Surgical evacuation of cesarean scar ectopic pregnancies

Author names and affiliations:

Simrit Nijjar[a], Eric Jauniaux[a], Davor Jurkovic[a]

[a]EGA Institute for Women's Health, Faculty of Population Health Sciences, University College London (UCL), London, UK

simrit.nijjar@nhs.net

e.jauniaux@ucl.ac.uk

davor.jurkovic@nhs.net

Corresponding author: Davor Jurkovic, davor.jurkovic@nhs.net

Abstract:

Cesarean scar ectopic pregnancy is associated with significant maternal morbidity, including severe haemorrhage, need for the blood transfusion and hysterectomy. Early diagnosis is therefore key in ensuring timely management, with consensus being that treatment before 9 weeks' gestation leads to reduced morbidity. There is no universally adopted management protocol for cesarean scar ectopic pregnancy, but surgical management generally has a higher success rate than medical management. The primary surgical treatment modalities are suction evacuation versus resection of the pregnancy via multiple routes. Adjuncts that have been shown to successfully minimise bleeding with surgical management include, cervical cerclage, balloon catheter and uterine artery embolization. However, there remains a lack of high-quality evidence regarding what the best surgical treatment option for cesarean scar ectopic pregnancy is, and therefore it is essential that clinicians provide tailored management to patients taking into account the presenting symptoms and local expertise with various surgical techniques.

Key words: cesarean scar pregnancy, ectopic, surgical treatment

A: Introduction

Cesarean scar ectopic pregnancy (CSP) is defined as implantation of a pregnancy into a myometrial defect or niche caused by dehiscence of the anterior uterine transverse lower segment cesarean scar [1]. CSP should be classified as a true ectopic gestation, as it shares the basic pathophysiological characteristics of all other ectopic pregnancies, development beyond the anatomical boundaries of the uterine cavity. The incidence of CSP is expected to continue to increase, given the global increase in cesarean births (CBs) since the 1960s [2] and is currently reported as 1.5 per 10,000 maternities [3].

CSP can be managed expectantly, medically and surgically, depending on several factors, including the type of CSP (Table 1), gestational age, viability of the pregnancy, patient symptom severity, clinician expertise, resource availability and patient preference.

Rempen and Albert reported the first case of CSP managed surgically in 1990 [4]; cases prior to that were probably not detected. Their case was diagnosed at 7 weeks' gestation and a laparotomy was performed to evacuate the pregnancy whilst preserving the uterus. Interestingly the second case reported in the literature in 1995, was initially managed expectantly as it was progressively developing into the uterine cavity (type 1 CSP) and the patient wanted to continue with the pregnancy, but she required an emergency CB at 35 weeks' gestation and hysterectomy [5]. Since then, various treatment regimens have been reported. Any treatment under consideration should be effective and aim to minimise the risk of harm to patients by avoiding significant haemorrhage, need for blood transfusion and emergency hysterectomy. Another important aim of treatment is preservation of fertility.

B: Surgery

When should surgery be offered?

Surgery is the only treatment option in patients presenting as emergencies with acute heavy vaginal bleeding or infection. Surgery is also indicated in cases of failed conservative management. In asymptomatic patients and those presenting with mild symptoms several ultrasound features have been reported that demonstrate an increased risk of complications with continuing CSP. A residual myometrial thickness (RMT) of <2mm of the scar surrounding the gestational sac at 6 to 10 weeks' gestation has been associated with an increased risk of uterine rupture and placenta accreta syndrome (PAS) in the second and third trimester of pregnancy, reported as 7.4% and 44.4% respectively [6]. Uterine rupture at the site of the cesarean scar defect (CSD) can be predicted by the depth of the niche at the start of the pregnancy, the RMT and the amount of villous tissue developing inside the defect itself [6]. These ultrasound parameters can help guide early pregnancy providers with regards to which pregnancies are at higher risk of complications and should therefore be managed actively rather than expectantly.

Can ultrasonographic parameters predict surgical outcomes?

Efficacy and complication rates of surgical treatment can be influenced by several factors, including the gestational age, size and type of CSP, as well as the surgeon's expertise and the type of surgery performed. Pre-operative ultrasound findings can help predict which patients could be at higher risk of complications during surgery.

In a cohort study of 62 patients with a live CSP managed surgically with transcervical suction curettage, an association was found between the size of the pregnancy, high colour Doppler index (CDI), presence of placental lacunae and the risk of complications [7]. Presence of placental lacunae and CDI scores of ≥3 were predictive factors for significant blood loss (>500mls) and needing a blood transfusion on univariate analysis. However, on multivariate analysis only crown rump length (CRL) was an independent significant factor for blood transfusion. A CRL of 23mm ≥ was associated with an increased risk of needing a blood transfusion, whereas a CRL < 16mm was associated with minimal blood loss. A third of patients required blood transfusion after 9 weeks' gestation versus none before 9 weeks' gestation.

Similarly, in a large multicentre retrospective study of 232 CSPs, 191 (82%) were managed surgically with ultrasound guided transcervical suction curettage [8]. On multivariable logistic regression analysis, the only two factors that were predictive of significant blood loss (>1000ml) were gestational sac diameter (OR 1.10, 95% CI 1.03-1.17) and increased vascularity on Doppler examination (OR 3.41, 95% CI 1.39-8.33). A retrospective, cohort observational study of 31 patients with CSPs between 6-9 weeks' gestation, managed surgically with ultrasound guided curettage with or without methotrexate (MTX) reported an association between increased risk of major bleeding (>500mls) and gestational age (>7 weeks' gestation), CSP type ('II, III, mixed and exogenous'), RMT (<2mm) and multiple placental lacunae [9]. The study authors did not define whether suction or sharp curettage was performed.

These studies all demonstrate that there is an increased risk of surgical complications (severe haemorrhage and need for blood transfusion) with increasing gestational age, size of the gestational sac and amount of the gestational sac developing inside the niche. This was confirmed in a recent systematic review of 36 studies, which showed that management of CSP <9 weeks' gestation is associated with 6% risk of maternal complications such as severe haemorrhage, need for blood transfusion, uterine rupture and emergency hysterectomy compared to 30% at ≥9 weeks' gestation [10]. Although studies report uterine rupture as a complication of CSP if it not treated, this does not fit with the pathophysiological principles of how a CSP develops, as the pregnancy implants into a deficient anterior uterine wall due to fibrosis, poor vascularity and impaired healing, which makes the likelihood of rupture at this site very unlikely.

The ultrasonographic parameters discussed above can be used to predict the risk of serious complications with surgical treatment of CSP and therefore allow early pregnancy healthcare providers to not only counsel patients diagnosed with CSP appropriately with their individualised risk profile, but also ensure that they are managed in regional centres with the surgical expertise and appropriate infrastructure and support systems if they are deemed high risk.

C: What surgery to choose: the most common treatment modalities

There is no consensus or high-quality evidence regarding the optimal treatment option for CSP and therefore multiple treatment regimens and combinations have been reported in the literature (Table 2). These studies are predominantly case series of varying number of cases and quality, with a limited number of randomised controlled trials (RCTs) (Table 3). The

Society for Maternal-Fetal Medicine (SMFM) has concluded that the optimal treatment option remains unknown but have strongly recommended (based on moderate quality evidence) against expectant management of CSPs [11].

