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## Observational Study

## Diagnosing early scar pregnancy in the lower uterine segment after cesarean section by intracavitary ultrasound

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**Institutional review board**

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**Abstract****BACKGROUND**

Early scar pregnancy (CSP) in the lower uterine segment after cesarean section is a type of ectopic pregnancy that can cause major complications if left untreated. Transabdominal ultrasound is a common procedure but is influenced by external factors. Thus, intracavitary ultrasound may have better diagnostic efficiency for CSP.

**AIM**

To assess the value of intracavitary ultrasound for diagnosing CSP in the lower uterine segment after cesarean section.

**METHODS**

Patients diagnosed with CSP in our hospital from October 2019 to April 2021 were recruited. Transabdominal and intracavitary ultrasound examinations were performed to compare the diagnostic differences for CSP and its types.

**RESULTS**

Sixty-three patients were diagnosed during the study period. The diagnostic accuracy for CSP was higher in intracavitary ultrasound (96.83%) than in transabdominal ultrasound (84.13%) ( $P < 0.05$ ). The missed diagnosis and misdiagnosis rates did not differ among the ultrasound types (intra: 0.00% and 3.17%; trans: 4.76% and 11.11%, respectively;  $P > 0.05$ ). For the diagnostic rates for the CSP types, the rates for gestational sac (100.00% vs 90.48%), heterogeneous mass (93.75% vs 75.00%), and part of the uterine cavity (80.00% vs 60.00%) were higher in intracavitary ultrasound than in transabdominal ultrasound, but the difference was not statistically significant ( $P > 0.05$ ). For gestational sac CSP patients, intracavitary ultrasound showed that the gestational sac was located in the lower uterine segment scar with abundant peripheral blood flow; the distance between the gestational sac and the serosal layer was  $2.42 \pm 0.50$  cm. Intracavitary ultra-

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sound for heterogeneous mass CSP patients indicated that the mass mainly occurred in the lower anterior uterine wall, protruding into the bladder, and was surrounded by abundant internal and peripheral blood flow; the distance between the mass and serosal layer was  $1.79 \pm 0.30$  cm. For CSP type partly located in the uterine cavity, the gestational sac was partly located in the lower uterine cavity and partly in the scar with abundant internal and peripheral blood flow; the distance between the gestational sac and the serosal layer was  $2.29 \pm 0.28$  cm.

## CONCLUSION

Intracavitary ultrasound had a higher diagnostic accuracy and application value for diagnosing CSP than transabdominal ultrasound, with reduced risk of missed diagnoses and misdiagnosis, thereby preventing delayed treatment.

**Key Words:** Ultrasonography; Cesarean section; Uterus; Pregnancy; Cesarean section; Repeat; Ultrasonography; Doppler

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**Core Tip:** This study assessed the value of using intracavitary ultrasound for diagnosing early scar pregnancy after cesarean section and found that it had higher diagnostic accuracy than traditional transabdominal ultrasound, reducing the risk of missed diagnosis and misdiagnosis, likely resulting in prompt treatment and improved patient prognosis.

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## INTRODUCTION

Early scar pregnancy (CSP) in the lower uterine segment after cesarean section is primarily an embryonic pregnancy at the lower uterine segment incision scar, also known as an incision pregnancy, which is a type of ectopic pregnancy[1,2]. In recent years, the CSP incidence has risen, threatening patients' physical and mental health and quality of life with increasing cesarean section rates[3,4]. If an embryo implants into the site of the lower uterine scar from a previous cesarean, and timely and accurate diagnosis and treatment is not provided, then the implantation and adhesion of villi and myometrium can cause uncontrollable massive bleeding, and, in severe cases, uterine rupture as the pregnancy progresses[5,6]. Consequently, early CSP diagnosis remains a critical research topic.

Ultrasound is a commonly used diagnostic modality. Traditional abdominal ultrasound is easily affected by external factors, such as abdominal fat thickness and poor bladder filling, leading to an increased risk of misdiagnosis. However, an intracavitary ultrasound resists the influences of external factors on the diagnostic results[7,8].

This study compared the diagnostic value of intracavitary and transabdominal ultrasound for diagnosing CSP and its types.

