

Endovascular embolo-sclerotherapy using absolute ethanol for pelvic arteriovenous malformations: Initial experience at the University Medical Center Ho Chi Minh City

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Summary

Background: Pelvic arteriovenous malformations (pAVMs) are rare, complex lesions that are challenging to treat surgically. Endovascular embolo-sclerotherapy with absolute alcohol has emerged as a promising, less invasive treatment modality. **Objective:** To evaluate the clinical and imaging outcomes of endovascular absolute ethanol embolo-sclerotherapy in patients with pelvic arteriovenous malformations. **Method:** This retrospective case series included six patients (5 males, 1 female; mean age 49 ± 11 years) diagnosed with pAVMs and treated with ethanol embolo-sclerotherapy at our institution from October 2022 to October 2025. All procedures were performed under general anesthesia via transarterial access. Absolute ethanol (99.9%) was used as the primary sclerosant, with adjunctive N-butyl cyanoacrylate (NBCA) in one case. Patients were evaluated clinically and radiologically immediately after treatment and during follow-up at 1, 6, and 12 months. **Result:** A total of 13 embolo-sclerotherapy sessions were performed (range: 1–5 per patient; mean: 2.2). Complete angiographic obliteration was achieved in 5 patients (83.3%). Clinical improvement, including reduction in pelvic pain, pelvic fullness, and pelvic pain associated with sexual activity, was observed in 5 patients. One patient demonstrated partial improvement and required additional staged treatment. No major complications such as bladder or uterine necrosis occurred; minor transient pelvic discomfort and hemoglobinuria were managed conservatively. **Conclusion:** Endovascular ethanol embolo-sclerotherapy is an effective and safe treatment option for pelvic AVMs, demonstrating high rates of clinical and angiographic success with manageable complications.

Keywords: Pelvic arteriovenous malformation; ethanol embolization; embolo-sclerotherapy; endovascular intervention.

I. BACKGROUND

Among arteriovenous malformations (AVMs), lesions localized to the pelvis are a particularly challenging clinical entity due to their rarity, non-specific clinical presentation, and deep, difficult-to-access location. Pelvic AVMs can be life-threatening

due to the risk of congestive heart failure and severe hemorrhage if the nidus ruptures¹.

Surgery is the conventional treatment for vascular malformations, including pelvic AVMs. Common techniques include ligation of feeding arteries or complete excision of the malformation. However, the efficacy of surgical treatment is limited, as complete removal of the lesion is very difficult, while recurrence and progression rates after surgery remain high^{2,3}.

Received: 10/11/2025, **Accepted:** 8/12/2025

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In recent years, selective embolo-sclerotherapy techniques targeting the malformation nidus have been more widely implemented to occlude abnormal arteriovenous shunts. Embolization of feeding arteries with particulate materials may improve symptoms but often fails to achieve long-term efficacy because the nidus is not completely obliterated and tends to recanalize ^{4,5}.

The technique of superselective catheterization or direct puncture into the nidus, followed by the use of absolute ethanol as a permanent sclerosing and embolic agent, has shown promising results both clinically and radiologically, with an acceptable complication rate ⁵.

The objective of this study was to retrospectively evaluate the outcomes of embolo-sclerotherapy with absolute alcohol for the treatment of pelvic arteriovenous malformations.

II. SUBJECT AND METHOD

Study design: Retrospective descriptive case series

Study population: All patients diagnosed with pelvic arteriovenous malformations (AVMs) and treated with endovascular embolo-sclerotherapy using absolute ethanol at the Department of Thoracic and Vascular Surgery, University Medical Center Ho Chi Minh City, from October 2022 to October 2025.

Inclusion criteria: (1) Diagnosed with pelvic AVMs based on MRI; (2) Presented with pelvic symptoms, with other pelvic pathologies excluded; (3) Complete clinical and imaging data available in medical records.

Exclusion criteria: Diagnosed with pelvic AVMs and previously treated with surgery.

Interventional technique:

All procedures were performed under general anesthesia. A Swan-Ganz catheter was used to monitor pulmonary artery pressure before the embolization procedure. If the mean pulmonary artery pressure (PAP) was found to be > 25mmHg, Nitroglycerin was administered via intravenous bolus (50-100µg) followed by continuous infusion

(0.3-3.0 µg/kg/min) through the Swan-Ganz catheter until the mean PAP returned to a normal level.