We provide an overview of the main surgical treatment modalities reported in the English medical literature, which can be divided into two main categories: suction evacuation versus resection via various routes. However, given the heterogeneity of studies, varying efficacy and complication rates are presented, meaning a head-to-head comparison of different treatment modalities is challenging.

Transcervical suction evacuation of pregnancy including dilatation and curettage (D&C) and suction curettage (vacuum aspiration)

D&C is transcervical evacuation of the CSP performed blind or under ultrasound guidance. The procedure is performed using sharp curette and it is associated with a higher risk of uterine trauma and bleeding and should therefore be avoided [11]. However, more commonly, curettage is now performed with a vacuum (suction curettage), but there remains an inconsistency in the terminology used in the literature with D&C interchangeably used with suction curettage, leading to confusion when interpreting study findings.

In a national cohort study of 92 cases of CSP, over half underwent surgical management with D&C or suction curettage (mostly under ultrasound guidance) [3]. The reported success rate was 96%, which was higher than the success of expectant (43%) and medical (46%) management. Treatment success was defined as complete resolution of the pregnancy

without the need for further intervention following the primary management. Complication rates for surgical management were lower (36%) than expectant (71%) and medical management (60%) and the median number of days of discharge from care was also lowest with surgical management. Complications included: bleeding (34%), retained products of conception (RPOC, 4%) and collapse (2%). There were no cases of uterine rupture or emergency hysterectomy in the surgically managed CSPs. However, 82% of surgically managed cases required additional hemostatic measures, including misoprostol, syntometrine, uterine artery embolization (UAE), Shirodkar suture and Foley catheter insertion. This study demonstrates surgical management with suction curettage is associated with a higher efficacy rate than medical or expectant management, whilst maintaining a lower complication rate.

Similarly, in a series of 191 cases of CSP managed with suction curettage under ultrasound guidance, the procedure was found to be successful with a low complication rate including 11% rate of blood loss ≥1000 mL, 5% rate of blood transfusion, 6% rate of repeat surgery for cases of RPOC at follow-up and a single case of hysterectomy due to severe haemorrhage [8]. The efficacy and safety of suction curettage reported in these two large studies is likely due to the procedure being performed under ultrasound guidance, as it is more likely to ensure complete removal of pregnancy tissue, whilst reducing the risk of uterine perforation and shortening the operative time [8]. However, performing transabdominal ultrasound in patients with a high body mass index (BMI) and those with retroflexed uteri can be challenging and therefore transrectal scan is a possible alternative that can provide more optimal images [12]. These two studies have demonstrated that suction curettage under ultrasound guidance provides a rapid resolution of pregnancy with a quicker recovery time

and is generally an acceptable treatment option to patients; however, it does require ultrasound expertise to ensure a low complication rate.

In a retrospective study of 232 patients with CSPs managed by suction curettage, success was defined as normalization of maternal serum human chorionic gonadotropin (hCG) levels without residual pregnancy tissue on transvaginal sonography (TVS) or major complications requiring further treatment such as UAE, laparoscopic surgery, laparotomy, hysteroscopy or hysterectomy [13]. The overall success rate in that cohort study was 80%. Success rate was found to vary by gestational age, with pregnancies of <7 weeks' gestation having a success rate of 90%, compared to pregnancies of ≥7 weeks' gestation having a success rate of only 58% ($p < 0.001$). Higher blood loss with greater gestations of CSPs is likely due to the suction curette disrupting the placental bed, which has implanted deeper, close to the radial and arcuate arteries in advanced pregnancies [14, 15]. Myometrial thickness was not found to be associated with the success of suction curettage in this study, but in another smaller case series of 33 CSPs the authors reported that suction curettage under ultrasound guidance had lower success rates when the RMT was <3.5mm [16]. Similarly, suction curettage has been reported to be more effective in treating CSPs with a resulting lower blood loss if the Cesarean scar is >2-3mm thick, maximum diameter of the gestational sac is <30mm, gestational age <7 weeks' and the ectopic is not highly vascular [17, 18].

In comparison, a systematic review of treatment options for CSP including 243 cases managed with 'D&C' reported a success rate of only 48% and a severe complication rate of 21% [19]. However, the systematic review did not differentiate between sharp curettage (traditionally known as D&C) and vacuum aspiration (suction curettage); therefore, these

results should be interpreted with caution. In twelve of the included studies the procedure was suction curettage, but the remaining nine studies did not clarify the technique used. Success was defined as no additional treatment was required and severe complications including hysterectomy (5%), blood loss >1000mls or blood transfusion (15%) were reported. The included 21 studies were all cases series, the majority of which were assessed as medium quality.

In a recent systematic review of 3127 cases of CSP, the success rate of cases managed with 'D&C' was higher at 76% with a risk of haemorrhage of 28% and a risk of hysterectomy of 3% [20]. Although, the risk of haemorrhage dropped from 28% to 4% when UAE was used in combination with D&C. Similarly, the authors again used the terminology D&C, but most of the included studies described suction curettage with only a small number not clarifying if sharp or blunt curettage were used.

The different success and complication rates reported in the literature may be due to studies not distinguishing between sharp curettage and suction aspiration, as well as if ultrasound guidance was used or not. Furthermore, the definition of success used is variable, from no additional treatments being required to complete removal of the CSP. The type of CSP is postulated to influence the success rate, as type 1 CSPs which progress into the uterine cavity may allow suction curettage to more adequately and completely remove the pregnancy tissue than type 2 CSPs, although the evidence is conflicting [13]. Not all studies stipulate the type of CSP included.

Predicting success of treatment and complications

The two main factors that predict the success of treatment and risk of significant blood loss are, the gestational age and vascularity for live and failed CSPs respectively [7, 8]. As the pregnancy advances trophoblastic cells migrate deeper towards the larger diameter radial and arcuate arteries and increased vascularity around the gestational sac is an indicator of the proximity of the abnormally implanted placenta to these large uterine vessels [6], which when disrupted during suction curettage will inevitably lead to a higher blood loss. To be able to accurately evaluate the success of a treatment these factors must be accounted for, as otherwise results will provide a skewed outcome.

Despite the variations reported in the literature the SMFM have recommended that ultrasound-guided vacuum aspiration can be considered for surgical management of CSP, but sharp curettage alone should be avoided, which we agree with [11]. This recommendation is Grade 2c, which means it is a weak recommendation, based on low-quality evidence, which reflects the inconsistencies in study findings. The risk of complications with suction curettage is lowest in CSPs <9 weeks' gestation (CRL ≤15mm), therefore we agree with the recommendation that early live CSPs can be managed safely by general obstetricians and gynecologists [7]. Success of managing more advanced live CSPs between 9 and 14+6 weeks' gestation with ultrasound guided suction curettage has been described, but these procedures should be performed by gynecologists with expertise in uterine ectopic pregnancies given the significantly increased risk of surgical complications at this gestational age [7, 8]. In our experience, suction curettage performed under ultrasound guidance is generally a safe procedure with a good success rate; it is also less invasive, less expensive and does not require the expertise required for vaginal or pelvic laparoscopic resection.

