Original Article

The value of ultrasound for early classification in cesarean scar pregnancy

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Abstract: Objective: To investigate the value of ultrasound early classification in Cesarean scar pregnancy (CSP). Methods: Ultrasound images were utilized to categorize 95 CSP patients by cavity, partial, and complete types based on the villi implant positions of the embryos. The patients also were categorized according to signs of scar blood flow levels. CSP patients were separated by type for conservative or interventional treatment and cure rates were assessed. Results: The cure rate was 96.56% for the cavity types, 76.19% for the partial types and 45.83% for the complete types ($\chi^2=5.432$, $P=0.020<0.05$; $\chi^2=17.379$, $P=0.000<0.001$). The total cure rate for the interventional group was 84.48% and for the conservative group it was 59.46% ($\chi^2=7.492$, $P=0.006<0.05$). Conclusion: Although the interventional therapy was an effective method for most CSP patients, the conservative therapy was also effective for types with shallow implantation of the gestational sacs. The use of ultrasound for the early classification of CSP patients evidenced important clinical significance. Treatment should be individualized and which types should be considered.

Keywords: Ultrasound classification, cesarean scar pregnancy, interventional treatment, conservative treatment

Introduction

Cesarean scar pregnancy (CSP) is defined as an ectopic pregnancy (EP) implanted in the myometrium of a previous Cesarean section scar [1]. Without timely and proper management, CSP may cause major bleeding, uterine rupture, and other life-threatening complications [2]. Diagnostic criteria for caesarean scar pregnancy have been described in the literature [3, 4]. Diagnosis is made based on an ultrasonography which shows an empty uterine cavity, an empty cervical canal, a gestational sac in the anterior part of the uterus, and an absence of healthy myometrium between the bladder and sac [5]. Although there are universal diagnostic criteria for CSP, different ultrasound images may be evidence of these criteria. At present, there are many studies on the classification of CSP by ultrasound images. Most studies have separated the ultrasound images according to gestational sac, mass and abortion types. The mass and abortion types are formations caused by an incomplete destruction of the gestational sac. These cannot reflect the actual position of the gestational sac [6]. We present our findings and evaluate the importance and feasibility of ultrasound classification in the gestational sac type.

Materials and methods

The research team performed a prospective analysis of 95 CSP patients which were all gestational sac types at the Xinqiao Hospital Department of Obstetrics and Gynecology from January 1, 2013 to January 1, 2015. The research protocol was approved by the ethics committee of Xinqiao Hospital, Third Military Medical University. All patients were informed of treatment benefits and risks, potential complications, as well as alternatives and patient consent was obtained. Additional informed consent was obtained from all individual participants for whom identifying information was included in this article.
All examinations and evaluation reports were performed by three sonographers, each of whom had more than five years of experience with ultrasonography to perform gynecologic and obstetric examinations. Ultrasonography (5-9 MHz convex probe, Phillips IU22, GE E8 7) was used in all the cases.

**Ultrasound classification**

**Cavity type:** The gestational sac is located in the lower part of the uterine cavity, and the nourishing vessel of the gestational sac is derived from the edge of scar (Figure 1).

**Partial type:** Part of the gestational sac is located in the wall of the cesarean scar, partially located in the uterine cavity, and the nourishing vessel of the gestational sac is derived from the middle of scar (Figure 2).

**Complete type:** The pregnancy sac is located in the thinnest wall of the scar, and the nourishing vessel of the gestational sac is derived from the thinnest wall of the scar (Figure 3).

A semi-quantitative ultrasound grading system developed by Adler was used for grading blood flow: grade 0 (absent) exhibits no blood flow; grade I (minimal) exhibits one or two pixels containing blood flow (usually <1 mm in diameter); grade II (moderate) exhibits a main vessel and/or several small vessels; grade III (marked) exhibits four or more vessels. Grade 0-I represents signs of low blood flow and grade II-III represents rich blood flow [7].

The therapy for CSP included an interventional group and a conservative group. The interventional group was treated with uterine artery embolization (UAE) combined with curettage. The conservative group was treated with methotrexate (MTX) and curettage.

Of the 95 CSP patients the interventional group included 58 patients and the conservative group 37 patients.

Successful treatment was defined as the disappearance of the gestational sac, a steady decline to no active vaginal bleeding, serum β-HCG concentration settling down to normal levels, no severe complications, and no need to repeat embolization or laparotomy. Failed treatment was defined as the continued presence of the pregnancy sac or mass type, continuous or increased vaginal bleeding, or a rise in serum β-HCG [6].

Recorded data included cure rate, curettage blood loss, serum β-HCG readings, estimated vaginal blood loss, and length of hospitalization. All cases were followed up for at least one year. Statistical analysis of all data was performed using the Student t test and the mean ± standard deviation (X±s) by the SPSS version 17.0 (SPSS Inc., Chicago, IL, USA).