## MATERIALS AND METHODS

### Patient selection

This study was approved by the ethics committee of our hospital, and informed consent was obtained from all patients and their families. Patients diagnosed with CSP in our hospital from October 2019 to April 2021 were recruited. The inclusion criteria

were as follows: (1) A history of cesarean section; (2) The interval between current and previous cesarean sections was more than one year; (3) The previous cesarean section incision was transverse and healed well; (4) The patient was mentally fit and could cooperate with the researchers to complete the investigation; (5) An abnormally increased human chorionic gonadotropin level; and (6) Variable degrees of abdominal pain and irregular vaginal bleeding.

The exclusion criteria were as follows, patients with: (1) Organic diseases, such as kidney, liver, and heart disease; (2) Malignant tumors; (3) Speech communication disorders, hearing impairment, or mental system disease; and (4) Poor compliance and who were unable to cooperate to complete the survey.

### **Transabdominal ultrasonography**

All patients were examined by transabdominal and intracavitary ultrasonography. The Toshiba LOGIQ S7 type four-dimensional color Doppler ultrasound diagnostic instrument and matching ultrasound probe were used for the transabdominal ultrasound. When the patient's bladder was full, an assistant helped the patient into a supine position. An ultrasound probe with 5-9 MHz was smeared on the coupling agent and placed on the lower abdomen for examination to determine the position, size, and appendages of the uterine pregnancy and investigate the myometrium thickness, abnormal mass around the uterus, myometrial defects, and incision scar.

### **Intracavitary ultrasonography**

The equipment and probe frequency of intracavitary ultrasonography were the same as those of transabdominal ultrasonography. The probe smeared on the coupling agent was placed on the condom. Iodophor (2%) was evenly applied on the outside of the condom, then slowly inserted into the vagina to perform longitudinal and transverse scanning at the uterine incision, pregnancy site, cervix, uterine cavity, bilateral accessories, and pelvic cavity, and investigate the myometrium thickness, the gestational sac implantation position, scar blood flow, and incision echo.

### **Observation index**

CSP diagnosis by transabdominal and intracavitary ultrasonography were analyzed, as were the CSP types, including gestational sac, heterogeneous mass, and part of the uterine cavity.

### **Statistical analyses**

Data were analyzed using SPSS version 22.0 (IBM Corp., Armonk, NY, USA). Measurement data were expressed as means  $\pm$  SD, and the data were expressed as *n* (%). A *P* value of  $< 0.05$  indicated statistical significance.

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## **RESULTS**

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### **Patient demographics**

In total, 63 patients with CSP were included, with an average age of  $29.56 \pm 6.64$  (range, 23 to 36) years. The average gravidity was  $2.48 \pm 1.10$  (range, 1 to 4) times. The average interval between the current and previous cesarean sections was  $4.63 \pm 2.91$  (range, 1 to 8) years. The average menopause duration was  $51.41 \pm 13.91$  (range, 36 to 67) d.

### **Examination methods and CSP diagnoses**

The diagnostic accuracy was significantly higher in intracavitary ultrasonography (96.83%) than in transabdominal ultrasonography (84.13%;  $P < 0.05$ ). The missed diagnosis and misdiagnosis rates did not differ between the two methods (intra: 0.00% and 3.17%; trans: 4.76% and 11.11%, respectively;  $P > 0.05$ ; [Table 1](#)).

### **Examination methods and diagnosing CSP types**

The intracavitary ultrasound diagnostic rates were higher than the transabdominal ultrasound diagnostic rates, but the difference was not statistically significant for the gestational sac (100.00% *vs* 90.48%), heterogeneous mass (93.75% *vs* 75.00%), and part-of-the-uterine-cavity (80.00% *vs* 60.00%) types ( $P > 0.05$ ; [Table 2](#)).

