at https://publicationethics.org/. The authors also undertake that they are not associated with any other third party (governmental or non-governmental agencies) linking with any form of unethical issues connecting to this publication. The authors also declare that they are not withholding any information that is misleading to the publisher in regard to this article.

Declaration on official E-mail:
The corresponding author declares that lifetime official e-mail from their institution is not available for all authors

License statement:
This is an Open Access article which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly credited. This is distributed under the terms of the Creative Commons Attribution License

Comments from readers:
Articles published in BIOINFORMATION are open for relevant post publication comments and criticisms, which will be published immediately linking to the original article without open access charges. Comments should be concise, coherent and critical in less than 1000 words.

Disclaimer:
Bioinformation provides a platform for scholarly communication of data and information to create knowledge in the Biological/ Biomedical domain after adequate peer/editorial reviews and editing entertaining revisions where required. The views and opinions expressed are those of the author(s) and do not reflect the views or opinions of Bioinformation and (or) its publisher Biomedical Informatics. Biomedical Informatics remains neutral and allows authors to specify their address and affiliation details including territory where required.

Edited by Vini Mehta
E-mail: vmehta@statsense.in
Citation: Tali *et al.* Bioinformation 22(10): 6852-6859 (2026)

Outcomes of laparoscopic excision in caesarean scar pregnancy

Irshad Ahmad Tali[1,*], Falak Ara[2], Asif Majid Wani[3], Zarnain Abid[1] & Raana Syed[1]

[1]Department of OBG, Kashmir Medical College, Srinagar, India; [2]Department of Neuro Anesthesia and Critical Care, Sher Kashmir Institute of Medical Sciences, Srinagar, India; [3]Department of Radio Diagnosis and Imaging, Kashmir Medical College, Srinagar, India; *Corresponding author

Affiliation URL:
https://www.kmckashmir.com/
https://www.skims.ac.in/

Author contact:
Irshad Ahmad Tali - E-mail:drirshadtali1141@gmail.com; Phone +91 7006311401

ISSN 0973-2063 (online) 0973-8894 (print)
Bioinformation 22(10): 6852-6859 (2026)
©Biomedical Informatics (2026)

Falak Ara - E-mail:falakara1220@gmail.com; Phone +91 7006003199
Asif Majeed Wani - E-mail:dramwani707@gmail.com; Phone +91 9596942181
Zarnain Abid - E-mail: zarnainabidbanday@gmail.com; Phone +91 7889389987
Raana Syed - E-mail:raana.wani@gmail.com; Phone: +91 9906950634

Abstract:
Cesarean scar pregnancy is a potentially life-threatening ectopic pregnancy for which fertility-preserving treatment remains clinically challenging. This retrospective cohort study evaluated 40 women with cesarean scar pregnancy undergoing laparoscopic excision with scar reconstruction between January 2018 and December 2024. Treatment success was 97.5%, with a mean operative time of 78.6±21.4 minutes, median blood loss of 120 mL, no laparotomy conversions and 7.5% post-operative complications. During 24±8 months of follow-up, 66.7% achieved subsequent conception, 50.0% achieved live birth and recurrence occurred in 2.8%. Thus, data support laparoscopic excision with scar reconstruction as a safe, effective and fertility-preserving approach for cesarean scar pregnancy with favourable reproductive outcomes.

Keywords: Cesarean scar pregnancy (CSP), laparoscopic excision, scar reconstruction, ectopic pregnancy, fertility preservation, β-hCG normalization, reproductive outcomes

