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Clinical investigation of fertility after uterine artery embolization combined with dilation and curettage(D&C) or D&C alone for cesarean scar pregnancies

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ABSTRACT

Objective: The aim of this study was to compare the reproductive outcomes of patients with cesarean scar pregnancies (CSP) following uterine artery embolization (UAE) and dilation and curettage (D&C) treatments, and to evaluate the impact of UAE on fertility.

Materials: and methods: A retrospective case-control study was conducted. Patients diagnosed with CSP between 2019 and 2021 were included in the study. Clinical data and fertility outcomes were collected and reviewed retrospectively. Patients were divided into two groups based on their treatment option: the UAE combined with D&C group and the D&C alone group.

Results: A total of 91 CSP patients were enrolled in the study. Of these, 49 were treated with D&C, while 42 received UAE combined with D&C. The average gestational age in the UAE group was significantly longer than that in the D&C group. The average diameter of the gestational mass was significantly larger in the UAE group than in the D&C group (42.2 ± 19.8 mm vs 23.8 ± 15.9 mm). The other clinical features were not significantly different between the two groups. The average menstrual recovery time was 1.0 ± 0.20 months (range: 1–2 months) in the D&C group, and 2.0 ± 2.85 months (range: 1–18 months) in the UAE combined with D&C group, with a significant difference between the two groups. The average menstrual blood volume (MBV) decreased in 79 % of patients in the UAE group, compared to 18 % in the D&C group, with a significant difference between the two groups. There was no significant difference between the two groups in terms of pregnancy rate and birth rate (75 % vs 78 %, 63 % vs 56 %).

Conclusion: UAE combined with D&C is an efficient and safe treatment for CSP. Our study showed that decreased MBV and longer menstrual recovery time in UAE combined with D&C group, but there are no statistical difference in fertility outcomes between the two groups, which suggests probably a reversible impact on the reproductive function.

Introduction

A Cesarean scar pregnancy (CSP) is defined as the pregnancy implanted on the uterine scar or in the niche after a previous cesarean scar [1]. Although initially considered a rare ectopic pregnancy when first reported in 1978, CSP has become increasingly common due to the rising rates of cesarean deliveries worldwide [2]. Once the CSP is diagnosed, the patients need to terminate pregnancy to avoid serious complications, such as life-threatening hemorrhage, uterine rupture, hysterectomy, and even maternal mortality. Uterine artery embolization (UAE) was efficient and safe for CSP management, and has an overall high success rate [3]. To mitigate the risk of life-threatening bleeding complications during treatment, UAE is often used as a prophylactic measure prior to dilation and curettage (D&C) with or without hysteroscopy.

Although UAE combined with D&C is proved effective in treating

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CSP, the adverse effect of this treatment strategy on postoperative fertility is not clear [4,5]. This minimally invasive procedure was considered as one of the treatment options which enable preservation of fertility after treatment [6]. Some studies suggest it may reduce menstrual flow and pregnancy rate [7], while others show no adverse effect on pregnancy outcomes [8]. Since the reproductive outcomes remain controversial, this study compares the reproductive outcomes between patients receiving D&C alone and UAE combined with D&C, to assess the influence of uterine artery embolization on fertility.

Materials and methods

Patients

This study included patients diagnosed with CSP between 2019 and 2021. Clinical data and fertility outcomes were collected and reviewed retrospectively. Patients were divided into two treatment groups: those who underwent UAE combined with D&C (UAE group) and those who underwent D&C alone (D&C group). The ultrasound features of CSP included the following: (1) an empty uterine cavity with no gestational sac; (2) a gestational sac in the anterior part of the uterine isthmus; (3) a decreased myometrial thickness between the bladder and the sac; and (4) a gestational sac implanted in the cesarean delivery scar [9]. Magnetic resonance imaging (MRI) was performed when ultrasound was unable to determine the location of the pregnancy.

The inclusion criteria were as follows: (1) CSP diagnosed by ultrasound or MRI before the first trimester of pregnancy, (2) the patients were performed UAE or D&C for CSP, (3) full follow-up. The exclusion criteria were as follows: (1) patients were performed additional procedures, such as operative hysteroscopy, (2) gestational trophoblastic neoplasia could not be excluded. The flowchart of patient selection was shown in fig. 1.

The study was approved by the Ethics Committee of Tongji University Affiliated Shanghai First Maternity and Infant Hospital in Shanghai on March 1, 2022 (Registration number: KS2259).