**Results**

Ninety-five women with CSP were enrolled in this prospective study. The details of their clini-
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With an average age of 32.42±2.56. Gravidity ranged from five to eight, with an average of 7.36. Most of the participants (78.94%) had given birth through Cesarean once and some women had given birth through Cesarean twice (21.05%).

Twenty-nine of the patients were categorized as cavity type; twelve of them had low blood flow (41.37%) and 17 (58.63%) rich blood flow (Figure 4). Forty-two patients were categorized as partial type (Figure 5); twelve (25.87%) of them exhibited low blood flow and 30 (71.43%) rich blood flow. Finally, 24 patients were categorized as complete type (Figure 6); seven of them (29.16%) exhibited low and 17 (70.84%) of them high blood flow (Table 2).

In the conservative group of 37 patients, there were 13 patients categorized as cavity type. Five (38.46%) of the cavity type patients exhibited low blood flow and eight (61.54%) rich blood flow. Seventeen patients were partial type; four (23.53%) exhibited low blood flow, and 13 (76.47%) rich blood flow. Seven patients were complete type; three patients (42.85%) with low blood flow signal, 13 patients (57.15%) with rich blood flow (Table 2).

In the interventional group of 58 patients, there were 16 patients with cavity type of which seven (43.75%) exhibited low blood flow, and nine (56.25%) rich blood flow. Twenty-five patients were partial type; eight patients (32.00%) exhibited low blood flow and 17 patients (68.007%) rich blood flow. Seventeen patients were complete type; four patients (17.39%) with low blood flow signal, 13 patients (2.61%) with rich blood flow (Table 2).

The conservative group demonstrated a success rate of 59.45% (22 of 37 cases). The interventional group demonstrated a success rate of 84.48% (49 of 58 cases). The breakdown of success rate by patients with different blood flow grade is shown in the table. The success rate of cavity type was 96.56%, significantly higher than partial type patients (76.19%) and complete type (45.83%), with χ²=5.432, P=0.020; χ²=17.379, P<0.001 (Table 2).

Among the cavity type patients, 12 of them (92.30%) showed success with conservative treatment, compared to 16 patients (100%)...
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cured in the interventional group. Statistically, the cure rates of the two groups had no significant difference regardless of the measure of the blood flow (\( \chi^2=1.275, P=0.259 \)) (Table 2).

In partial type patients, the success rate of the interventional group (92.00%) was significantly higher than the conservative group (52.94%, \( \chi^2=8.510, P=0.004 \)), for the patients with low and rich blood flow; the success rate was 100.00% for both groups. The success rate of the interventional group for patients with rich blood flow (88.23%) was higher than for the conservative group (38.46%) (\( \chi^2=8.213, P=0.004 \)) (Table 2).

In complete type patients with low blood flow, the success rate of the interventional group (75.00%) was significantly higher than the conservative group (0.00%) (\( \chi^2=3.938, P=0.047 \)). For patients with rich blood flow, there was no significant difference between the conservative group (25.00%) and the interventional group (53.84%, \( \chi^2=1.022, P=0.312 \)) (Table 2).

The 15 failure cases in the conservative group included three patients with low blood flow and 12 patients with rich blood flow. The three patients with low blood flow received UAE treatment after ineffective therapy. During follow-up, the patient was stable and no complications occurred. The other 12 patients with rich blood flow were transferred to UAE treatment immediately because of heavy bleeding (>500 mL); in nine cases the patients recovered during follow-up. However, massive vaginal bleeding occurred again in the other three cases on the third day after the UAE, accompanied by rapid blood loss of around 800 mL, episodes of dizziness and fainting, and a mass visible with ultrasound (Figure 7). Thus, the three patients underwent urgent laparoscopic hysterectomy.

The nine failure cases in the interventional group included one patient with low blood flow and eight patients with rich blood flow. The patient with low blood flow received UAE treatment the second time after ineffective therapy. There were no complications during follow-up. All eight patients with rich blood flow did not have heavy bleeding during curettage. They returned for treatment due to massive vaginal bleeding within a period of one week to one month pursuant to hospital discharge. Following a second UAE therapy, seven patients were cured; only one patient failed to heal and had to undergo an urgent laparoscopic hysterectomy.

Comparison of different therapies for CSP

The success rate of 59.45% for the conservative group was higher than the interventional group (84.48%) (\( \chi^2=7.492, P=0.006 \)). The interventional group fared better than the conservative group with regard to intraoperative bleeding loss (t=5.920, P=0.000), time of vaginal bleeding (t=4.656, P=0.000). There was no difference in the average duration of hospitalization (t=-0.884, P=0.379) (Table 3).