Background:
Cesarean scar pregnancy (CSP) is a rare but potentially life-threatening form of ectopic pregnancy characterized by implantation of the gestational sac within a previous cesarean section scar **[1].** Since the first case was reported in 1978, the incidence of CSP has increased substantially, largely due to the rising global rate of cesarean deliveries and improved diagnostic capabilities **[2, 3].** Current estimates indicate that CSP occurs in approximately 1 in 1,800–2,500 pregnancies and accounts for nearly 6% of ectopic pregnancies among women with a history of cesarean delivery **[4].** The increasing prevalence of cesarean section worldwide has transformed CSP from a rare clinical entity into a significant obstetric concern requiring prompt diagnosis and individualized management **[5].** The pathophysiology of CSP is believed to involve implantation of the blastocyst into a microscopic dehiscent tract or niche within a previous cesarean scar **[6]**. Inadequate healing of the uterine incision may result in fibrosis and myometrium discontinuity, providing a favourable site for abnormal trophoblastic invasion **[7]**. Progressive invasion of the gestational tissue into the myometrium can lead to uterine rupture, catastrophic hemorrhage, placenta accreta spectrum disorders and loss of fertility if diagnosis and treatment are delayed **[8]**. Two distinct forms of CSP have been described: endogenic CSP, which grows toward the uterine cavity and exogenic CSP, which extends toward the serosal surface and carries a higher risk of uterine rupture and severe bleeding **[9]**. Early diagnosis is essential to minimize maternal morbidity and preserve reproductive potential. Transvaginal ultrasonography remains the gold standard diagnostic modality and allows identification of characteristic findings, including an empty uterine cavity and cervical canal, localization of the gestational sac within the lower anterior uterine segment, reduced myometrium thickness between the gestational sac and bladder and prominent peri trophoblastic vascularity on Doppler imaging **[10, 11]**. Serial serum β-human chorionic gonadotropin (β-hCG) measurements provide valuable adjunctive information for diagnosis and follow-up, whereas magnetic resonance imaging may be useful in selected complex cases requiring detailed assessment of myometrium invasion **[12]**. A wide range of treatment modalities have been proposed for CSP, reflecting the absence of universally accepted management guidelines **[13]**. Conservative medical treatment with systemic or local methotrexate may be effective in selected cases but is associated with prolonged resolution times and variable success rates **[14]**. Surgical options include ultrasound-guided suction curettage, hysteroscopy resection, uterine artery embolization, laparoscopic excision, and laparotomy and combined therapeutic approaches **[15, 16]**. Although many of these techniques achieve satisfactory short-term outcomes, concerns remain regarding persistent trophoblastic tissue, excessive hemorrhage, recurrence and inadequate repair of the cesarean scar defect **[17]**. Laparoscopic excision has emerged as an attractive minimally invasive approach for the management of CSP, particularly in patients with deeply implanted gestations, high serum β-hCG levels, foetal cardiac activity, or failed conservative treatment **[18]**. The technique enables complete removal of gestational tissue under direct visualization while simultaneously allowing excision of the scar defect and reconstruction of the lower uterine segment **[19]**. This dual therapeutic benefit may reduce the risk of recurrent CSP and improve subsequent reproductive outcomes **[20]**. Furthermore, laparoscopic management offers the advantages of reduced postoperative pain, shorter hospitalization, faster recovery and improved cosmetic outcomes compared with conventional laparotomy **[21]**. Despite increasing utilization of laparoscopic surgery, the available evidence remains limited to relatively small retrospective studies and case series **[22]**. Considerable heterogeneity exists regarding patient selection, surgical techniques, perioperative outcomes and reporting of long-term reproductive performance **[23]**. Moreover, data evaluating treatment success, perioperative safety, recurrence rates and future fertility outcomes following laparoscopic excision remain insufficient. Consequently, additional institutional experiences are required to strengthen the evidence base and facilitate the development of standardized treatment recommendations **[24]**. Therefore, it is of interest to assess the treatment success, operative outcomes, perioperative complications, post-operative recovery, β-hCG normalization,

recurrence rates and subsequent reproductive outcomes following laparoscopic management.

Materials and Methods:

Study design:

This retrospective cohort study was conducted at a tertiary care referral center specializing in minimally invasive gynaecologic surgery. Medical records of women diagnosed with cesarean scar pregnancy (CSP) and treated with laparoscopic excision between January 2022 and December 2025 were reviewed. The study aimed to evaluate the safety, efficacy, perioperative outcomes and reproductive outcomes associated with laparoscopic management of CSP.

Ethical approval statement:

The study protocol was reviewed and approved by the Institutional Ethics Committee of Kashmir Medical College. The study was conducted in accordance with the ethical principles outlined in the Declaration of Helsinki and its subsequent amendments. Owing to the retrospective nature of the study and anonymization of patient data, the requirement for informed consent was waived by the Institutional Review Board.

Patient selection:

Consecutive patients diagnosed with CSP and managed by laparoscopic excision during the study period were identified through institutional electronic medical records and operative databases. Clinical, laboratory, radiological, operative and follow-up data were retrieved and analyzed. All eligible patients underwent preoperative evaluation by an experienced multidisciplinary team consisting of gynaecologic surgeons, radiologists and anaesthesiologists before surgical intervention.

Inclusion criteria:

Patients were included if they fulfilled all of the following criteria:

[1] Age between 18 and 45 years.
[2] Confirmed diagnosis of cesarean scar pregnancy based on transvaginal ultrasonography.
[3] History of at least one previous cesarean delivery.
[4] Underwent laparoscopic excision with scar repair as the primary treatment modality.
[5] Availability of complete clinical, operative and follow-up records.

Exclusion criteria:

Patients were excluded if they met any of the following criteria:

[1] Hemodynamic instability requiring emergency laparotomy.
[2] Uterine rupture at presentation.
[3] Patients managed exclusively with medical therapy, uterine artery embolization, hysteroscopy, suction evacuation, or laparotomy.
[4] Incomplete medical records.
[5] Loss to follow-up before assessment of primary outcomes.
[6] Co-existing intrauterine pregnancy (heterotopic pregnancy).
[7] Known uterine malformations or major gynecological malignancy.