Embolization sessions were performed to achieve complete or partial occlusion of the nidus. Endovascular transarterial access via the femoral artery was used in all cases to assess the lesion's morphology, classify the lesion, and determine the approach to the nidus. Using arterial catheters, appropriate microcatheters were advanced for selective and/or super-selective access to the nidus, aiming for the most direct approach possible to perform embolo-sclerotherapy ⁵.

Absolute ethanol (99.9%) was used as the embolo-sclerosing agent. The dose of absolute ethanol was based on the volume of contrast medium required to fill the AVMs nidus without opacifying normal blood vessels during diagnostic angiography. Bio-glue (Histoacryl, n-butyl-2-cyanoacrylate, B Braun, Spain) was used in cases where the feeding artery to the nidus had high-velocity flow, requiring occlusion to reduce blood flow and thereby increase the sclerosing efficacy of the ethanol.

To manage minor complications such as localized soft tissue swelling in the pelvic wall and uterus, Solu-Medrol (0.1 mg/kg, Methylprednisolone, Pfizer, USA) was injected immediately before the procedure and then every eight hours via IV bolus during the hospital stay ⁵. After discharge, Medrol 16mg (Methylprednisolone, Pfizer, USA) was administered orally at a dose of 1 tablet/day for 1 week. If gross hemoglobinuria occurred during the procedure, the patient was managed with intravenous crystalloid solution hydration.

Evaluation timepoints: Immediately post-procedure, and at 1 month, 6 months, and 12 months post-intervention

Evaluation criteria:

Technical success: The complete occlusion of the target AVMs nidus immediately post-procedure, confirmed by contrast-enhanced computed tomography (CECT) at follow-up.

Clinical success: The improvement or resolution of clinical symptoms (pelvic pain, pelvic pressure, dyspareunia) at the one-month follow-up visit.

Procedural complications: Including local complications (puncture site complications), manageable minor complications (pelvic pain/swelling, hemoglobinuria, deep vein thrombosis, infection), and major complications (bladder or uterine necrosis, ovarian dysfunction).

Residual nidus: The reappearance of flow within the embolized nidus, confirmed on CECT imaging during follow-up at 6 and 12 months.

Statistical analysis: Quantitative variables were described using mean $\pm$ standard deviation (SD) or median (Interquartile Range - IQR); qualitative variables were presented as frequencies and percentages.

III. RESULTS

3.1. Baseline characteristics

A total of 6 patients were included, consisting of 5 males (83.3%) and 1 female (16.7%). The mean age was 49 ± 11 years. The most common clinical symptoms included: a sensation of pelvic pressure (6/6, 100%), frequent pelvic pain (4/6, 66.7%), dyspareunia (3/6, 50%), and superficial flank varices (1/6, 16.7%). No patients had a history of deep vein thrombosis.

Table 1. Characteristics of the study population (n = 6)

Characteristic	Value n (%)
Male	5 (83,3%)
Mean age (years)	49 ± 11
Sensation of pelvic pressure	4 (66,7%)
Frequent pelvic pain	4 (66,7%)
Superficial flank varices	1 (16,7%)
Dyspareunia	3 (50%)

3.2. Intervention characteristics

Over a total of 13 embolo-sclerotherapy sessions using absolute ethanol (range: 1-5, mean 2.2), the volume of absolute ethanol used ranged from 5 to 15 ml (mean: 7.1 ml) per session. One patient received 1ml of a bio-glue mixture (1ml glue mixed with 1ml Lipiodol) to reduce the flow velocity in the nidus-feeding artery, aiming to enhance the

sclerosing efficacy of the ethanol. No patients experienced adverse events due to absolute ethanol toxicity. Five (83.3%) patients were cured, and one patient (16.6%) showed improvement of the AVMs.