Discussion

Pregnant women with a prior cesarean delivery should be aware of the possibility of CSP, which is a type of ectopic gestation that may lead to heavy and life-threatening bleeding as well as uterine rupture due to an abnormally adherent placenta. The transvaginal ultrasound combined with color and pulsed Doppler evaluation is relatively reliable in diagnosing CSP [8, 9]. The development of ultrasound technique, enables high sensitivity and specificity for the detection of blood flow in tissue that could better reveal vascularization around the gestational sac and intrauterine membrane [10].

Earlier studies highlighted different types of classification that corresponded to ultrasound images. The two main types were identified as

Figure 6. Ultrasound image of complete type for CSP (arrow).
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Table 2. Comparison of treatment efficacy different CSP types with treatment methods (cure rate, % (n, total n))

<table>
<thead>
<tr>
<th>CSP classification</th>
<th>Total</th>
<th>Conservative group</th>
<th>Interventional group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Few blood flow signal</td>
<td>Rich blood flow signal</td>
</tr>
<tr>
<td>Cavity type</td>
<td>96.56 (28/29)</td>
<td>100 (5/5)</td>
<td>87.50 (7/8)</td>
</tr>
<tr>
<td>Partial type</td>
<td>76.19 (32/42)</td>
<td>100 (4/4)</td>
<td>38.46 (5/13)</td>
</tr>
<tr>
<td>Complete type</td>
<td>45.83 (11/24)</td>
<td>0 (0/3)</td>
<td>25.00 (1/4)</td>
</tr>
<tr>
<td>Total</td>
<td>74.74 (71/95)</td>
<td>75 (9/12)</td>
<td>52 (13/25)</td>
</tr>
</tbody>
</table>

Figure 7. A massive mass was visible with ultrasound (arrow).

gestational sac and mass. However, the mass type represented an incomplete destruction of the gestational sac, and therefore did not reflect its position. In recent years, some researchers classified the CSP into two types. Type I is caused by implantation of the amniotic sac on the scar with progression toward either the uterine cavity or the cervicisthmic space. Type II is caused by deep implantation in a previous cesarean scar, a defect with growth that infiltrates into the uterine myometrium and bulges from the uterine serosal surface [11, 12]. This classification is of importance for treatment and prognosis of CSP. However, it is a phenomenon that the gestational sac presents and cannot reflect the implantation position of it. Ultrasound classification permits a clear understanding of the implantation position and vascularization around the gestational sac. This study has demonstrated that the deeper the gestational sac has invaded the scar, the richer the blood flow. Therefore, the complete type with blood flow proved to be most prevalent (71.43%), followed by the partial (70.84%) and cavity types (58.63%).

Systemic or local administration of methotrexate (MTX) and/or uterine artery embolization (UAE) followed by uterine curettage to remove the conceptus has been suggested as standard treatment for CSP [13-16]. In this study, we found different types of CSP resulted in different outcomes for the two therapies. In cavity type CSP, both methods were effective irrespective of blood flow. In partial type CSP, UAE therapy proved effective irrespective of blood flow. However, the conservative treatment method was effective only in patients with low blood flow, and was not effective in patients with rich blood flow. In complete type CSP, only three patients with low blood flow experienced positive outcomes with UAE treatment; the others’ outcomes were poor. Through therapeutic effect monitoring, we found that UAE therapy was effective for the majority of CSP patients. This was consistent with other research [17]. Similarly, conservative treatment was effective for nearly half of all CSP patients.

There could be several explanations for these results. First, the UAE could effectively block the flow of uterine arteries which would impede massive bleeding during curettage and contribute to removal of the entire gestational sac. Consequently, most CSP patients could be cured. There would still remain a small number of patients that could not be cured due to the infiltrating growth of the gestational sac into the uterine myometrium and bulging from the uterine serosal surface evident in the ultrasound image. In this case, the curette and aspirator could not completely remove the gestational sac during the curettage. Second, the conservative therapy was effective for cavity
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Table 3. Comparison of the Cure rate, intraoperative bleeding, and main outcomes between the conservative and interventional groups

<table>
<thead>
<tr>
<th></th>
<th>Conservative group</th>
<th>Intervventional group</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cure rate (%)</td>
<td>59.45</td>
<td>84.48</td>
<td>0.006</td>
</tr>
<tr>
<td>Intraoperative bleeding loss (ml)</td>
<td>75.92±48.32</td>
<td>35.60±15.50</td>
<td>0.000</td>
</tr>
<tr>
<td>Time of vaginal bleeding (days)</td>
<td>7.79±1.26</td>
<td>3.72±0.48</td>
<td>0.000</td>
</tr>
<tr>
<td>Hospital stay (days)</td>
<td>5.44±1.03</td>
<td>5.62±0.87</td>
<td>0.379</td>
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Disclosure of conflict of interest
None.

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