Diagnostic workup:

The diagnosis of CSP was established using a combination of clinical evaluation, transvaginal ultrasonography (TVS), colour Doppler imaging and serial serum β-human chorionic gonadotropin (β-hCG) measurements.

The sonographic diagnostic criteria included:

[1] Empty uterine cavity.
[2] Empty endocervical canal.
[3] Gestational sac located within the anterior lower uterine segment at the site of a previous cesarean scar.
[4] Thin or absent myometrial layer between the gestational sac and urinary bladder.
[5] Increased peri trophoblastic vascularity on colour Doppler examination.

Additional parameters recorded included gestational age, foetal cardiac activity, mean gestational sac diameter, residual myometrial thickness and preoperative serum β-hCG levels. Magnetic resonance imaging (MRI) was performed selectively when sonographic findings were inconclusive or when extensive myometrial invasion was suspected.

Surgical technique of laparoscopic excision and scar repair:

All procedures were performed under general anesthesia by experienced laparoscopic surgeons. Following establishment of pneumoperitoneum using a standard four-port laparoscopic technique, the pelvis was systematically inspected. The vesicouterine peritoneal fold was dissected and the urinary bladder was carefully mobilized inferiorly to expose the cesarean scar defect. Diluted vasopressin solution was injected into the surrounding myometrium when deemed appropriate to minimize intraoperative bleeding. The CSP lesion was identified and excised using monopolar scissors or ultrasonic energy devices. Complete removal of gestational tissue and scar tissue was achieved under direct laparoscopic visualization. After excision, the uterine defect was reconstructed using interrupted or continuous absorbable sutures in one or two layers according to surgeon preference and residual myometrial thickness. Hemostasis was meticulously secured and the pelvis was irrigated before completion of the procedure. Excised specimens were routinely submitted for histopathological examination to confirm the presence of chorionic villi and trophoblastic tissue.

Data collection:

Data were extracted from institutional medical records using a standardized data collection form. The following variables were recorded:

Demographic variables:

[1] Age (years)
[2] Body mass index (BMI, kg/m²)

Obstetric characteristics:

[1] Gravidity
[2] Parity

[3] Number of previous cesarean deliveries
[4] Previous uterine procedures

Clinical and gestational variables:
[1] Gestational age
[2] Serum β-hCG level
[3] Gestational sac diameter
[4] Presence of foetal cardiac activity
[5] Residual myometrial thickness

Operative variables:
[1] Operative duration (minutes)
[2] Estimated blood loss (mL)
[3] Intraoperative complications
[4] Requirement for blood transfusion
[5] Conversion to laparotomy

Post-operative variables:
[1] Length of hospital stay (days)
[2] Postoperative complications
[3] Time to β-hCG normalization
[4] Histopathological confirmation

Follow-up variables:
[1] Recurrence of CSP
[2] Subsequent pregnancy
[3] Live birth
[4] Miscarriage
[5] Placenta accreta spectrum disorders
[6] Repeat cesarean scar pregnancy

Outcome measures:
Primary outcome:
The primary outcome was treatment success, defined as complete removal of the cesarean scar pregnancy with preservation of the uterus, absence of major perioperative complications, no requirement for additional surgical intervention and subsequent normalization of serum β-hCG levels.

Secondary outcomes:
[1] Operative duration
[2] Estimated blood loss
[3] Requirement for blood transfusion
[4] Conversion to laparotomy
[5] Intraoperative complications
[6] Postoperative complications
[7] Duration of hospitalization
[8] Time to β-hCG normalization
[9] Recurrence rate
[10] Subsequent reproductive outcomes

Statistical analysis:
Statistical analysis was performed using Statistical Package for the Social Sciences (SPSS) version 29.0 (IBM Corp., Armonk, NY, USA). Continuous variables were assessed for normality using the Shapiro–Wilk test. Normally distributed variables were expressed as mean ± standard deviation (SD), whereas non-normally distributed variables were presented as median and interquartile range (IQR). Categorical variables were summarized as frequencies and percentages. Comparisons between groups, where applicable, were performed using the independent samples t-test or Mann–Whitney U test for continuous variables and the Chi-square test or Fisher's exact test for categorical variables. Univariate and multivariate logistic regression analyses were performed to identify factors associated with perioperative complications and treatment success. Results were reported as odds ratios (ORs) with 95% confidence intervals (CIs).A two-sided p-value <0.05 was considered statistically significant.