Procedure

All D&C procedures were performed under ultrasound guidance. The UAE indication is as blows: 1) rich blood supply on ultrasonography or MRI; 2) longer pregnancy duration (>8 weeks); 3) a distance of < 2 mm between the gestational mass and the bladder [10]. UAE was performed through femoral artery access under fluoroscopic guidance. A 5-F RUC catheter (APT Medical, Hunan, China) was used to catheterize each uterine artery selectively. Bilateral UAE was performed in all procedures using gelatin sponge particles (560–710 μm/ 710–1000 μm) (Alicon, HangZhou, China). when there were uterine arteriovenous malformation, the larger gelatin sponge particle (1000–1400um)were used. Gelatin sponge particles were mixed with iodinated contrast medium, which was injected into the uterine artery until blood flow stasis in the uterine artery was achieved, which was defined as no flow for 5–6 heartbeats.

Clinical data

All the patients were followed up for three years and regular phone called for every six months. Fertility outcomes, including menstruation recovery (menstrual blood volume and duration), reproductive outcomes and pregnancy complications (pregnancy rate, live birth rate, preterm rate, hemorrhage rate, abruption of the placenta rate, and miscarriage rate), and the average time interval between previous CSP treatment and subsequent conception, were recorded.

Statistical analysis

Statistical analysis was performed using SPSS version 26.0(IBM, Armonk, New York). One-way ANOVA and Fisher's exact test was used to compare the data outcomes between the 2 groups. Logistic regression analysis was performed to investigate the influences of each factor on subsequent pregnancy rate. A P value of < 0.05 was considered statistically significant.

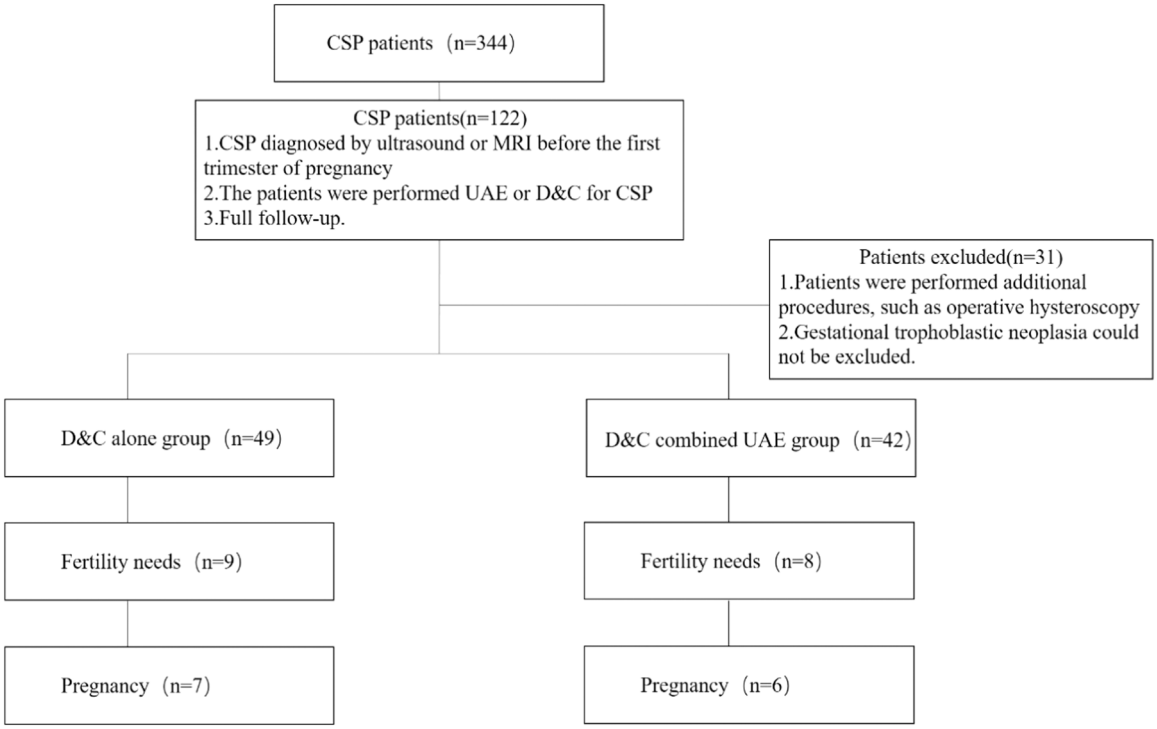

Fig. 1. The flowchart of patients selection.

