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# Pelvic Artificial Isolation with Ultrasound-Guided Fluid: A New Technique In Ovarian Endometriotic Cyst Transabdominal Sclerotherapy

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Study Design A  
Data Collection B  
Statistical Analysis C  
Data Interpretation D  
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**Conflict of interest:** None declared

**Background:** The aim of this study was to investigate the preparation method and effect of artificial pelvic fluid during the sclerotherapy of ovarian endometrioma cysts guided by ultrasound through an abdominal wall puncture.





**Material/Methods:** Under the guidance of ultrasound, a total of 70 cases of artificial pelvic isolation fluid were isolated during the sclerosis of ovarian endometrioma cysts through an abdominal wall puncture. The success rate, time required, intraoperative pain incidence, vagal reflex incidence, related complications, and efficacy of artificial pelvic isolation fluid were summarized and analyzed.

**Results:** The results showed that the success rate of artificial pelvic isolation fluid was 100%, the average time of surgery was  $9.1 \pm 1.3$  min, the incidence of intraoperative pain was 5.71% (4/70), and the incidence of vagal reflex was 2.86% (2/70). No complications, such as bleeding, intestinal perforation, or infection, occurred. After 12 months of follow-up, the cure rate was 97.14% (68/70) and the effective rate was 100% (70/70).

**Conclusions:** We were first to use artificial pelvic isolation fluid technology to solve the problems of unclear cyst display, lack of safe puncture path, and severe pain during or after surgery in patients, and to exhibit a high level of intraoperative comfort for patients with a safe and effective clinical treatment.

**Keywords:** **Sclerotherapy • Extracorporeal Shockwave Therapy • Carcinoma, Ovarian Epithelial**

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## Background

Endometriosis and ovarian endometrial cysts (OECs) are very common diseases in women during the reproductive age [1,2]. Endometriosis is diagnosed, with varying delay, at about 7.5 years after the onset of symptoms. OECs cause adverse consequences, such as pain, infertility, torsion of the pedicle, and rupture, with a 0.5% to 1.0% risk of malignant transformation [3,4]. The causes of endometriosis include different factors, such as microRNA [5-7], antibodies, and cellular signaling [8-12]. The Endometriosis Collaborative Group of the Obstetrics and Gynecology Branch of the Chinese Medical Association and the Endometriosis Professional Committee of the Obstetrics and Gynecology Branch of the Chinese Medical Doctor Association proposed that the goal of OEC treatment is to reduce and eliminate lesions and pain, improve and promote fertility, and avoid recurrence [13,14]. Young patients needing to maintain fertility can undergo surgical resection, ultrasound-guided puncture, postoperative drug therapy, and assisted reproductive technology.

Artificial isolation fluid technology is usually used in treating thermal ablation of liver cancer, kidney cancer, and thyroid nodules [15]. The main purpose is to use normal saline solution to isolate the diseased organs from other surrounding tissues and organs that are blocked by the generated isolation-fluid to avoid heat damage to the surrounding tissues and organs. OECs can be harmful to women, potentially leading to infertility, pain, and malignant transformation [1,2]. OECs also have poor clinical outcomes after current drug treatment, and outcomes after using routine laparoscopic surgery include a large area of tissue damage and high recurrence rate, with some surgeries exhibiting small trauma and good curative effect [16,17].

However, during surgery of puncture and hardening therapy of the skin in treating OECs, the common obstacles include unclear cyst display or large omentum obstruction, no safe puncture path that can be observed or determined, and severe pain caused by leakage stimulation and vagus nerve reflex in the patients. To solve these problems, we were the first to use artificial pelvic isolation liquid technology to inject physiological saline in the pelvic cavity, which can push the intestinal tube or large omentum blocked in front of the cysts, so that the cysts can be displayed more clearly and a safe puncture path can be easily determined. Also, the physiological saline can be wrapped around the cyst, which can quickly dilute the leakage of sclerotic agent drugs, decrease irritation and damage to the surrounding tissues, and reduce the possibility of pain and vagus nerve reflex in patients. Our data have demonstrated that this technology plays an important role in protecting the surrounding tissue, improving the safety of surgery, and increasing patient comfort.

## Material and Methods

### Patients

A total of 70 patients who received ultrasound-guided OEC transabdominal sclerotherapy in the Department of Interventional Ultrasound, Zhejiang Rongjun Hospital from January 2020 to September 2021 were selected to participate in our research program. The study was approved by the institution's Ethics Committee (approval no. 20220112). All patients gave informed consent for the ultrasound-guided puncture sclerotherapy.