Results:
A total of 40 women diagnosed with cesarean scar pregnancy underwent laparoscopic excision with simultaneous scar repair during the study period. All procedures were completed laparoscopically without intraoperative mortality. Histopathological examination confirmed the presence of chorionic villi in all excised specimens. The overall treatment success rate was 97.5%, with only one patient requiring additional intervention because of persistent trophoblastic tissue. **Table 1** summarizes the demographic profile and obstetric history of the study population. The mean age of the patients was 32.8 ± 4.6 years, indicating that CSP predominantly affected women of reproductive age. Most patients were multiparous, with a median gravidity of 3 and parity of 2. A substantial proportion of women had undergone multiple previous cesarean deliveries, with 70% reporting two or more prior cesarean sections. Previous miscarriage and uterine curettage were noted in 27.5% and 20.0% of patients, respectively. These findings support the well-established association between repeated uterine surgery and the development of cesarean scar pregnancy. **Table 2** presents the clinical presentation and preoperative ultrasonographic characteristics of the patients. The mean gestational age at diagnosis was 7.9 ± 1.8 weeks, reflecting early detection of CSP. Vaginal bleeding was the most frequent presenting symptom, occurring in 77.5% of cases, followed by pelvic pain in 35.0%. Foetal cardiac activity was identified in 42.5% of pregnancies. The mean residual myometrial thickness was only 2.1 ± 0.9 mm, indicating a high risk of uterine rupture and hemorrhage if left untreated. Furthermore, 70% of patients demonstrated moderate-to-severe peri trophoblastic vascularity on Doppler imaging, emphasizing the need for definitive surgical management. Type I CSP was slightly more common than Type II CSP in the present cohort. **Table 3** outlines the intraoperative outcomes of laparoscopic excision and scar repair. The mean operative duration was 78.6 ± 21.4 minutes, demonstrating the feasibility of the procedure. Estimated blood loss was relatively low, with a median value of 120 mL. Only two patients required blood transfusion, while conversion to laparotomy was not necessary in any case. Uterine defect reconstruction was successfully completed in all patients and histopathological examination confirmed the diagnosis of CSP in every specimen.

The overall treatment success rate was 97.5%, highlighting the effectiveness of laparoscopic excision as a definitive treatment option. Intraoperative complications were uncommon, occurring in only 5% of cases. **Table 4** describes post-operative recovery and short-term outcomes. Patients experienced favourable postoperative recovery, with a mean hospital stay of 2.8 ± 1.1 days. The average postoperative decline in haemoglobin was minimal, indicating effective intraoperative hemostasis. Postoperative complications occurred in only three patients (7.5%), including one case each of pelvic hematoma, postoperative fever requiring antibiotics and persistent trophoblastic tissue. No patient required reoperation and only one patient required readmission within 30 days. Serum β-hCG levels normalized within a median duration of 28 days, demonstrating rapid biochemical resolution following surgical treatment. **Table 5** presents the long-term reproductive outcomes following laparoscopic management of CSP. Among the 36 patients available for follow-up, 24 (66.7%) achieved subsequent conception, indicating preservation of reproductive potential after surgery. Eighteen women (50.0%) subsequently achieved live births, while first-trimester miscarriage occurred in four cases. Only one patient experienced recurrent cesarean scar pregnancy, corresponding to a recurrence rate of 2.8%. Similarly, placenta accreta spectrum disorder was reported in one subsequent pregnancy. Importantly, no cases of uterine rupture or ectopic pregnancy were observed during follow-up. These findings suggest that laparoscopic excision with scar reconstruction may contribute to favourable fertility outcomes and a low recurrence rate. The majority of patients had undergone two previous cesarean sections (47.5%), followed by one previous cesarean section (30.0%) and three or more cesarean sections (22.5%). The findings show a strong association between increasing cesarean delivery history and the occurrence of cesarean scar pregnancy **(Figure 1)**.The Kaplan–Meier curve illustrates the cumulative probability of serum β-human chorionic gonadotropin (β-hCG) normalization following laparoscopic excision and scar reconstruction in women with caesarean scar pregnancy. A progressive increase in the cumulative normalization rate was observed throughout the postoperative follow-up period, indicating effective removal of trophoblastic tissue and successful resolution of the ectopic gestation. The median time to β-hCG normalization was 28 days (IQR: 21–35 days), with the majority of patients achieving complete biochemical resolution within the first five weeks after surgery. By 42 days postoperatively, nearly all patients demonstrated normalized β-hCG levels, reflecting the high efficacy of laparoscopic management. No cases of persistent elevation requiring repeat surgical intervention were observed beyond the early postoperative period. These findings highlight the effectiveness of laparoscopic excision in achieving rapid biochemical recovery while minimizing the risk of persistent trophoblastic disease **(Figure 2)**. **(Figure 3)** illustrates the distribution of cesarean scar pregnancy (CSP) types among the study population. Type I (endogenic) CSP accounted for 57.5% (n = 23) of cases, whereas Type II (exogenic) CSP represented 42.5% (n = 17) of cases. Type I CSP, characterized by implantation and growth toward the uterine cavity, was slightly more prevalent in the present cohort. In contrast, Type II CSP, which extends deeply into the myometrium and toward the serosal surface of the uterus, constituted a substantial proportion of cases and is generally associated with a higher risk of uterine rupture and severe hemorrhage.