Results

Clinical outcomes

A total of 91 cases of CSP were included in the study, with 49 treated with D&C alone and 42 treated with UAE combined with D&C. The clinical characteristics of the patients are presented in Table 1. There was no significant difference in median age between the two groups. However, the average gestational age was significantly longer in the UAE group compared to the D&C group. The number of previous cesarean deliveries, miscarriages, and pregnancy history did not differ between the two groups. The average diameter of the gestational mass was significantly larger in the UAE group (42.2 ± 19.8 mm) compared to the D&C group (23.8 ± 15.9 mm). The average amount of blood loss during the procedure was not significantly different between the D&C group (32 ± 47.3 ml) and the UAE combined with D&C group (27 ± 31.4 ml).

Reproductive outcomes

Of the 91 patients included in the study, the average time to menstrual recovery was significantly shorter in the D&C group (1.0 ± 0.20 months, range: 1–2 months) compared to the UAE combined with D&C group (2.0 ± 2.85 months, range: 1–18 months). The menstrual duration was shorter in 18 % of patients in the D&C group and 10 % of patients in the UAE group, with no significant difference between the two groups. Menstrual blood volume (MBV) decreased in 79 % of patients in the UAE group and 18 % of patients in the D&C group, with a significant difference between the two groups. MBV increased in 0 % of patients in the UAE group and 4 % of patients in the D&C group, with no significant difference between the two groups. No patients reported amenorrhea (Table 2).

Reproductive outcomes are presented in Table 3. In the D&C group, 9 patients desired to conceive after treatment for CSP, and 7 of these women (78 %) successfully conceived, with 5 giving birth to healthy babies and 2 experiencing spontaneous miscarriages. In the UAE group, 8 patients attempted to conceive, and 6 became pregnant, with 5 giving birth to healthy babies and 1 experiencing a spontaneous miscarriage. No patients suffered pregnancy complications in the two groups, including preterm, postpartum hemorrhage, abruption of the placenta. There was no significant difference in reproductive outcomes between the two groups. The average time interval between previous CSP treatment and subsequent conception was not significantly different between the two groups.

Discussion

As there are various treatment options for CSP, individualized treatment modalities should be considered. Ultrasound-guided D&C is commonly used for CSP and has a high success rate in low-risk bleeding patients, but a lower success rate in high-risk bleeding patients. One study reported a 95 % success rate for D&C in type 1 CSP, but only a 27 % success rate in type 2 CSP [11]. Another study found that D&C alone for CSP with a scar thickness of less than 3 mm required additional treatment in 52 % of patients [12]. Due to increased vascularity and the potential presence of arteriovenous malformations, the complication rates of D&C for CSP can range from 21 % to 86 % [13]. Additionally, CSP may damage myometrial contractility at the cesarean scar, leading to severe hemorrhage during the D&C procedure [14]. UAE is considered the first-line treatment for CSP with a high risk of bleeding and has a high overall success rate and low rate of requiring additional treatment, especially when combined with D&C with or without hysteroscopy [15].

UAE combined with D&C has been shown to be safe and effective for managing CSP and may be considered as one of the treatment options that enable preservation of fertility after treatment [16]. However, there is still controversy regarding its use in patients planning to conceive. Previous studies have reported adverse effects on ovarian reserve and fertility following UAE [17]. One study found that UAE combined with D&C in CSP patients reduced menstrual blood volume and subsequent pregnancy rates [7], while another study found no significant difference in pregnancy or live birth rates between UAE and non-UAE groups [18]. Serres-Cousine Oeta et al. also demonstrated that UAE may restore favorable uterine anatomy without intracavity distortion or residues, enabling viable pregnancies with clinically acceptable rates of post-embolization placental abnormalities, postpartum hemorrhage, and miscarriage [19].

In terms of fertility outcomes, our results showed that the average time to menstrual recovery was significantly longer in the UAE combined with D&C group compared to the D&C alone group, and more patients experienced relative amenorrhea in the UAE combined with D&C group. However, there was no significant difference between the two groups in reproductive outcomes or the average time interval between previous CSP treatment and subsequent conception. These results suggest that while UAE combined with curettage may affect menstrual recovery, which indicate that UAE may effect the endometrial function. One study reviewed hysteroscopy and endometrial biopsy cases after 6 months of UAE, and although 90 % of female patients showed normal endometrial function by histology evaluation, only 37 % had completely

Table 1
Clinical characteristics.