Hysteroscopic resection

This is a relatively new approach that involves identifying the CSP with a hysteroscope and then resecting the pregnancy under direct observation with a resectoscope. Wang et al. reported the first successful treatment of CSP with operative hysteroscopy in 2005 [21]. Since then, several studies have reported on the success rate and complication profile of hysteroscopic resection. It has generally been found to have a low complication rate ranging from 3-18%, which has made some experts recommend it as a first line treatment option for type 1 CSP [19, 20, 22]. However, in a systematic review of 95 women (all from cases series) managed with hysteroscopic resection, 17% needed additional treatments, but the major complication rate, defined as hysterectomy, laparotomy, bleeding >1000ml or blood transfusion was only 3% [19]. Similarly, in another systematic review of 63 studies the success rate of hysteroscopic excision of CSP was 88% with a risk of haemorrhage of ≤ 4% and a risk of hysterectomy of ≤2% [20]. The main indication for additional treatment was persistent gestational sac tissue on TVS and an insufficient fall in hCG levels. However, the majority of these studies were classified as weak quality.

A recent systematic review containing 812 cases of CSP managed with three different hysteroscopic regimes; (i) hysteroscopic resection, (ii) hysteroscopy after preoperative use of high-intensity focused ultrasound and (iii) preoperative use of UAE before hysteroscopic treatment reported an overall success rate of 91% [23]. Complication rates were 2% for blood loss >500mls and <1% for hysterectomy. The mean gestational age was reported as 56.44 days, but the review provided no data regarding whether the CSPs were live or failing. Half of the included studies in the review also did not specify if CSP cases had cardiac activity or not, with fetal cardiac activity being present in only 229 of the 812 cases included. This

information is crucial to evaluate the effectiveness of a treatment, as presence of cardiac activity and gestational age influence success and complication rates.

Performing hysteroscopic resection under ultrasound guidance has been advocated to minimise the risk of complications from uterine perforation and damage to close surrounding structures (bladder), with complication rates falling from 14% to 0% with the use of transabdominal ultrasound [20, 22]. This treatment modality is therefore appealing as it is minimally invasive, allows visually directed treatment, is generally acceptable to patients, with a fast recovery time and is more increasingly available, but it does require a skilled hysteroscopist, operative equipment and follow-up, with some authors recommending mandatory follow-up with serial hCG [24, 25]. Studies have shown if the Cesarean scar thickness is <3mm or the uterus is extremely retroflexed hysteroscopic resection may be more challenging and alternative treatment modalities using an abdominal approach should be considered [26, 27], as the risk of perforation would be significantly higher. It may also not be suitable in patients with heavy bleeding and who present in an emergency haemodynamically unstable as it relies on optimal views to perform the resection, which may be technically challenging if the uterus is actively filling with blood, especially with more advanced gestations. The procedure requires administration of fluid under high pressure for optimisation of the surgical field, which is counterproductive, as it prevents contraction of the uterus and therefore may propagate bleeding. Given these very valid concerns we do not recommend hysteroscopic resection of CSP.

Laparoscopic excision

A laparoscopy is performed using standard entry techniques and the bladder is then dissected off the lower uterine segment followed by hysterotomy to excise the CSP and the CSD is then repaired. Lee et al. reported the first successful laparoscopic treatment of CSP in 1999 [28], but it is still not a 'mainstream' treatment. Laparoscopic treatment is generally recommended in haemodynamically stable cases of type 2 and 3 CSPs, where the pregnancy is growing away from the uterine cavity towards the bladder or the broad ligament [29, 30], but one must be mindful that it requires a trained surgeon and the appropriate facilities and equipment, which may not always be readily available. It can be performed with or without hysteroscopy, to help aid complete excision of the CSP and repair of the hysterotomy site [31-33].

In two separate systematic reviews the success rate of laparoscopic excision is reported as high as 97% [19, 20]. The complication rate is reported as 0%, but this is based on 7 case series, consisting of a total of only 69 patients [19] and should therefore be interpreted with caution. Laparoscopic excision should not be recommended as a first line treatment for CSPs that have a communication with the uterine cavity (the majority), as these can be managed successfully with suction curettage.

Transvaginal resection

Resection of CSP can also be performed transvaginally, which requires making an incision along the anterior cervicovaginal junction, followed by bladder dissection and hysterotomy at the lower margin, through which the CSP is excised and the hysterotomy is then repaired [34]. Efficacy is reported as > 99% with very low complication rates, <1%, and only 1 case of emergency hysterectomy [19]. However, these conclusions are based on six case series

including a total of 118 patients. Although a latter systematic review confirmed these findings and also reported a success rate of 99% [20], one must take into account that transvaginal resection relies on specific surgical expertise and therefore these results may not be widely applicable.

Some experts advocate laparoscopic or transvaginal resection as first line treatment options, as the CSD can then be completely removed or repaired at the same time and there is evidence at post-op imaging of a decrease in the CSD with this approach [32, 35], but whether this will prevent recurrence of CSP remains unknown. However, the CSD is much larger when distended by pregnancy and the tissues are highly vascular. This makes the immediate repair technically more challenging compared to elective surgery on a less vascular non-pregnant uterus.

Resection at open surgery

Traditionally a Pfannenstiel incision would be made followed by a wedge resection of the CSP and closure of the hysterotomy [36]. Success rates are very high with this technique (96%) [20], but recovery and hospital stay is significantly longer than other techniques; therefore, it is recognised this is no longer a first line treatment option, as more surgeons are now trained in minimal access techniques leading to the growing number of reports of hysteroscopic and laparoscopic resection.

Hysterectomy

This is the most radical treatment option and should not be used routinely as a primary treatment modality, as over the last decade there has been a significant increase in the availability and evidence for less invasive therapeutic options. Hysterectomy as a secondary treatment modality should only be performed for emergency cases where there is uncontrollable major haemorrhage.

The SMFM have recommended that hysterectomy may be an appropriate treatment option for early second-trimester CSPs or for patients who do not wish to retain their fertility and opt for this procedure [11]. However, there is data that suggests ultrasound guided suction curettage is a successful, less invasive treatment option for patients with advanced second trimester CSPs, as not only is it less risky than a hysterectomy, but it preserves fertility [7].

Combined treatment options

There are numerous treatment options, combining different surgical and medical modalities reported in the English medical literature, with 31 different primary treatment options identified by one review in 751 patients with CSP [22]. We have summarized combination treatments that include surgical modalities in Table 2. Forty-five years after CSP was first described in the literature by Larsen et al. [37] there remains no consensus on the optimal treatment strategy, despite the vast number of treatment options available, likely due to the lack of high-quality studies.

C: Findings of randomized controlled trials

The majority of published studies consist of small case series or larger cohort studies, which are predominantly of low or medium methodological quality. A relatively small number of RCTs have been published in the English medical literature, which have been summarised in Table 3 [38-41]. A recent Cochrane review included 4 RCTs that evaluated the effectiveness and safety of surgical management [42]. Two compared UAE or uterine arterial chemoembolization (UACE) with MTX versus systemic MTX and subsequent suction curettage, and two compared suction curettage under hysteroscopy versus suction curettage under ultrasonography after UAE/UACE. One of the studies performed suction and sharp curettage [40], the remaining three performed only suction curettage [38, 39, 41]. The review concluded that it was uncertain whether there is a difference in success and complication rates between UAE/UACE and administration of systemic MTX before suction curettage [42]. Blood loss was lower if suction curettage was conducted after UAE/UACE than after administration of systemic MTX. It is unclear whether there is a difference in treatment success rates, complications, adverse effects or time to normalization of hCG between suction curettage under hysteroscopy and under ultrasonography. However, these conclusions were based on moderate to very low-quality evidence, which means any conclusions drawn are not reliable, as the studies included had small sample sizes leading to wide confidence intervals and multiple comparisons within a small number of trials and insufficient data available to assess for heterogeneity.