Table 1: Baseline demographic and obstetric characteristics of the study population (n = 40)

Variable	Value
Age (years), mean ± SD	32.8 ± 4.6
BMI (kg/m²), mean ± SD	26.1 ± 3.9
Gravidity, median (IQR)	3 (2–4)
Parity, median (IQR)	2 (1–3)
Previous cesarean sections, n (%)	
One previous CS	12 (30.0)
Two previous CS	19 (47.5)
≥ Three previous CS	9 (22.5)
Previous miscarriage, n (%)	11 (27.5)
Previous uterine curettage, n (%)	8 (20.0)
Previous ectopic pregnancy, n (%)	2 (5.0)
Interval from last cesarean section (years), mean ± SD	4.2 ± 2.1

Table 2: Clinical and ultrasound findings (n = 40)

Variable	Value
Gestational age (weeks), mean ± SD	7.9 ± 1.8
Serum β-hCG (IU/L), median (IQR)	36,800 (18,200–58,600)
Gestational sac diameter (mm), mean ± SD	25.7 ± 8.4
Foetal cardiac activity present, n (%)	17 (42.5)
Residual myometrial thickness (mm), mean ± SD	2.1 ± 0.9
CSP Type I (Endogenic), n (%)	23 (57.5)
CSP Type II (Exogenic), n (%)	17 (42.5)
Moderate-to-severe vascularity on Doppler, n (%)	28 (70.0)
Pelvic pain at presentation, n (%)	14 (35.0)
Vaginal bleeding at presentation, n (%)	31 (77.5)
Asymptomatic diagnosis, n (%)	7 (17.5)

Table 3: Operative outcomes following laparoscopic excision (n = 40)

Variable	Value
Operative time (minutes), mean ± SD	78.6 ± 21.4
Estimated blood loss (mL), median (IQR)	120 (80–220)
Intraoperative transfusion required, n (%)	2 (5.0)
Conversion to laparotomy, n (%)	0 (0.0)
Uterine defect repaired, n (%)	40 (100)
Histopathological confirmation, n (%)	40 (100)
Intraoperative complication rate, n (%)	2 (5.0)
Bladder injury, n (%)	1 (2.5)
Excessive bleeding (>500 mL), n (%)	1 (2.5)
Treatment success rate, n (%)	39 (97.5)

Table 4: Post-operative outcomes (n = 40)

Variable	Value
Length of hospital stay (days), mean ± SD	2.8 ± 1.1
Postoperative haemoglobin drop (g/dL), mean ± SD	1.2 ± 0.6
Postoperative complications, n (%)	3 (7.5)
Fever requiring antibiotics, n (%)	1 (2.5)
Pelvic hematoma, n (%)	1 (2.5)
Persistent trophoblastic tissue, n (%)	1 (2.5)
Readmission within 30 days, n (%)	1 (2.5)
Reoperation required, n (%)	0 (0.0)
Time to β-hCG normalization (days), median (IQR)	28 (21–35)

Table 5: Follow-up reproductive outcomes (Follow-up: 24 ± 8 Months)

Variable	Value
Patients available for follow-up	36
Subsequent conception, n (%)	24 (66.7)
Live birth, n (%)	18 (50.0)
First-trimester miscarriage, n (%)	4 (11.1)
Infertility during follow-up, n (%)	6 (16.7)

ISSN 0973-2063 (online) 0973-8894 (print)
Bioinformation 22(10): 6852-6859 (2026)
©Biomedical Informatics (2026)

Repeat cesarean scar pregnancy, n (%)	1 (2.8)
Placenta accreta spectrum disorder, n (%)	1 (2.8)
Ectopic pregnancy, n (%)	0 (0.0)
Uterine rupture in subsequent pregnancy, n (%)	0 (0.0)

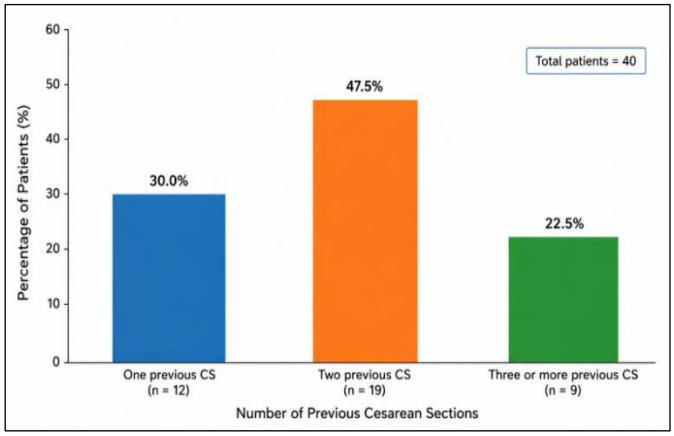


Figure 1: Distribution of previous cesarean deliveries among women with cesarean scar pregnancy