Characteristic	UAE group (n = 42)	D&C group (n = 49)	*P* value
Age(years)	34 ± 5.1	36 ± 5.4	0.296
Gestational age(days)	57 ± 16.9	46 ± 11.2	< 0.01
Previous CS (times)	1.3 ± 0.56	1.5 ± 0.62	0.202
Gravidity (times)	3.2 ± 1.82	3.3 ± 1.48	0.799
Parity (times)	1.3 ± 0.57	1.5 ± 0.62	0.28
Previous miscarriage (times)	2.0 ± 1.75	1.9 ± 1.27	0.709
Diameter of the gestational mass (mm)	42.2 ± 19.8	23.8 ± 15.9	< 0.01
Blood loss during procedure(ml)	27 ± 31.4	32 ± 47.3	0.604

UAE uterine artery embolization **CS** cesarean section.

Table 2
Fertility Outcomes of two groups.

Outcomes	UAE group (n = 42)	D&C group (n = 49)	*P* value
menstrual recovery time (months)	2.0 ± 2.85	1.0 ± 0.20	0.028
MBV (reduction) (%)	33/42,79 %	9/49,18 %	< 0.01
MBV (increase) (%)	0/42,0	2/49,4 %	0.186
menstrual duration(short)(%)	4/42,10 %	9/49,18 %	0.229
amenorrhoea(%)	0	0	1

MBV menstrual blood volume.

Table 3
Reproductive outcomes and pregnancy complications of two groups.

Outcomes and complications	UAE group (n = 8)	D&C group (n = 9)	*P* value
Pregnancy (%)	6(75 %)	7(78 %)	0.893
Miscarriage(%)	1(13 %)	2(22 %)	0.6
Preterm(%)	0	0	1
Postpartum hemorrhage(%)	0	0	1
Abruption of the placenta(%)	0	0	1
Live birth(%)	5(63 %)	5(56 %)	0.772
The average time interval between previous CSP treatment and subsequent conception(months)	21 ± 11.6	12 ± 5.1	0.116

normal hysteroscopic findings [20]. UAE can lead to endometrial ischemia and endometrial damage [21]. Besides, the larger gestational sacs and longer gestational ages in the UAE group, as well as their higher risk of bleeding, which may more easily damage the endometrium during D&C and UAE as well.

The total natural pregnancy rate 77 %, which is similar with the nature pregnancy rate after CSP treatment reported (60 %-88.0 %) in the literature [4,22]. Besides, the rate of live birth and spontaneous miscarriage rate were no significant differences between the two groups. And there was no significant difference between the two groups in reproductive outcomes or the average time interval between previous CSP treatment and subsequent conception.

Several studies have documented that UAE is linked to increased incidences of preterm labor, malpresentation, miscarriage, and postpartum hemorrhage [23–25]. However, other research has indicated that the rate of pregnancy complications following UAE can be similar to that observed in the general population. Specifically, the miscarriage rate was found to be comparable to that in patients with untreated leiomyomas.[26]. In our study, there were no cases of pregnancy complications in the two groups. It may due to our small sample size, or we chose relatively larger gelation sponge particles to perform UAE.

These results suggest that while UAE combined with curettage may affect menstrual recovery, it does not have an adverse effect on reproductive outcomes and pregnancy complications.

This study had several limitations. Firstly, it was a retrospective study conducted at a single center, introducing the potential for selection bias. Secondly, changes in menstrual blood volume were based on subjective evaluations by the women rather than objective measurements such as a pictorial blood loss assessment chart. Finally, the sample size was relatively small, and further research with larger sample sizes is needed.

Conclusion

UAE combined with D&C is an efficient and safe treatment for CSP. Our study showed that decreased MBV and longer menstrual recovery time in UAE combined with D&C group, but there are no statistical difference in fertility outcomes between the two groups, which suggests probably a reversible impact on the reproductive function.

CRediT authorship contribution statement

Fu Le: Conceptualization. **Gao Feng:** Writing – review & editing, Supervision. **Gao Jie:** Writing – original draft. **Wang Wenjing:** Data curation. **Cheng Jiejun:** Project administration. **Zhang zhuoying:** Investigation. **Cheng Saiming:** Methodology.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this article.