**Table 1** Early scar pregnancy diagnoses by examination method, *n* (%)

Method	Cases	Accuracy	Missed diagnosis	Misdiagnosis
Intracavitary	63	61 (96.83)	0 (0.00)	2 (3.17)
Transabdominal	63	53 (84.13)	3 (4.76)	7 (11.11)
$\chi^2$ value		4.513	1.366	1.915
<i>P</i> value		0.034	0.242	0.166

**Table 2** Examination methods and the diagnostic accuracy for early scar pregnancy types, *n* (%)

Methods	Cases	Gestational sac	Heterogeneous mass	Uterine cavity	Accuracy
Intracavitary	63	42/42 (100.00)	15/16 (93.75)	4/5 (80.00)	61/63 (96.83)
Transabdominal	63	38/42 (90.48)	12/16 (75.00)	3/5 (60.00)	53/63 (84.13)
$\chi^2$ value		2.363	0.948	0.000	4.513
<i>P</i> value		0.124	0.330	1.000	0.034

### ***Intracavitary ultrasonography and CSP types***

Intracavitary ultrasonography for the gestational sac CSP type showed that the gestational sac was located on the scar of the lower uterine segment with abundant peripheral blood flow, and the distance between the gestational sac and the serosal layer was  $2.42 \pm 0.50$  cm. For the heterogeneous mass type, the heterogeneous mass was located on the lower anterior uterine wall, protruding into the bladder, and was surrounded by abundant internal and peripheral blood flow; the distance between the mass and serosal layer was  $1.79 \pm 0.30$  cm. For the part-of-the-uterine-cavity CSP type, the gestational sac was located partly in the lower uterine cavity and partly in the scar and surrounded by abundant internal and peripheral blood flow; the distance between the gestational sac and the serosal layer was  $2.29 \pm 0.28$  cm (Table 3).

## **DISCUSSION**

CSP, a multiple ectopic pregnancy type, has a complex pathogenic mechanism that has yet to be clarified[9-11]. However, some studies have suggested that CSP is closely related to abnormal changes in local biochemical factors and the anatomical status of the uterine incision scar[12]. Others suggested that CSP is associated with decidual vascular defects, poor wound healing, and endometrial injury[13,14]. Further, typical clinical CSP manifestations are lacking. Thus, there is a high risk of missed diagnosis or misdiagnosis. Correctly diagnosing CSP soon after a cesarean section is difficult, and the optimal time to diagnose CSP is unclear. Consequently, the initial treatment plan may be ineffective, increasing the risk of uncontrollable massive hemorrhage, uterine rupture, and other adverse events. Severe cases require a hysterectomy, seriously affecting the psychological and physical health of these patients.

In recent years, the social economy and medical technology have continuously developed. For CSP, color Doppler ultrasound can determine the scar blood flow, muscle layer thickness, and gestational sac implantation, which is advantageous for diagnosing and evaluating the treatment[15]. However, the traditional transabdominal ultrasound is limited by abdominal fat and intestinal gas and requires a full bladder, resulting in a low accuracy. Conversely, in intracavitary ultrasound, these adverse diagnostic effects are avoided and the probe is as close to the abdominal cavity as possible, which is beneficial for obtaining the information needed for a diagnosis, improving the diagnostic accuracy[16].

CSP grows in two ways. In one, growth starts from the scar and orients toward the uterine cavity, making continuous growth and survival possible. In the second, growth starts from the scar but orients toward the uterine wall, resulting in an intramuscular pregnancy and possibly uterine rupture, perforation, or abortion. With the continuous development of eggs, the gestational sac and viable germ may occur in the uterine cavity based on the intrauterine ultrasound examination and some pregnant tissues and placenta accreta at the incision[17,18]. The lack of specific clinical CSP manifest-

Table 3 Intracavitary ultrasound for diagnosing early scar pregnancy types

Types	Cases	Performance	Blood flow	Interval (cm)
Gestational sac	42	The gestational sac was located in the scar of the lower uterine segment	Abundant peripheral blood flow	2.42 ± 0.50
Heterogeneous mass	16	The heterogeneous mass was located in the lower part of the anterior wall of uterus, protruding into the bladder	Abundant internal and peripheral blood flow	1.79 ± 0.30
Part of the uterine cavity	5	The gestational sac was located in the lower part of the uterine cavity and part in the scar	Abundant internal and peripheral blood flow	2.29 ± 0.28

ations easily leads to misdiagnoses of cervical pregnancy, trophoblastic tumor, intrauterine pregnancy, and threatened abortion. However, it was observed that most of the cervix of CSP patients was enlarged without considerable enlargement of the uterine body and isthmus, the isthmus did not have abundant blood flow signal, and the embryo did not exceed the uterine orifice. The gestational sac and uneven echo could be detected in the uterine tube with a closed cervical orifice.