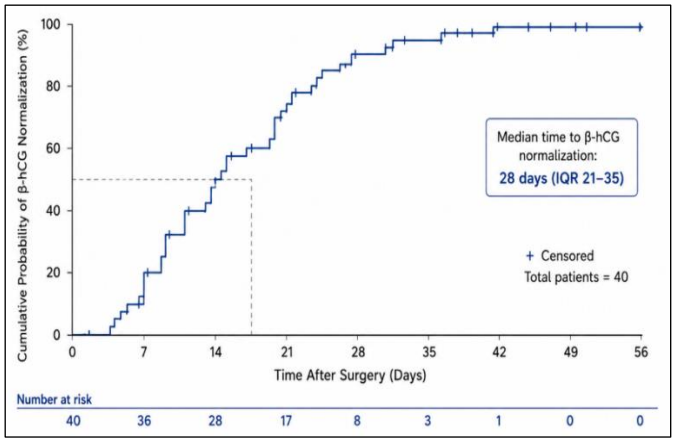


Figure 2: Kaplan–Meier analysis showing cumulative β-hCG normalization after laparoscopic excision of caesarean scar pregnancy

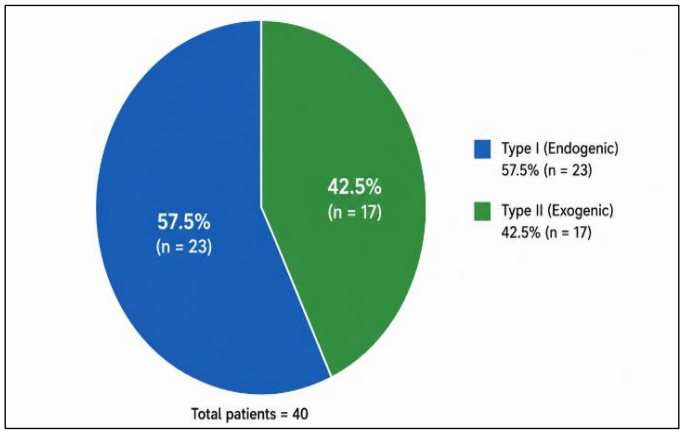


Figure 3: Distribution of caesarean scar pregnancy types

Discussion:

The present study evaluated the clinical outcomes of laparoscopic excision and scar reconstruction in women diagnosed with cesarean scar pregnancy (CSP). The findings demonstrated a high treatment success rate of 97.5%, low perioperative morbidity, minimal blood loss, short hospitalization, rapid β-hCG normalization and favourable reproductive outcomes during follow-up. These results support laparoscopic excision as a safe, effective and fertility-preserving treatment strategy for appropriately selected patients with CSP. The demographic characteristics of the present cohort demonstrated that most patients were multiparous women with a history of multiple cesarean deliveries. This observation is consistent with previous evidence indicating that repeated cesarean sections contribute to defective scar healing and formation of uterine niches that predispose women to abnormal implantation within the cesarean scar **[25, 26].** Furthermore, vaginal bleeding was the most common presenting symptom, a finding that is consistent with previous reports identifying abnormal vaginal bleeding as the predominant clinical manifestation of CSP **[27].** The overall treatment success rate of 97.5% observed in this study is comparable to outcomes reported in contemporary laparoscopic series. Previous studies have demonstrated success rates exceeding 90–95% following laparoscopic resection and scar repair, with low rates of major complications and preservation of uterine integrity **[18, 19].** Rouholamin *et al.* reported successful laparoscopic management in most patients, although excessive intraoperative bleeding required blood transfusion in two patients and conversion to laparotomy in two others **[28].** Similarly, Wehbe *et al.* reported successful laparoscopic excision of CSP in all eight patients in their case series, with favourable surgical outcomes following excision and immediate uterine repair **[29].** The excellent success rate observed in the present study may be attributed to direct visualization of the implantation site, complete removal of gestational tissue and meticulous multilayer reconstruction of the cesarean scar defect. These factors likely contributed to the low incidence of persistent trophoblastic disease and rapid postoperative recovery. A notable finding was the relatively low median blood loss of 120 mL and the low transfusion rate of 5.0%. Excessive hemorrhage remains one of the most feared complications of CSP because of extensive trophoblastic invasion and increased vascularity surrounding the gestational sac **[17].** The favourable hemostatic outcomes observed in the present study may be explained by careful bladder dissection, controlled excision under direct visualization, vasopressin-assisted devascularization and immediate reconstruction of the uterine defect. Similar findings have been reported in previous minimally invasive surgical studies evaluating laparoscopic treatment of CSP **[18, 19].** Compared with methotrexate therapy, laparoscopic excision offers several important advantages. Although systemic or local methotrexate administration may be effective in carefully selected cases, treatment failure, prolonged monitoring, delayed β-hCG resolution and the need for repeated treatment cycles remain important limitations **[13, 30].** The importance of individualized treatment selection is also