D: Haemostatic measures

Regardless of the treatment modality employed, bleeding is a potential complication and several measures have been reported in the literature to achieve haemostasis. At abdominal surgery pre-emptive intrauterine vasopressin can be injected directly into the myometrium overlying the CSP to minimise blood loss, similarly intraoperative vascular clamps and

uterine artery ligation have also been reported as measures used to achieve haemostasis [43-46]. Pharmacological treatments including misoprostol, ergometrine and syntometrine are commonly used to stimulate uterine contractions, which then facilitates tamponade by blood clots at the implantation site of the CSP [3, 8].

Uterine artery embolization

UAE has been reported to prevent blood loss. In a cohort study of 119 cases of CSP, UAE followed by suction curettage 24 hours later was reported to be associated with a lower blood loss compared to MTX followed by suction curettage [47]. These findings were confirmed by two RCTs, which concluded that UAE combined with suction curettage significantly reduces the risk of haemorrhage compared to systemic MTX with suction curettage [38, 39]. In most studies, UAE is generally undertaken 28-48 hours prior to suction curettage and the reported success rate is 93% with a risk of haemorrhage ≤ 5% [20]. In a retrospective study of 169 women with CSP, UAE followed by ultrasound guided curettage (the authors did not define if they used sharp or suction curettage) 1-3 days later reported success rates of over 96%, with lower blood loss [48]. UAE has been reported in several studies as an efficient treatment for preventing bleeding before suction curettage [38, 49, 50]. However, it has also been found to be associated with a complication rate of 10% [41] and therefore its use should be limited to those surgical cases where significant haemorrhage is expected based on ultrasound parameters, and we go further and propose that if required UAE should be used sequentially with suction curettage rather than pre-surgery.

The safety of UAE in patients who desire subsequent pregnancies is not clear, with some research on pregnancy outcomes after usage of UAE for treatment of leiomyomas suggests sporadic reports of healthy pregnancies, but the actual fertility rate remains uncertain [51]. However, low birth weight, miscarriage, and preterm delivery have all been associated with UAE.

Balloon catheter versus cervical suture

Both insertion of a Shirodkar cervical suture and a Foley or Cooks balloon catheter have been reported as measures to help minimise bleeding following evacuation of CSPs [52, 53]. Placement of the Shirodkar suture has been described prior to commencement of suction curettage but it is only secured if there is significant haemorrhage to control the bleeding [53]. In one series, it was required in 48% of cases of live CSP managed with suction curettage [7]. This technique was successful in 97% of cases, but in 1 case of an advanced CSP emergency UAE was required in addition to achieve haemostasis. It has been shown to be an effective method for securing hemostasis, reducing the need for blood transfusion with no significant complications [7, 53]. In comparison, control of bleeding after evacuation of CSP has also been reported to be successful with insertion of a Foley catheter, which is inflated with 30-90mls of water and it then obstructs the cervical canal, usually for 12-24 hours [52, 54]. In a small cases series of 21 CSPs, local intragestational sac MTX injection, followed by suction curettage and insertion of a Foley balloon catheter was reported to be an effective treatment, with only 1 patient having significant bleeding necessitating a blood transfusion [55].

Overall, a Shirodkar suture is believed to be more effective at occluding the cervix than the Foley catheter, as it gives instant haemostasis when the knot is tied [8, 53]. The risk of postoperative infection with a Shirodkar suture appears to be very low [8].

E: Treatment recommendations

There is no universally agreed surgical treatment option for CSP supported by any national or international society. This is likely due to the heterogeneity in reported success and complication rates of different treatment modalities and publication bias, with a significant proportion of studies published from a relatively small number of countries. This contribution disparity may partially be explained by differences in CB rates [56].

Surgical treatments are generally associated with higher success rates than medical management, which has higher failure rates, but bleeding can be more significant with surgery [57]. In a systematic review including 3127 CSPs the overall success rate of medical treatment was 62% with a 10% rate of complications (7% for haemorrhage and 3% for hysterectomy), in comparison the overall success rate of surgical treatment was 83% with a 20% rate of complications (18% for haemorrhage and 2% of hysterectomy) [20]. However, surgery tends to be used in patients who present with more severe symptoms and with more advanced pregnancies, which could explain higher rates of bleeding complications. In a more recent study from 2021 containing 135 patients managed with five different surgical treatment modalities (transvaginal resection, laparoscopic resection, UAE combined with hysteroscopic curettage, UAE combined with uterine curettage, and hysteroscopic curettage) the authors concluded that the results were inconclusive and treatment regimens should be selected based on the patient's individual circumstances [58]. A recent meta-

analysis of 31 studies (16 RCTs and 15 case control studies, from English and Chinese medical databases) compared the efficacy and safety of 'D&C' (alone or combined with other treatments including UAE and MTX) and resection of CSPs vaginally, laparoscopically and abdominally [59]. Most of the included studies pertained to suction curettage with a small number not defining if sharp or suction curettage was used. The authors concluded that resection of CSP was more effective, as it had a lower failure rate and less adverse events. The SMFM propose that CSPs should be immediately terminated by surgical management (either ultrasound guided vacuum aspiration or vaginal/laparoscopic resection) or by medical management with local MTX [11]. However, this recommendation is based on low quality evidence and therefore is weak at best, predominantly based on small case series.

There is variation in the literature in the definitions used for reported success and complication rates. For example, the insertion of a Shirodkar suture following suction curettage was considered a complication in one review, but not in another study [3, 22]. It remains unclear what defines the success of a treatment, no retained pregnancy tissue versus no additional treatment required. Furthermore, many studies group all CSPs as one homogenous group, including pregnancies that have failed with live pregnancies, which will inevitably lead to inaccurate evaluation of the treatment modality, as more than two thirds of CSPs with no cardiac activity are likely to miscarry without any further intervention [60]; therefore inclusion of live and failed CSPs as one group will lead to unreliable results.

We therefore propose that a core outcome set should be developed of agreed outcomes that should be measured and reported as a minimum in all studies evaluating management

of CSP. This should include the following parameters: definition of success, definition of complications, type of CSP (as type 2 and 3 CSPs are more likely to lead to uterine rupture and severe haemorrhage), gestational age and viability at a minimum.

We also propose a high-quality multi-centre RCT to evaluate surgical treatment options: suction curettage, hysteroscopic resection, transvaginal resection and laparoscopic resection. This study should be performed at an international level, given the rarity of CSP and variability of treatments offered in different centres and countries. It is only through conducting high quality research with experts in the field will we be able to provide our patients with evidence-based recommendations for treatment, as currently recommendations vary depending on where the patient is seen and are generally based on low quality case series or small cohort studies.