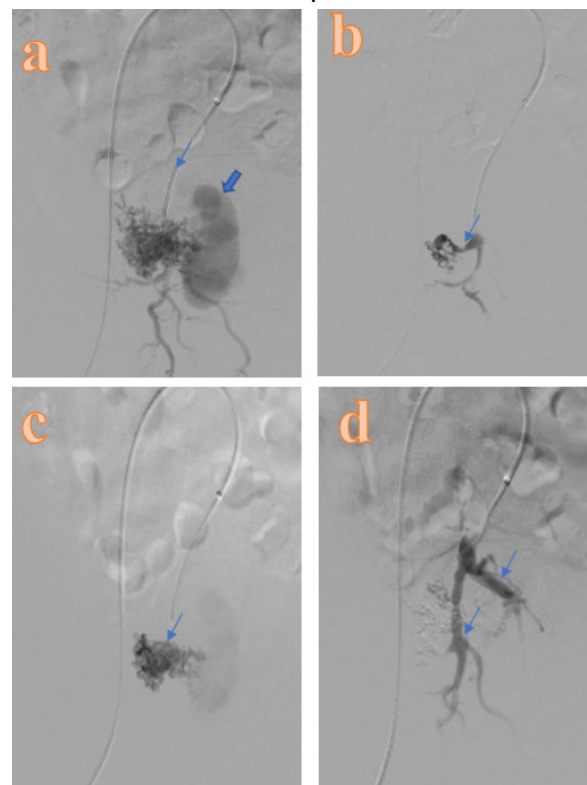


Figure 1: A 56-year-old male patient presenting with left pelvic pressure. (a) Angiography shows the nidus in the left pelvis, with a feeding artery from a branch of the left internal iliac artery (small arrow) and a dilated draining vein (large arrow); (b) Selective catheterization of the feeding artery (small arrow); (c) Injection of absolute ethanol solution into the nidus (small arrow); (d) Post-embolization control angiography shows significant reduction in nidus size; normal arterial branches (small arrows) are preserved.

3.3. Post-intervention results

All patients were monitored and had follow-up visits at 1 month, 3 months, 6 months, and 12 months post-treatment. At follow-up, patients were assessed for clinical symptom improvement and radiological changes via contrast-enhanced computed tomography (CECT). Accordingly, five patients who underwent embolo-sclerotherapy with absolute ethanol were deemed effective, with complete elimination of the pelvic AVMs nidus

imaging. One patient had only partial removal of the pelvic lesion and still experienced pelvic pressure symptoms. This patient underwent 5 procedures (1/month), resulting in the removal of the majority of the nidus.

After the intervention, three patients (50%) complained of pelvic pain and pressure; symptoms persisted but resolved completely after 1 week of treatment with analgesics and anti-inflammatory drugs. One patient experienced post-procedural gross hemoglobinuria, which was managed with crystalloid solution infusion; the patient recovered fully during hospitalization. No serious complications, such as bladder necrosis in males or uterine necrosis in females, were noted on CECT during postoperative monitoring and routine follow-up.

3.4. Follow-up at 1-12 months

At 1 month, CECT showed complete nidus occlusion in five patients (83.3%). These patients also reported early symptom improvement. One patient demonstrated only partial nidus reduction and continued to experience pelvic discomfort, requiring additional staged sessions.

At 6 months, all five patients with complete occlusion maintained stable radiologic results with no evidence of recanalization, accompanied by clear symptomatic improvement. The partially responsive patient showed further but still incomplete reduction of the nidus and continued with planned embolo-sclerotherapy.

At 12 months, five patients remained clinically stable and symptom-free with persistent complete occlusion on imaging. The remaining patient had >90% reduction in nidus volume and only mild residual symptoms that did not require further treatment. No delayed major complications were identified during follow-up.

IV. DISCUSSION

Pelvic AVMs may be congenital or acquired. Congenital AVMs result from abnormal differentiation or arrested development during

neovascularization of the primitive capillary plexus between the 4th and 10th weeks of embryonic development, typically presenting in younger patients. These lesions tend to infiltrate surrounding tissues (uterus, bladder, adnexa) ^{6, 7}. In contrast, acquired pelvic AVMs can occur due to procedures like dilation and curettage, pelvic surgery, cancer, and gestational trophoblastic disease. Acquired AVMs lesions are often confined to the uterus, have few feeding arteries, and only a single draining vein ⁸.

Surgical treatment of pelvic AVMs, whether ligation of feeding arteries or excision of the lesion, is often unsuccessful because complete removal of the AVMs nidus is rarely feasible and carries a high recurrence rate. Many studies agree that the classic surgical method of ligating feeding arteries to the nidus is ineffective because new collateral arterial branches quickly develop post-surgery. This is explained by the state of tissue ischemia in the nidus region following surgical ligation ^{2, 3, 6}.

Endovascular intervention to embolo-scleritize feeding arteries in cases of uterine AVMs was initially used as a method to control bleeding before hysterectomy in women with congenital AVMs. This method is particularly preferred for women who wish to preserve fertility, owing to its safety and efficacy ⁶.