illustrated by Yelurker *et al.*, who reported that five of seven patients responded to conservative medical management, whereas two required surgical intervention. One underwent laparoscopic excision with uterine repair, while the other required hysterectomy following uncontrolled bleeding during attempted hysteroscopic evacuation **[31].** Moreover, medical therapy does not correct the underlying scar defect and therefore may not reduce the risk of recurrent abnormal implantation. In contrast, laparoscopic excision provides immediate removal of gestational tissue and definitive treatment in a single procedure. Laparoscopic management may also offer advantages over uterine artery embolization (UAE). Although UAE effectively reduces blood flow and may decrease intraoperative hemorrhage, it is generally utilized as an adjunctive rather than definitive treatment modality **[32].** Concerns have been raised regarding potential adverse effects on endometrial function, ovarian reserve and future fertility following embolization procedures **[33].** By directly removing the gestational tissue while preserving uterine anatomy, laparoscopic surgery avoids many of these limitations and may provide superior long-term reproductive outcomes. Hysteroscopic resection has emerged as an alternative minimally invasive treatment for selected patients, particularly those with endogenic CSP extending toward the uterine cavity **[34].** However, hysteroscopy may be technically challenging in deeply implanted lesions with significant myometrial invasion and may not permit adequate assessment of the serosal surface or surrounding pelvic structures. Laparoscopy provides a broader surgical field and facilitates complete excision together with scar reconstruction, particularly in exogenic CSP. Similarly, ultrasound-guided dilation and curettage remains associated with risks of severe hemorrhage, uterine perforation, incomplete evacuation and repeat intervention, especially when performed without adjunctive vascular control measures **[14, 22].** The low complication rate observed in the present study supports the growing preference for definitive surgical excision in appropriately selected patients. An important finding of the current study was the favourable reproductive outcome observed during follow-up. Approximately two-thirds of women achieved subsequent conception, while half ultimately achieved a live birth. These findings are comparable to published studies demonstrating encouraging fertility outcomes following surgical correction of cesarean scar defects **[13, 20].** Preservation of reproductive potential is particularly important because many patients affected by CSP are of reproductive age and desire future pregnancies. The favourable fertility outcomes observed in the present cohort may be explained by restoration of lower uterine segment anatomy through scar reconstruction. Repair of the myometrial defect improves uterine structural integrity and may reduce the persistence of scar niches that serve as potential sites for recurrent implantation **[35].** This mechanism may also explain the low recurrence rate of 2.8% observed in the present study. Previous investigations have demonstrated that inadequate scar healing is associated with recurrent CSP, abnormal placentation and adverse obstetric outcomes in future pregnancies **[36].** The present study has several strengths. It provides comprehensive assessment of both perioperative and reproductive outcomes, utilizes a standardized laparoscopic technique with scar reconstruction and includes follow-up evaluation of future fertility. In addition, histopathological confirmation of CSP was obtained in all patients, strengthening diagnostic accuracy. Several limitations should be acknowledged. The retrospective study design introduces the possibility of selection and information bias. The relatively small sample size reflects the rarity of CSP and may limit statistical power. Furthermore, the study was conducted at a single tertiary referral center, potentially limiting generalizability. Although reproductive outcomes were evaluated, longer follow-up periods are required to assess future obstetric complications more comprehensively. From a clinical perspective, the findings support laparoscopic excision with scar reconstruction as an effective treatment strategy for women with CSP, particularly those presenting with high β-hCG levels, foetal cardiac activity, significant vascularity, thin residual myometrium, or failed conservative treatment. The procedure provides definitive treatment while preserving fertility and minimizing recurrence risk. Future multicenter prospective studies with larger patient populations are required to compare laparoscopic excision directly with medical therapy, hysteroscopic management, uterine artery embolization and combined treatment approaches. Standardized reporting of fertility outcomes, recurrence rates, obstetric complications and quality-of-life measures will be essential for developing evidence-based management guidelines for cesarean scar pregnancy.

Conclusion:

Laparoscopic excision with simultaneous scar reconstruction achieved favourable treatment success, minimal blood loss, low perioperative complications and rapid β-hCG normalization in cesarean scar pregnancy. Direct scar repair, with favourable conception and live birth outcomes, supports uterine integrity and potential preservation of future fertility. Laparoscopic excision may be an effective option for appropriately selected patients, although larger prospective multicenter studies are needed to establish long-term reproductive outcomes.