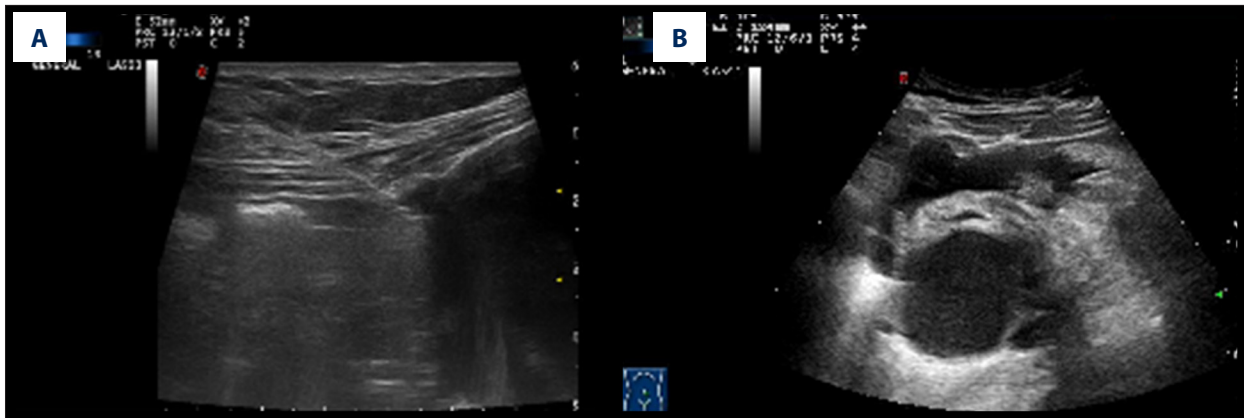
The patient age ranged from 22 to 46 years, with an average age of 35 years. The average cyst diameter in patients was 6.35 cm. Sixty patients had single cysts and 10 patients had multiple cysts. Seventeen patients already had initial treatment, and 36 patients had cyst recurrences after laparoscopic surgery.

### Inclusion Criteria

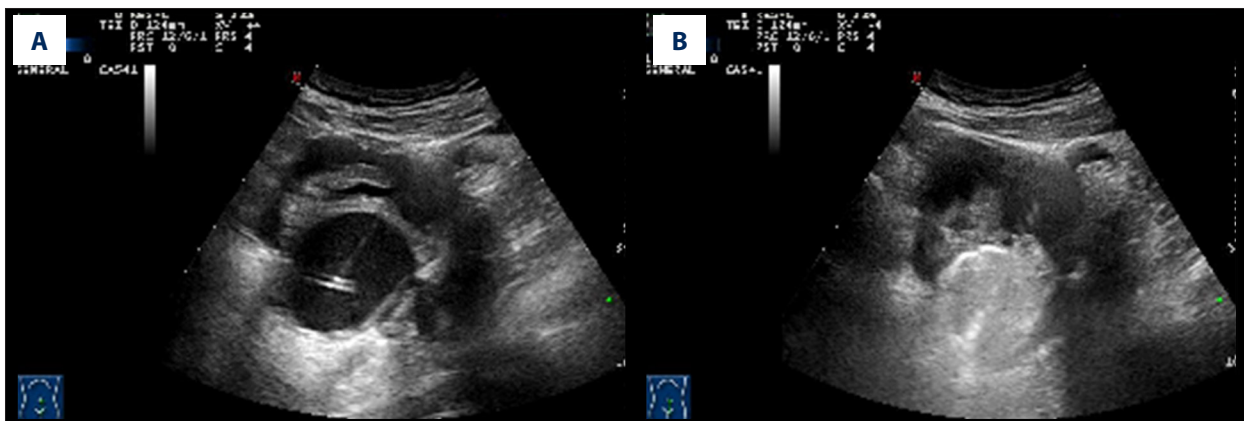
The inclusion criteria for the patients to participate in our study were (1) OEC ( $\geq 4$  cm); (2) preoperative assessment by ultrasound and magnetic resonance imaging (MRI); (3) willingness to undergo ultrasound-guided puncture sclerotherapy; and (4) postoperative cyst fluid exfoliation cytology. Exclusion criteria were (1) OEC  $< 4$  cm; (2) ovarian cysts with suspected malignant signs by ultrasound or MRI detection; (3) abnormal coagulation function; (4) infectious lesions on the puncture path; (5) comorbidity of other major organs functional or mental disorders; and (6) allergy to alcohol-containing drugs.