Summary

Surgical management of CSP is associated with a higher success rate, lower complication rates and shorter post-treatment follow up than medical and expectant management [3]. CSP has traditionally been viewed as a rare condition but as the rates of CB continue to increase in both high and low-income countries CSP incidence will continue to increase. Therefore, the onus is on all early pregnancy providers to always consider this diagnosis in any patient that they scan in the first trimester, as CSP has increased morbidity and mortality if not diagnosed or managed in a timely manner. We propose diagnosis and management should be in regional centres that manage this condition more commonly and have the appropriate expertise and support infrastructure, to minimise complications and morbidity.

Treatment recommendations are currently based predominantly on case series, with a handful of RCTs comparing treatment approaches. Comparison of the success or complication rate of a treatment is hindered by the heterogeneity of studies, which report multiple treatment options, preventing a true comparison of outcomes between studies. Therefore, there is no recommended optimal treatment option, but the literature supports an interventional or surgical approach rather than a medical approach, as success rates and complications are found to be generally better [19, 20]. The choice of surgical treatment should therefore be individualised based on the gestation, size and type of CSP, as well as the surgeon's expertise, whilst considering the patient's views.

Consensus is that both early diagnosis and treatment will lead to improved outcomes [22] and this is what we should be striving for. Treatment therefore should be evidence based to prevent severe complications and preserve fertility. The International CSP Registry (www.CSP-registry. com) is an online international database that collects anonymized data on diagnosis, disease behavior and management of CESPs. Data from this registry will help identify the most effective treatment strategies in the future and promote high-quality collaborative multi-centre research to compare the best surgical techniques, which is urgently warranted.

Funding: No funding was obtained for the study.

Conflict of interest: The authors report no conflict of interest.

Practice points:

- There is no single evidence based optimal surgical treatment that can be recommended as the gold standard for all types of CSP; therefore, care must be individualised.
- Partial CSPs, which communicate with the uterine cavity, can generally be managed using transvaginal surgical treatment options, with suction curettage a simple, cost-effective treatment option, which does not require minimal access or hysteroscopic expertise.
- Complete CSPs require laparoscopic or abdominal surgical techniques to manage them, as transvaginal access is not possible, as they do not communicate with the uterine cavity.
- Regional treatment centres should be developed that are equipped with expert staff that can manage CSPs and have access to supportive infrastructure, including interventional radiology and blood transfusion to reduce patient morbidity and mortality.

Research agenda:

- Studies that assess surgical treatment options are generally of low quality and a large number of different combinations of treatments are used therefore review conclusions are not powered or reliable, given the levels of heterogeneity.
- Given the lack of high-quality studies the ethical dilemma of how to counsel patients with viable CSPs in terms of expectant versus surgical management remains, as the literature on the natural history of CSPs is lacking.
- A significant proportion of studies published in the English literature are from one region, China, which means any conclusions drawn are potentially prone to publication and selection bias and therefore their generalizability to other populations is uncertain.
- The primary outcomes reported in studies are variable, with success of a treatment or complications reported varying, which make results heterogeneous and unreliable. We propose a set of core outcomes should be developed for studies reporting treatment of CSP, as this would then allow more reliable results to be drawn.
- There has been no study that has looked at surgical treatment from the patient's perspective in terms of satisfaction, acceptability or the psychological impact of treatment.

References:

[1] Jordans IPM, Verberkt C, De Leeuw RA, Bilardo CM, Van Den Bosch T, Bourne T, et al. Definition and sonographic reporting system for Cesarean scar pregnancy in early gestation: modified Delphi method. Ultrasound Obstet Gynecol. 2022;59(4):437-49.

[2] Glantz JC, McNanley TJ. Active management of labor: a meta-analysis of cesarean delivery rates for dystocia in nulliparas. Obstet Gynecol Surv. 1997;52(8):497-505.

[3]* Harb HM, Knight M, Bottomley C, Overton C, Tobias A, Gallos ID, et al. Caesarean scar pregnancy in the UK: a national cohort study. Bjog. 2018;125(13):1663-70.

[4] Rempen A, Albert P. [Diagnosis and therapy of an in the cesarean section scar implanted early pregnancy]. Z Geburtshilfe Perinatol. 1990;194(1):46-8.

[5] Herman A, Weinraub Z, Avrech O, Maymon R, Ron-El R, Bukovsky Y. Follow up and outcome of isthmic pregnancy located in a previous caesarean section scar. Br J Obstet Gynaecol. 1995;102(10):839-41.

[6]* Jauniaux E, Zosmer N, De Braud LV, Ashoor G, Ross J, Jurkovic D. Development of the utero-placental circulation in cesarean scar pregnancies: a case-control study. Am J Obstet Gynecol. 2022;226(3):399.e1-.e10.

[7]* De Braud LV, Knez J, Mavrelos D, Thanatsis N, Jauniaux E, Jurkovic D. Risk prediction of major haemorrhage with surgical treatment of live cesarean scar pregnancies. Eur J Obstet Gynecol Reprod Biol. 2021;264:224-31.

[8]* Jurkovic D, Knez J, Appiah A, Farahani L, Mavrelos D, Ross JA. Surgical treatment of Cesarean scar ectopic pregnancy: efficacy and safety of ultrasound-guided suction curettage. Ultrasound Obstet Gynecol. 2016;47(4):511-7.

[9] Wu DF, Zhang HX, He W, Liu X, Song HM, Yu TF. Experience in management of cesarean scar pregnancy and outcomes in a single center. J Int Med Res. 2022;50(10):3000605221123875.

[10] Timor-Tritsch I, Buca D, Di Mascio D, Cali G, D'Amico A, Monteagudo A, et al. Outcome of cesarean scar pregnancy according to gestational age at diagnosis: A systematic review and meta-analysis. Eur J Obstet Gynecol Reprod Biol. 2021;258:53-9.

[11]* Miller R, Timor-Tritsch IE, Gyamfi-Bannerman C. Society for Maternal-Fetal Medicine (SMFM) Consult Series #49: Cesarean scar pregnancy. Am J Obstet Gynecol. 2020;222(5):B2-b14.

[12] Bignardi T, Condous G. Transrectal ultrasound-guided surgical evacuation of Cesarean scar ectopic pregnancy. Ultrasound Obstet Gynecol. 2010;35(4):481-5.

[13] Wu XQ, Zhang HW, Fang XL, Ding H, Piao L, Joseph Huang S. Factors associated with successful transabdominal sonography-guided dilation and curettage for early cesarean scar pregnancy. Int J Gynaecol Obstet. 2015;131(3):281-4.

[14] López-Girón MC, Nieto-Calvache AJ, Quintero JC, Benavides-Calvache JP, Victoria-Borrero A, López-Tenorio J. Cesarean scar pregnancy, the importance of immediate treatment. J Matern Fetal Neonatal Med. 2022;35(6):1199-202.

[15] Jauniaux E, Jurkovic D, Hussein AM, Burton GJ. New insights into the etiopathology of placenta accreta spectrum. Am J Obstet Gynecol. 2022;227(3):384-91.