References:

[1] Larsen JV &Solomon MH. *S Afr Med J.* 1978 **53**:142. [PMID: 653492]
[2] Rotas MA *et al.ObstetGynecol.*2006 **107**:1373. [PMID: 16738166]
[3] Ash A *et al. BJOG.* 2007 **114**:253. [PMID: 17313383]
[4] Seow KM *et al. Ultrasound Obstet Gynecol.* 2004 **23**:247. [PMID: 15027012]
[5] Betran AP *et al. BMJ Glob Health.* 2021 **6**:e00567 [PMID: 34130991]
[6] Vial Y *et al. Ultrasound Obstet Gynecol.* 2000 **16**:592. [PMID: 11169360]
[7] Osser OV *et al. Ultrasound Obstet Gynecol.* 2009 **34**:90. [PMID: 19499514]
[8] Timor-Tritsch IE *et al. Ultrasound Obstet Gynecol.* 2014 **43**:383. [PMID: 24357257]

[9] https://pubmed.ncbi.nlm.nih.gov/27561933/
[10] Timor-Tritsch IE & Monteagudo A. *Am J Obstet Gynecol.*2012 **207**:14. [PMID: 22516620]
[11] Jordans IPM *et al. Ultrasound Obstet Gynecol.* 2023 **61**:518. [PMID: 29536581]
[12] Timor-Tritsch I *et al. Eur J Obstet Gynecol Reprod Biol.* 2021 **258**:53. [PMID: 33421811]
[13] Birch Petersen K *et al. Fertil Steril.* 2016 **105**:958. [PMID: 26794422]
[14] Jurkovic D *et al. Ultrasound Obstet Gynecol.* 2016 **47**:511. [PMID: 26764166]
[15] Wang CJ *et al. Fertil Steril.* 2006 **85**:494.e1. [PMID: 16595234]
[16] Maymon R *et al. Hum Reprod.* 2004 **19**:278. [PMID: 14747167]
[17] Timor-Tritsch IE *et al. Am J Obstet Gynecol.* 2012 **207**:44.e1. [PMID: 22607667]
[18] Bacila IF *et al. J Pers Med.* 2024 **14**:469. [PMID: 38793050]
[19] Wang G *et al. Fertil Steril.* 2014 **101**:1501. [PMID: 24656888]
[20] Wu J *et al. Eur J Obstet Gynecol Reprod Biol.* 2021 **262**:80. [PMID: 33993066]
[21] van Reesema L *et al. Fertil Steril.* 2025 **124**:571. [PMID: 40339782]
[22] Maheux-Lacroix S *et al. J Minim Invasive Gynecol.* 2017 **24**:915. [PMID: 28599886]
[23] Ivanovic S *et al. Diagnostics (Basel).*2026 **16**:793. [PMID: 41828069]
[24] https://pubmed.ncbi.nlm.nih.gov/35850938/
[25] Vikhareva Osser O &Valentin L. *BJOG.* 2010 **117**:1119. [PMID: 20604776]
[26] Bij de Vaate AJ *et al. Ultrasound Obstet Gynecol.* 2014 **43**:372. [PMID: 23996650]
[27] Timor-Tritsch IE *et al. Obstet Gynecol Clin North Am.* 2019 **46**:797. [PMID: 31677755]
[28] Rouholamin S *et al. Adv Biomed Res.* 2024 **13**:62. [PMID: 39411696]
[29] Salem Wehbe G *et al. J Clin Med.* 2023 **12**:7673. [PMID: 38137743]
[30] Alameddine S *et al. J Matern Fetal Neonatal Med.* 2024 **37**:2327569. [PMID: 39385517]
[31] Yelurker *et al. Int J Reprod Contracept Obstet Gynecol*. 2026 15:2738. [DOI: 10.18203/2320-1770.ijrcog20262130]
[32] Shen L *et al. Am J Obstet Gynecol.* 2012 **207**:386.e1. [PMID: 23107082]
[33] Sentilhes L *et al. Int J Gynaecol Obstet.*2018 **140**:291. [PMID: 29405320]
[34] Diakosavvas M *et al. Eur J Obstet Gynecol Reprod Biol.* 2022 **270**:42. [PMID: 35016136]
[35] Vervoort AJ *et al. Hum Reprod.* 2015 **30**:2695. [PMID: 26409016]
[36] van der Voet LF *et al. BJOG.* 2014 **121**:145. [PMID: 24373589]

Caveat Emptor is applicable among the literate community where required and possible. The publisher, its journal, editors and the internal/external reviewers take adequate steps to check, evaluate, correct, edit, revise and improve content where possible and required.