### Method to Generate Artificial Pelvic Fluid Isolation

To generate artificial pelvic fluid isolation, the patient was placed in the supine position, and the treatment operating table was adjusted to  $15^\circ$  in the head-high and feet-low position. A high-frequency linear array probe was used to search for a small amount of omentum tissue, colonic band, or a small amount of fluid in the intestinal space around the target puncture cyst. With the target puncture cyst located, preparation was made with a sterilized towel and local skin-parietal peritoneal infiltration anesthesia with 2% lidocaine. Then, an 18G PTC needle was used for target puncture under ultrasound guidance. After the successful puncture, 0.9% pressure was injected through an extension tube with sodium chloride solution to create the artificial pelvic isolation fluid. Then, it was switched to the convex array probe to observe the injection of artificial pelvic isolation fluid (**Figure 1**). The maximum pelvic fluid depth was more than 5 cm or the separation space between the cyst and the adjacent organs was  $\geq 5$  mm, which indicated the successful creation of the artificial pelvic isolation fluid (**Figure 1**).



**Figure 1.** Target puncture and analysis of injection of artificial pelvic isolation fluid. (A) Target puncture with 18G-PTC needle under ultrasound guidance. (B) Convex array probe to observe the injection of artificial pelvic isolation fluid.



**Figure 2.** PTC puncture needle and cyst fluid operation monitoring. (A) Under the real-time guidance of ultrasound, the PTC puncture needle is punctured to the endometriosis and ovarian endometriosis cyst center. (B) Repeated replacement and flushing of 95% medical ethanol with one-third of the total cyst fluid.

The time required for creating the artificial pelvic isolation fluid, amount of fluid required, and amount of fluid injected from the start of the artificial pelvic isolation fluid injection to completion were recorded.

If the artificial pelvic isolation fluid was continuously injected with a volume of 1000 mL, the separation space between the cyst and adjacent organs would be less than 5 mm, but the creation of artificial pelvic isolation fluid remaining in the local adhesion would be unsatisfactory. If the artificial ascites was continuously injected with the volume of fluid reaching 1000 mL, there would be no separation zone between the cyst and adjacent organs due to fluid loss, and ascites could be injected due to postoperative adhesions. This indicated the failure of the creation of artificial pelvic isolation fluid. If the artificial pelvic isolation fluid flowed away during the operation, the solution should be continuously injected.

When the injected fluid volume exceeded 1000 mL, it was stopped regardless of whether it was successful or not. The

creation of artificial pelvic isolation fluid and the surgical selection of OEC puncture sclerosis need to be discussed in the department before the surgery and completed by physicians familiar with interventional ultrasound techniques.

### Puncture Sclerotherapy Technique

Under the real-time guidance of ultrasound, the puncture direction of the PTC puncture needle was adjusted, puncture to the OEC center (Figure 2) was made, and the cystic fluid was slowly and uniformly aspirated. The needle tip should always be kept in the center of the cyst. The cyst fluid extracted from the first tube was sent to for pathological exfoliation cytology examination, then the fluid was aspirated until the cyst fluid was basically exhausted, to ensure that the puncture needle would not prolapse from the cyst, such as with thick cyst fluid. Part of the cystic fluid could be extracted first, and then injected with an equal amount of 0.9% sodium chloride solution. Then, it was diluted and rinsed repeatedly until the cystic fluid was basically exhausted. Then, 5 mL of 2% lidocaine

was injected and drawn out after standing for 1 min. Then, replacement and flushing of 95% medical ethanol, with no more than one-third of the total cyst fluid volume (maximum single injection volume of no more than 60 mL), was repeated (Figure 2) until the extracted liquid turned from turbid to clear. Next, the last injected ethanol was left in the cyst for 1 min and then drained, and finally 10 to 20 mL of lauryl alcohol was injected into the cyst. The needle was pulled out, the puncture point was disinfected and covered with a sterile dressing, and the abdominal cavity and pelvis were checked for bleeding by ultrasound.

### Observation Indicator

In this study, the collected data were blood pressure, heart rate, success rate of artificial pelvic isolation fluid, time required, incidence of intraoperative pain, incidence of vagal reflex, related complications, and efficacy. The patients were followed up for 3 to 12 months after surgery. The evaluation criteria for efficacy were based on the curative effect, which was evaluated according to the reduction rate of the cyst volume after surgery, as follows: cured: the cyst completely collapsed and disappeared; markedly effective: the cyst volume was reduced by more than two-thirds; effective: the cyst volume was reduced by one-half to two-thirds; and ineffective: the cyst volume was reduced by no more than one-third, did not shrink, or increased.