[16] Özdamar Ö, Doğer E, Arlıer S, Çakıroğlu Y, Ergin RN, Köpük Ş Y, et al. Exogenous cesarean scar pregnancies managed by suction curettage alone or in combination with other therapeutic procedures: A series of 33 cases and analysis of complication profile. J Obstet Gynaecol Res. 2016;42(8):927-35.

[17] Liu S, Sun J, Cai B, Xi X, Yang L, Sun Y. Management of Cesarean Scar Pregnancy Using Ultrasound-Guided Dilation and Curettage. J Minim Invasive Gynecol. 2016;23(5):707-11.

[18] Polat I, Ekiz A, Acar DK, Kaya B, Ozkose B, Ozdemir C, et al. Suction curettage as first line treatment in cases with cesarean scar pregnancy: feasibility and effectiveness in early pregnancy. J Matern Fetal Neonatal Med. 2016;29(7):1066-71.

[19]* Birch Petersen K, Hoffmann E, Rifbjerg Larsen C, Svarre Nielsen H. Cesarean scar pregnancy: a systematic review of treatment studies. Fertil Steril. 2016;105(4):958-67.

[20]* Maheux-Lacroix S, Li F, Bujold E, Nesbitt-Hawes E, Deans R, Abbott J. Cesarean Scar Pregnancies: A Systematic Review of Treatment Options. J Minim Invasive Gynecol. 2017;24(6):915-25.

[21] Wang CJ, Yuen LT, Chao AS, Lee CL, Yen CF, Soong YK. Caesarean scar pregnancy successfully treated by operative hysteroscopy and suction curettage. Bjog. 2005;112(6):839-40.

[22]* Timor-Tritsch IE, Monteagudo A. Unforeseen consequences of the increasing rate of cesarean deliveries: early placenta accreta and cesarean scar pregnancy. A review. Am J Obstet Gynecol. 2012;207(1):14-29.

[23] Diakosavvas M, Kathopoulis N, Angelou K, Chatzipapas I, Zacharakis D, Kypriotis K, et al. Hysteroscopic treatment of Cesarean Scar Pregnancy: A systematic review. Eur J Obstet Gynecol Reprod Biol. 2022;270:42-9.

[24] Mollo A, Conforti A, Alviggi C, De Placido G. Successful direct bipolar resection of 6th week cesarean scar pregnancy: case report and literature review. Eur J Obstet Gynecol Reprod Biol. 2014;179:229-31.

[25] Wang CJ, Chao AS, Yuen LT, Wang CW, Soong YK, Lee CL. Endoscopic management of cesarean scar pregnancy. Fertil Steril. 2006;85(2):494.e1-4.

[26] Wang G, Liu X, Bi F, Yin L, Sa R, Wang D, et al. Evaluation of the efficacy of laparoscopic resection for the management of exogenous cesarean scar pregnancy. Fertil Steril. 2014;101(5):1501-7.

[27] Shao MJ, Hu MX, Xu XJ, Zhang L, Hu M. Management of caesarean scar pregnancies using an intrauterine or abdominal approach based on the myometrial thickness between the gestational mass and the bladder wall. Gynecol Obstet Invest. 2013;76(3):151-7.

[28] Lee CL, Wang CJ, Chao A, Yen CF, Soong YK. Laparoscopic management of an ectopic pregnancy in a previous Caesarean section scar. Hum Reprod. 1999;14(5):1234-6.

[29] Li XM, Xu XF, Wang NN, Yao L. Clinical efficacy of laparoscopic surgery used for the excision of villus tissue and the repair of uterine scar in patients with cesarean scar pregnancy-II. Med Int (Lond). 2022;2(4):23.

[30] Jayaram PM, Okunoye GO, Konje J. Caesarean scar ectopic pregnancy: diagnostic challenges and management options. The Obstetrician & Gynaecologist. 2017;19(1):13-20.

[31] Shen F, Lv H, Wang L, Zhao R, Tong M, Lee AC, et al. A Comparison of Treatment Options for Type 1 and Type 2 Caesarean Scar Pregnancy: A Retrospective Case Series Study. Front Med (Lausanne). 2021;8:671035.

[32] He Y, Wu X, Zhu Q, Wu X, Feng L, Wu X, et al. Combined laparoscopy and hysteroscopy vs. uterine curettage in the uterine artery embolization-based management of cesarean scar pregnancy: a retrospective cohort study. BMC Womens Health. 2014;14:116.

[33] Qi F, Chai ZY, Liu MM, Zheng LZ, Zhu Y, Chen ZW, et al. Type 2 Cesarean Scar Pregnancy Successfully Treated via Hysteroscopy-Assisted Laparoscopy. J Minim Invasive Gynecol. 2019;26(7):1273-81.

[34] Huanxiao Z, Shuqin C, Hongye J, Hongzhe X, Gang N, Chengkang X, et al. Transvaginal hysterotomy for cesarean scar pregnancy in 40 consecutive cases. Gynecol Surg. 2015;12(1):45-51.

[35] Zhang Y, Duan H, Cheng JM, Guo YS. Treatment options to terminate persistent cesarean scar pregnancy. Gynecol Obstet Invest. 2013;75(2):115-9.

[36] Grechukhina O, Deshmukh U, Fan L, Kohari K, Abdel-Razeq S, Bahtiyar MO, et al. Cesarean Scar Pregnancy, Incidence, and Recurrence: Five-Year Experience at a Single Tertiary Care Referral Center. Obstet Gynecol. 2018;132(5):1285-95.

[37] Larsen JV, Solomon MH. Pregnancy in a uterine scar sacculus--an unusual cause of postabortal haemorrhage. A case report. S Afr Med J. 1978;53(4):142-3.

[38] Zhuang Y, Huang L. Uterine artery embolization compared with methotrexate for the management of pregnancy implanted within a cesarean scar. Am J Obstet Gynecol. 2009;201(2):152.e1-3.

[39] Li C, Li C, Feng D, Jia C, Liu B, Zhan X. Transcatheter arterial chemoembolization versus systemic methotrexate for the management of cesarean scar pregnancy. Int J Gynaecol Obstet. 2011;113(3):178-82.

[40] Qian ZD, Huang LL, Zhu XM. Curettage or operative hysteroscopy in the treatment of cesarean scar pregnancy. Arch Gynecol Obstet. 2015;292(5):1055-61.

[41] Li Y, Gong L, Wu X, Gao H, Zheng H, Lan W. Randomized controlled trial of hysteroscopy or ultrasonography versus no guidance during D&C after uterine artery chemoembolization for cesarean scar pregnancy. Int J Gynaecol Obstet. 2016;135(2):158-62.

[42]* Long Y, Zhu H, Hu Y, Shen L, Fu J, Huang W. Interventions for non-tubal ectopic pregnancy. Cochrane Database Syst Rev. 2020;7(7):Cd011174.

[43] Pirtea L, Balint O, Secosan C, Grigoras D, Ilina R. Laparoscopic Resection of Cesarean Scar Ectopic Pregnancy after Unsuccessful Systemic Methotrexate Treatment. J Minim Invasive Gynecol. 2019;26(3):399-400.

[44] Mahgoub S, Gabriele V, Faller E, Langer B, Wattiez A, Lecointre L, et al. Cesarean Scar Ectopic Pregnancy: Laparoscopic Resection and Total Scar Dehiscence Repair. J Minim Invasive Gynecol. 2018;25(2):297-8.