Transabdominal ultrasound has disadvantages, such as being easily affected by scar tissue, bladder capacity, and transabdominal fat. Intracavitary ultrasound does not have those disadvantages and has high definition, resolution, and performance and a wide scanning range. Further, our results indicated that the diagnostic accuracy of intracavitary ultrasound was higher than that of transabdominal ultrasound, suggesting a higher application value for disease diagnosis. Yule *et al*[19] reported that an intracavitary ultrasound can diagnose CSP by checking the implantation position of the gestational sac, the internal and accessory conditions of the uterus, and the changes in the cervix and isthmus of the uterus with high sensitivity and specificity. Huang Li also showed that although both transabdominal and intracavitary ultrasound examinations can show the specific condition of the uterus, the intracavitary ultrasound more accurately displays the myometrial and blood flow states, providing an objective reference for doctors, reducing the risk of misdiagnosis, and providing baseline data for follow-up evaluations. Furthermore, intracavitary color Doppler ultrasound accurately shows the blood flow status of the scar, gestational sac implantation position, and scar muscle layer thickness, which, as reported by Jabeen *et al*[20], are useful for the diagnosis and evaluation of CSP. However, attention should be given to identifying various situations, such as CSP and cervical pregnancies, local adenomyosis, abortion, and uterine incision hematoma. These conclusions are consistent with our results, confirming that intracavitary ultrasound has a higher diagnostic value for CSP than transabdominal ultrasound, by maximizing the diagnostic accuracy through reduction of the incidence of missed diagnosis and misdiagnosis. Finally, regarding diagnoses, the probe position is closer to the lesion in an intracavitary ultrasound, which is more convenient for doctors, as it allows the observation of the implantation position of the gestational sac, and a full bladder is not required.

## CONCLUSION

Intracavitary ultrasound has a higher diagnostic accuracy and, therefore, higher application value for diagnosing CSP than traditional transabdominal ultrasound. Intracavitary ultrasound reduces the risk of missed diagnosis and misdiagnosis, likely resulting in prompt treatment and improved patient prognosis. However, the sample size of this study is small; thus, to determine whether our conclusions are broadly valid, the scope of selected cases and the number of study cases should be expanded for in-depth exploration.

## ARTICLE HIGHLIGHTS

### Research background

Early scarring pregnancy (CSP) in the lower part of the uterus after cesarean section is an ectopic pregnancy. Intracavitary ultrasound may have a better diagnostic efficiency for CSP.

### Research motivation

This study evaluated the value of intracavitary ultrasound in the diagnosis of CSP in the lower uterus after cesarean section.

### Research objectives

In this manuscript, the authors aimed to study the value of intracavitary ultrasound in the diagnosis of CSP in the lower segment of the uterus after cesarean section, and to provide a better basis and method for the diagnosis of CSP.

### Research methods

An observational study was conducted on patients diagnosed with CSP in our hospital from October 2019 to April 2021.

### Research results

The diagnostic accuracy of intracavitary ultrasound for CSP is higher than that of transabdominal ultrasound. There was no difference between the missed diagnosis rate and the misdiagnosis rate between ultrasound types. For the diagnosis rate of CSP type, the diagnosis rate of pregnancy sac, heterogeneous mass and part of the uterine cavity by intracavitary ultrasound is higher than that of transabdominal ultrasound, and the difference is not statistically significant.

### Research conclusions

Intracavitary ultrasound had a higher diagnostic accuracy and application value for diagnosing CSP than transabdominal ultrasound, with reduced risk of missed diagnoses and misdiagnosis, thereby preventing delayed treatment.

### Research perspectives

Intracavitary ultrasound may have a better diagnostic efficiency for CSP and has a wider clinical application value.

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