### Statistical Analysis

SPSS 22.0 statistical software was used for statistical analysis, and all data are expressed in averages (mean)±SD. The measured data were tested for normality by Kolmogorov-Smirnov analysis. The incidence of pain, incidence of vagal reflex, and the incidence of complications were expressed in percentages. The data between different groups were compared using the *t* test, where *P*<0.05 was considered statistically significant.

## Results

### General Information of the Patients

Patients who participated in this program were women of childbearing age. Patient age ranged from 22 to 46 years, with an average age of 35 years. The average cyst diameter in patients was 6.35 cm. Sixty patients had single cysts and 10 patients had multiple cysts. Seventeen patients already had initial treatment, and 36 patients had cyst recurrences after laparoscopic surgery. The recurrence rate after laparoscopic surgery among patients was high, at 51.4% (36/70).

### Creation of Artificial Pelvic Effusion by Transabdominal Puncture

After a successful puncture, 0.9% pressure was injected through an extension tube with sodium chloride solution to create the artificial pelvic isolation fluid (Figure 1A). It was then switched to the convex array probe to observe the injection site of the artificial pelvic isolation fluid. The maximum pelvic fluid depth was greater than 5 cm, or the separation space between the cyst and the adjacent organs was greater than 5 mm, suggesting that the artificial pelvic isolation fluid was successfully created (Figure 1B). The success rate of the generation of artificial pelvic isolation fluid was 100%. Among all patients, the average time of surgery was 9.1±1.3 min, suggesting that the surgery for the creation of artificial pelvic isolation fluid was effective and fast.

### Puncture Sclerotherapy Method

Under the real-time guidance of ultrasound, the direction of the PTC puncture needle could be adjusted to the OEC center (Figure 2A) to slowly and uniformly aspirate the cystic fluid, and about one-third of the total cyst fluid volume was injected (maximum single injection volume of no more than 60 mL) (Figure 2B). Injection of fluid was done until the extracted liquid turned from turbid to clear, and the last injection of ethanol was left in the cyst for 1 min and then drained. Finally, 10 to 20 mL of lauryl alcohol injection was kept in the cyst. The needle was pulled out, the puncture point was disinfected and covered with a sterile dressing, and then the abdominal cavity and pelvis were checked for bleeding via ultrasound imaging.

### Assessment of Patient Comfort and Related Complications

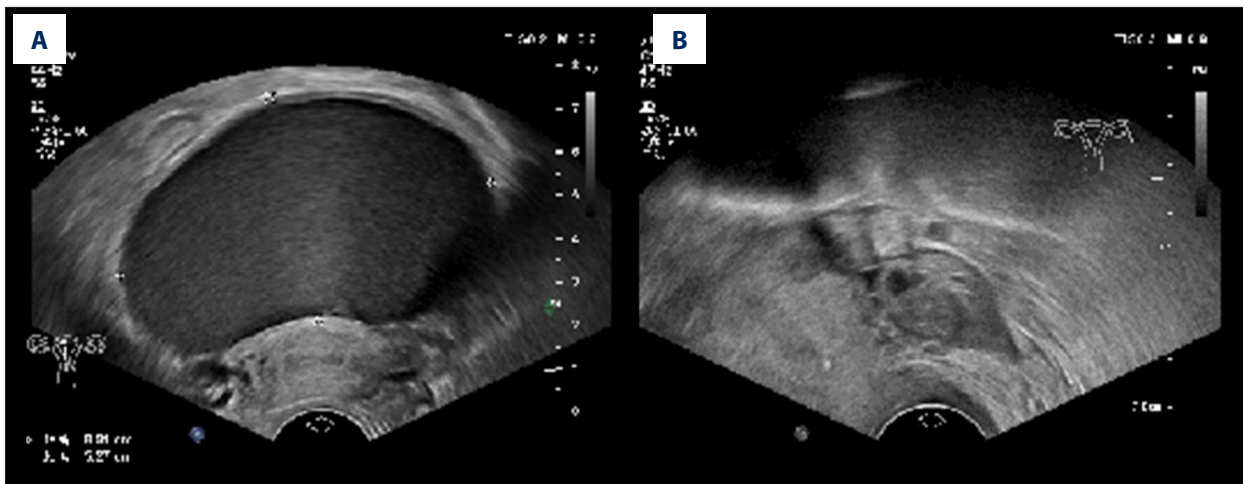
The incidence of intraoperative pain was 5.71% (4/70), and the average visual analogue scale (VAS) score for pain was 2 points, indicating that the pain was controllable. The incidence of vagus nerve reflex was 2.86% (2/70), without bleeding, intestinal perforation or infection, and other complications in patients, indicating that the surgery was generally safe and effective.