[45] Fuchs N, Manoucheri E, Verbaan M, Einarsson JI. Laparoscopic management of extrauterine pregnancy in caesarean section scar: description of a surgical technique and review of the literature. Bjog. 2015;122(1):137-40.

[46] Litwicka K, Greco E. Caesarean scar pregnancy: a review of management options. Curr Opin Obstet Gynecol. 2013;25(6):456-61.

[47] Gao L, Huang Z, Gao J, Mai H, Zhang Y, Wang X. Uterine artery embolization followed by dilation and curettage within 24 hours compared with systemic methotrexate for cesarean scar pregnancy. Int J Gynaecol Obstet. 2014;127(2):147-51.

[48] Li X, Niu H, Li J, Zhang L, Qu Q. Clinical assessment of uterine artery embolization combined with curettage when treating patients with cesarean scar pregnancy: A retrospective study of 169 cases. J Obstet Gynaecol Res. 2020;46(7):1110-6.

[49] Zhang B, Jiang ZB, Huang MS, Guan SH, Zhu KS, Qian JS, et al. Uterine artery embolization combined with methotrexate in the treatment of cesarean scar pregnancy: results of a case series and review of the literature. J Vasc Interv Radiol. 2012;23(12):1582-8.

[50] An X, Ming X, Li K, Wang J. The analysis of efficacy and failure factors of uterine artery methotrexate infusion and embolization in treatment of cesarean scar pregnancy. ScientificWorldJournal. 2013;2013:213603.

[51] Ludwig PE, Huff TJ, Shanahan MM, Stavas JM. Pregnancy success and outcomes after uterine fibroid embolization: updated review of published literature. Br J Radiol. 2020;93(1105):20190551.

[52] Timor-Tritsch IE, Cali G, Monteagudo A, Khatib N, Berg RE, Forlani F, et al. Foley balloon catheter to prevent or manage bleeding during treatment for cervical and Cesarean scar pregnancy. Ultrasound Obstet Gynecol. 2015;46(1):118-23.

[53] Jurkovic D, Ben-Nagi J, Ofilli-Yebovi D, Sawyer E, Helmy S, Yazbek J. Efficacy of Shirodkar cervical suture in securing hemostasis following surgical evacuation of Cesarean scar ectopic pregnancy. Ultrasound Obstet Gynecol. 2007;30(1):95-100.

[54] Ash A, Smith A, Maxwell D. Caesarean scar pregnancy. Bjog. 2007;114(3):253-63.

[55] Tan KL, Jiang L, Chen YM, Meng Y, Lv BQ, Wei LF, et al. Local intra-gestational sac methotrexate injection followed by dilation and curettage in treating cesarean scar pregnancy. Arch Gynecol Obstet. 2020;302(2):439-45.

[56] Hellerstein S, Feldman S, Duan T. China's 50% caesarean delivery rate: is it too high? Bjog. 2015;122(2):160-4.

[57] Noël L, Thilaganathan B. Caesarean scar pregnancy: diagnosis, natural history and treatment. Curr Opin Obstet Gynecol. 2022;34(5):279-86.

[58] Wu Y, Sun LF, Si YN, Luan XL, Gao YM. Clinical efficacy analysis of different therapeutic methods in patients with cesarean scar pregnancy. Taiwan J Obstet Gynecol. 2021;60(3):498-502.

[59]* Li J, Li H, Jiang J, Zhang X, Shan S, Zhao X, et al. Dilatation and curettage versus lesion resection in the treatment of cesarean-scar-pregnancy: A systematic review and meta-analysis. Taiwan J Obstet Gynecol. 2021;60(3):412-21.

[60] Calì G, Timor-Tritsch IE, Palacios-Jaraquemada J, Monteaugudo A, Buca D, Forlani F, et al. Outcome of Cesarean scar pregnancy managed expectantly: systematic review and meta-analysis. Ultrasound Obstet Gynecol. 2018;51(2):169-75.

MCQs

1. The following statements about the management of cesarean scar ectopic pregnancies (CSPs) are true:

a. There is no consensus about the optimal treatment option.

b. Expectant management is recommended for live CSPs in the first trimester.

c. Elective surgical management has a lower success rate than medical management.

d. Hysteroscopic resection of CSP should be first line surgical management in patients presenting with heavy bleeding.

e. Retained pregnancy tissue post evacuation of CSP occurs in >30% of patients.

a= T; b= F; c= F; d= F; e= F

Explanation to the answers for Question 1:

a. There is no high quality evidence to suggest a particular treatment option is superior to another and therefore multiple treatment regimens are described in the literature [1].

b. The Society for Maternal-Fetal Medicine has strongly recommended against expectant management of CSPs, as it is associated with an increased risk of severe maternal morbidity: haemorrhage, placenta accreta spectrum, uterine rupture and emergency hysterectomy [1]. However, in cases of early pregnancy failure expectant management may be considered and if people opt for it after counselling.

c. Studies show that medical management has a higher failure rate than surgical management. It has been reported in the literature that medical management has a success rate of 46-62%, whereas surgery has a success rate of 83-96%, which is significantly higher [2, 3]. The overall complication rate for medical management is reported as 10%, in comparison the complication rate for surgery is double, at 20% [3]. However, these results should be interpreted with caution as the definition of complications varies between included studies and surgical treatments are more likely to be performed in patients presenting as emergencies with heavy vaginal bleeding.

d. Hysteroscopic resection should not be first line surgical management in patients presenting with heavy bleeding, as this technique relies on optimal views to perform the resection, which would not be possible to maintain if the uterus is actively filling with blood. Furthermore, bleeding may be propagated by the inability of the uterus to contract because of the use of fluid under high pressure during hysteroscopy.

e. Studies have reported retained pregnancy tissue post evacuation of CSP in 4% of cases [2] and repeat surgery was required in 6% of cases for retained pregnancy tissue [4].

2. The following are haemostatic measures that can be used with surgical modalities:

a. Uterine artery embolization.

b. Foley balloon.

c. Cervical cerclage.

d. Hysterectomy.

e. Methotrexate.

a= T; b= T; c= T; d= T; e= F

Explanation to the answers for Question 2:

a. There is a risk of significant bleeding with any form of surgical management and therefore having haemostatic measures on standby and ready to be employed is key, but not all hospitals may have access to interventions such as uterine artery embolization (UAE). UAE performed prior to surgery has been reported to reduce blood loss, with a risk of haemorrhage ≤ 5% [3], but it can also be used sequentially (after or during surgery) to control haemorrhage.

b. c.

The Foley balloon catheter and cervical cerclage have also both been reported to minimise bleeding after suction evacuation of CSPs and have reduced the need for blood transfusion [5, 6]. The suture works by creating an intrauterine hematoma to exert tamponade and therefore control haemostasis. The reported risk of infection is very low with both techniques.

d. Hysterectomy should not routinely be used as a primary surgical treatment modality, but should be reserved for cases where haemorrhage is uncontrollable by alternative haemostatic measures, and therefore should be the last resort. In people that opt to continue with a CSP there is evidence that they are at increased risk of requiring a cesarean hysterectomy at delivery to manage severe haemorrhage secondary to placenta accreta syndrome [7].

e. Methotrexate (local) is a recognised medical treatment for CSP, but it is not a haemostatic tool to be used with surgical treatment. Studies have shown that the risk of haemorrhage is lower when UAE is combined with suction curettage compared to MTX with suction curettage [8, 9].