References

[1] Timor-Tritsch IE, Monteagudo A, Cali G, D'Antonio F, Kaelin Agten A. Cesarean scar pregnancy: diagnosis and pathogenesis. Obstet Gynecol Clin North Am 2019;46(4):797–811.
[2] Bick D, National Collaborating Centre for Ws, Children's H, National Institute for Clinical E. Caesarean Section. Clinical Guideline. National Collaborating Centre for Women's and Children's Health: commissioned by the National Institute for Clinical Excellence. World Evid Based Nurs 2004;1(3):198–9.
[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] Wang J, Wang D, Zhang X, Liu Y, Yang Q, Zhang N. The effect of prophylactic uterine artery embolization on reproductive outcomes in patients with cesarean scar pregnancy: a propensity score-matched study. Arch Gynecol Obstet 2022;305(3):651–9.
[5] Ou J, Peng P, Li C, Teng L, Liu X. Assessment of the necessity of uterine artery embolization during suction and curettage for caesarean scar pregnancy: a prospective cohort study. BMC Pregnancy Childbirth 2020;20(1):378.
[6] Tumenjargal A, Tokue H, Kishi H, Hirasawa H, Taketomi-Takahashi A, Tsushima Y. Uterine artery embolization combined with dilation and curettage for the treatment of cesarean scar pregnancy: efficacy and future fertility. Cardiovasc Interv Radio 2018;41(8):1165–73.
[7] 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.
[8] Lou T, Gao Y, Feng Y, Lu J, Zhang Z, Bai H. Reproductive outcomes of cesarean scar pregnancies pretreated with methotrexate and uterine artery embolization prior to curettage. Taiwan J Obstet Gynecol 2020;59(3):381–6.
[9] Chen YT, Chen YC, Chen M, Chang YJ, Yang SH, Tsai HD, Wu CH. Reproductive outcomes of cesarean scar pregnancies treated with uterine artery embolization combined with curettage. Taiwan J Obstet Gynecol 2022;61(4):601–5.
[10] Gao F, Lu Y, Guo X, Gao J, Wang W, Cheng J, Fu L. Complex blood supply patterns in cesarean scar pregnancy: insights from digital subtraction angiography imaging. Med Sci Monit 2023;29:e940133.
[11] Shen F, Lv H, Wang L, Zhao R, Tong M, Lee AC, Guo F, Chen Q. 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.
[12] 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.
[13] Liu L, Ross WT, Chu AL, Deimling TA. An updated guide to the diagnosis and management of cesarean scar pregnancies. Curr Opin Obstet Gynecol 2020;32(4):255–62.
[14] 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.
[15] Yang XY, Yu H, Li KM, Chu YX, Zheng A. Uterine artery embolisation combined with local methotrexate for treatment of caesarean scar pregnancy. BJOG 2010;117(8):990–6.
[16] Zhang B, Jiang ZB, Huang MS, Guan SH, Zhu KS, Qian JS, Zhou B, Li MA, Shan H. 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 Inter Radio 2012;23(12):1582–8.
[17] Hehenkamp WJ, Volkers NA, Broekmans FJ, de Jong FH, Themmen AP, Birnie E, Reekers JA, Ankum WM. Loss of ovarian reserve after uterine artery embolization: a randomized comparison with hysterectomy. Hum Reprod 2007;22(7):1996–2005.
[18] Arthur R, Kachura J, Liu G, Chan C, Shapiro H. Laparoscopic myomectomy versus uterine artery embolization: long-term impact on markers of ovarian reserve. J Obstet Gynaecol Can 2014;36(3):240–7.
[19] Serres-Cousine O, Kuijper FM, Curis E, Atashroo D. Clinical investigation of fertility after uterine artery embolization. Am J Obstet Gynecol 2021;225(4). 403 e401-403 e422.
[20] Mara M, Fucikova Z, Kuzel D, Maskova J, Dundr P, Zizka Z. Hysteroscopy after uterine fibroid embolization in women of fertile age. J Obstet Gynaecol Res 2007;33(3):316–24.
[21] Tropeano G, Litwicka K, Di Stasi C, Romano D, Mancuso S. Permanent amenorrhea associated with endometrial atrophy after uterine artery embolization for symptomatic uterine fibroids. Fertil Steril 2003;79(1):132–5.
[22] Gao L, Huang Z, Zhang X, Zhou N, Huang X, Wang X. Reproductive outcomes following cesarean scar pregnancy - a case series and review of the literature. Eur J Obstet Gynecol Reprod Biol 2016;200:102–7.
[23] Goldberg J, Pereira L, Berghella V. Pregnancy after uterine artery embolization. Obstet Gynecol 2002;100(5):869–72.
[24] Goldberg J, Pereira L, Berghella V, Diamond J, Daraï E, Seinera P, Seracchioli R. Pregnancy outcomes after treatment for fibromyomata:: Uterine artery embolization versus laparoscopic myomectomy. Am J Obstet Gynecol 2004;191(1):18–21.
[25] Homer H, Saridogan E. Uterine artery embolization for fibroids is associated with an increased risk of miscarriage. Fertil Steril 2010;94(1):324–30.
[26] Mohan PP, Hamblin MH, Vogelzang RL. Uterine artery embolization and its effect on fertility. J Vasc Interv Radiol 2013;24(7):925–30.