### Curative Effect

After all surgeries, we analyzed the curative effect in patients. The cure rate of the OEC puncture sclerotherapy was 97.14% (68/70) (Figure 3), and the effective rate was 100% (70/70).

## Discussion

The current medical evidence shows that the recurrence rate after OEC is very high, with an annual recurrence rate of up to 10% and a recurrence rate after laparoscopic surgery as high



**Figure 3.** Analysis of endometriosis and ovarian endometriosis cyst before surgery and after surgery in a patient. (A) In a patient with an endometriosis and ovarian endometriosis cyst (OEC), the preoperative OEC diameter was 8.9 cm, and the left ovary was unclear. (B) Eight months after puncture sclerotherapy, the OEC disappeared and the left ovary was clearly displayed.

as 51.4%. In recent years, studies have found that ultrasound-guided puncture sclerotherapy for ovarian cysts is similar to surgery and laparoscopy [18,19]. Moreover, ultrasound-guided puncture and sclerotherapy of ovarian cysts have major advantages, such as less damage, high efficacy, less pain, low cost, rapid effect, and a repeatable treatment [4]. The mechanism of OEC puncture sclerotherapy is mainly to kill the ectopic endometrial tissue on the inner wall of the cyst through sclerotherapy, so that the cyst loses the ability to proliferate and bleed.

At present, there are 2 main ways to puncture ovarian cysts: the transabdominal puncture and the transvaginal puncture [14,20]. The transabdominal puncture has advantages in terms of simple operation, flexible adjustment of needle tip direction, and low infection rates. Owing to the lack of a safe puncture route for transabdominal puncture, some patients use the vaginal route. During the puncture, some problems, such as a limited puncture direction, cumbersome preoperative preparation, and susceptibility to infection, were encountered [1,21]. In addition, patients without a history of sexual activity are not suitable for a transvaginal puncture. Findings in animal experiments showed that when the concentration of lauryl alcohol is maintained above 0.25%, injection into the cyst model without extraction helps to enhance the sclerosis effect [22-26], and the efficacy is close to that of the use of absolute ethanol method [14,27]. The combination of anhydrous medical ethanol with lauryl alcohol sclerotherapy to treat OEC through the transvaginal puncture route could achieve good clinical efficacy.

During ovarian cyst puncture sclerotherapy, abdominal pain and vagus nerve reflexes, including dizziness, pale complexion, decreased blood pressure, slow heart rate, sweating, and nausea, are prone to occur [28,29]. Studies have shown that the

incidence of abdominal pain during sclerotherapy with medical alcohol in OEC is as high as 52.3% (23/44), incidence of postoperative abdominal pain is as high as 100% (44/44), and pain was not evaluated quantitatively. However, during surgery of puncture and hardening therapy of the skin in treating OECs, the common obstacles include unclear cyst display or large omentum obstruction [22-26], no safe puncture path that can be observed or determined, and severe pain caused by leakage stimulation and mini-reflex reflection in patients [22,25,30].

The main reason may be the stimulation of extravasation of the sclerosant drug through the puncture needle hole. To solved these problems, we were the first to use the artificial pelvic isolation liquid technology to inject physiological saline in the pelvic cavity. The physiological saline can push the intestinal tube or large omentum blocked in front of the cyst, so that the cysts are displayed more clearly and a safe puncture path is created. In addition, the physiological saline can also be wrapped around the cyst, which can quickly dilute the leakage of sclerotic agent drugs and loosen irritation and damage to the surrounding tissues, reducing pain and vagus nerve reflex during surgery. In our study, after using artificial pelvic isolation fluid, the incidence of pain during OEC sclerotherapy was 5.71% (4/70). Patient intraoperative comfort was significantly higher than shown in the literature ( $P<0.05$ ), suggesting that our method is very promising and effective for the artificial creation of pelvic isolation fluid.

## Conclusions

During the process of puncture and sclerotherapy of ovarian cysts, we pioneered the use of artificial pelvic isolation fluid

technology, which solved the problems of unclear cyst display, lack of a safe puncture path, severe pain during or after surgery, and vagal reflex symptoms. Our data demonstrated that the surgery was safe and effective to treat ovarian cysts and to bring back physical comfort and hope to the treated patients.

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