3. The following statements about the management of CSPs are true:

a. Assessment of blood supply on colour Doppler does not help in assessing the risk of bleeding.

b. Treatment should ideally start before 9 week's gestation.

c. Laparoscopic repair of the niche at the time of resection of CSP significantly reduces the risk of recurrence.

d. Degree of CSP protrusion into the peritoneal cavity can be used to assess the risk of surgical difficulty.

e. Hysterectomy should be performed in all CSPs presenting after 13 weeks' gestation.

a= F; b= T; c= F; d= T; E= F

Explanation to the answers for Question 3:

a. Colour Doppler assessment has been shown to help predict significant blood loss [10], as it provides evidence of whether the utero-placental circulation is prominent or not and therefore allows the surgeon to plan and prepare for severe blood loss.
b. The general consensus by experts is that CSPs should be managed before 9 weeks' gestation [11]. Studies have shown that management after this gestation is associated with a significantly increased risk of maternal morbidity, with rates of severe haemorrhage, need for blood transfusion, uterine rupture and hysterectomy all higher, (6% before 9 weeks' vs. 30% after 9 weeks' gestation). Another study found that one third of patients treated after 9 weeks' gestation required blood transfusion versus none before 9 weeks' gestation [10]. Early diagnosis and management is therefore critical and should be considered in every person with a history of cesarean birth (CB) that attends an early pregnancy unit for a scan.
c. Repair of the niche at the time of laparoscopic or transvaginal resection of CSP is advocated by some groups, as by completely removing or repairing the niche it has been shown to decrease the cesarean scar defect on post-operative imaging, but whether this leads to a reduced the risk of recurrence of CSP is unknown [12, 13].
d. CSPs that protrude into the peritoneal cavity are more likely to be surgically challenging and have an increased risk of major bleeding, uterine rupture and retained pregnancy tissue [14, 15].
e. Hysterectomy should not be considered as a primary treatment option for all advanced CSPs, as there are less invasive but successful treatment options that also preserve future fertility, such as ultrasound guided suction curettage [10].

4. The following ultrasonographic parameters predict poor surgical outcomes.

a. Presence of placental lacunae.

b. A colour Doppler imaging (CDI) score of 1 or 2.

c. Adenomyosis.

d. A crown rump length (CRL) of <16mm.

e. Residual myometrial thickness (RMT) of >4mm.

a= T; b= F; c= F; d= F; E= F

Explanation to the answers for Question 4:

Ultrasonographic features can help with surgical planning as they enable risk stratification of patients and therefore identify those at higher risk of complications, whom should be treated in a regional centre with appropriate expertise and supporting infrastructure. Placental lacunae, a higher CDI score (particularly ≥3) and a CRL of 23mm ≥ have been shown to be associated with a higher complication rate, specifically severe haemorrhage and need for blood transfusion [10]. The only other sonographic features that have shown an association with increased complication rates are a larger gestational sac diameter, amount of gestational sac developing inside the cesarean scar niche and a RMT of <2mm [14].

References

[1] Miller R, Timor-Tritsch IE, Gyamfi-Bannerman C. Society for Maternal-Fetal Medicine (SMFM) Consult Series #49: Cesarean scar pregnancy. Am J Obstet Gynecol. 2020;222(5):B2-b14.

[2] Harb HM, Knight M, Bottomley C, Overton C, Tobias A, Gallos ID, et al. Caesarean scar pregnancy in the UK: a national cohort study. Bjog. 2018;125(13):1663-70.

[3] Maheux-Lacroix S, Li F, Bujold E, Nesbitt-Hawes E, Deans R, Abbott J. Cesarean Scar Pregnancies: A Systematic Review of Treatment Options. J Minim Invasive Gynecol. 2017;24(6):915-25.

[4] Jurkovic D, Knez J, Appiah A, Farahani L, Mavrelos D, Ross JA. Surgical treatment of Cesarean scar ectopic pregnancy: efficacy and safety of ultrasound-guided suction curettage. Ultrasound Obstet Gynecol. 2016;47(4):511-7.

[5] Jurkovic D, Ben-Nagi J, Ofilli-Yebovi D, Sawyer E, Helmy S, Yazbek J. Efficacy of Shirodkar cervical suture in securing hemostasis following surgical evacuation of Cesarean scar ectopic pregnancy. Ultrasound Obstet Gynecol. 2007;30(1):95-100.

[6] Timor-Tritsch IE, Cali G, Monteagudo A, Khatib N, Berg RE, Forlani F, et al. Foley balloon catheter to prevent or manage bleeding during treatment for cervical and Cesarean scar pregnancy. Ultrasound Obstet Gynecol. 2015;46(1):118-23.

[7] Calì G, Timor-Tritsch IE, Palacios-Jaraquemada J, Monteaugudo A, Buca D, Forlani F, et al. Outcome of Cesarean scar pregnancy managed expectantly: systematic review and meta-analysis. Ultrasound Obstet Gynecol. 2018;51(2):169-75.

[8] Zhuang Y, Huang L. Uterine artery embolization compared with methotrexate for the management of pregnancy implanted within a cesarean scar. Am J Obstet Gynecol. 2009;201(2):152.e1-3.

[9] Li C, Li C, Feng D, Jia C, Liu B, Zhan X. Transcatheter arterial chemoembolization versus systemic methotrexate for the management of cesarean scar pregnancy. Int J Gynaecol Obstet. 2011;113(3):178-82.

[10] De Braud LV, Knez J, Mavrelos D, Thanatsis N, Jauniaux E, Jurkovic D. Risk prediction of major haemorrhage with surgical treatment of live cesarean scar pregnancies. Eur J Obstet Gynecol Reprod Biol. 2021;264:224-31.

[11] Timor-Tritsch I, Buca D, Di Mascio D, Cali G, D'Amico A, Monteagudo A, et al. Outcome of cesarean scar pregnancy according to gestational age at diagnosis: A systematic review and meta-analysis. Eur J Obstet Gynecol Reprod Biol. 2021;258:53-9.

[12] He Y, Wu X, Zhu Q, Wu X, Feng L, Wu X, et al. Combined laparoscopy and hysteroscopy vs. uterine curettage in the uterine artery embolization-based management of cesarean scar pregnancy: a retrospective cohort study. BMC Womens Health. 2014;14:116.

[13] Zhang Y, Duan H, Cheng JM, Guo YS. Treatment options to terminate persistent cesarean scar pregnancy. Gynecol Obstet Invest. 2013;75(2):115-9.

[14] Wu DF, Zhang HX, He W, Liu X, Song HM, Yu TF. Experience in management of cesarean scar pregnancy and outcomes in a single center. J Int Med Res. 2022;50(10):3000605221123875.

[15] Wu XQ, Zhang HW, Fang XL, Ding H, Piao L, Joseph Huang S. Factors associated with successful transabdominal sonography-guided dilation and curettage for early cesarean scar pregnancy. Int J Gynaecol Obstet. 2015;131(3):281-4.