Many agents have been used, and the choice of agent is evaluated based on the degree of embolo-sclerotherapy, the persistence of arteriovenous shunting, and the ease of performing the occlusion ⁵. In a study evaluating the efficacy of embolization using PVA (polyvinyl alcohol) particles (150-500 µm) for pelvic AVMs related to gestational trophoblastic disease, results showed that uterine bleeding control was achieved in 11 of 14 patients [8]. In another study using bio-glue as an embolic agent, six of 15 patients required repeat procedures due to recurrent bleeding ⁹.

Using absolute ethanol as an embolo-sclerosing agent has shown good results in treating AVMs. This agent can denature the proteins of vascular endothelial cells, causing complete vessel lumen

occlusion rather than just an inflammatory reaction on the vessel wall [5]. However, the use of absolute ethanol can cause minor complications such as local tissue injury (skin swelling, reversible tissue necrosis, peripheral nerve palsy), or serious complications like: renal tubule necrosis (renal failure), thrombus formation (systemic deep vein thrombosis), and pulmonary artery vasospasm causing pulmonary embolism (systemic hypotension, arrhythmia, cardiac collapse) [5]. Careful use of absolute ethanol and frequent monitoring of pulmonary artery pressure are necessary for the interventionalist.

Absolute ethanol has demonstrated efficacy in treating peripheral AVMs. In the study by Lâm Van Nut, 34 patients underwent 54 embolization interventions with absolute ethanol solution via a transarterial approach; 55.9% of cases involved endovascular intervention alone, and 44.1% combined an endovascular approach with direct puncture into the nidus. Over a mean follow-up of 16.2 ± 0.3 months for 32 patients (2 patients were lost to follow-up), the results showed 50% of patients were cured, 31.3% had significant symptom improvement, 12.5% showed no change, and 6.2% reported worsening symptoms [10].

In the study by Nguyen Dinh Luan et al, the authors treated peripheral AVMs with absolute ethanol embolization in 13 patients, noting: Two cases were completely cured clinically and radiologically. Two cases were nearly completely cured, with small residual nidi noted. The remaining nine cases all showed signs of clinical and radiological symptom reduction. Recorded complications: 1 case of necrosis of the 1st finger of the left hand requiring amputation, 1 case of infection unresponsive to antibiotics requiring debridement of the 5th finger ¹¹.

Following previous recommendations, we did not exceed the maximum volume of absolute ethanol in a single treatment (0.5-1.0 mL/kg) ⁵. During the procedure, we attempted to induce embolo-sclerotherapy to maximally reduce the nidus volume via a transarterial approach. However, in some cases, due to highly tortuous vascular

morphology or the presence of arterial branches supplying adjacent healthy tissue, the procedure was prolonged, and the goal of embolo-sclerotherapy could not be achieved as expected ¹². Some studies have suggested that arterial embolization is unnecessary due to the slow flow of the arterial system, and that the nidus can instead be approached via the draining vein². However, the transvenous approach may unintentionally occlude normal veins, leading to venous hypertension and post-intervention deep vein thrombosis ⁵.

Some studies have reported complications of localized bladder necrosis post-intervention, diagnosed by cystoscopy, which resolved completely after conservative treatment. Another recorded complication is irreversible ovarian failure after embolo-sclerotherapy. The frequency of ovarian dysfunction is about 1-14% in patients after undergoing uterine artery embolization for symptomatic uterine fibroids ⁵.

Although the technical success rate was relatively high (83.3%), several important limitations should be acknowledged. First, the study lacks objective quantitative measures to evaluate clinical efficacy. Standardized assessments, such as validated pain scales, quality-of-life measures, or pre- and post-procedural imaging metrics, were not reported, making it difficult to quantify the true magnitude of symptom improvement. One patient required up to five embolo-sclerotherapy sessions; however, the study does not provide an analysis of the underlying reasons, prognostic factors, or nidus characteristics associated with this treatment-resistant course. The follow-up duration (1–12 months) is relatively short. Several clinically relevant late complications, such as nidus recanalization, delayed tissue injury, or late-onset ethanol-related adverse effects, may not manifest within this timeframe. Longer-term follow-up is needed to assess the durability and safety of the treatment.

V. CONCLUSION

Although pelvic arteriovenous malformations may have subtle clinical manifestations, their course

can be dangerous in certain situations if not appropriately detected and treated. Embolosclectherapy with absolute ethanol solution shows initial good efficacy for cases of pelvic AVMs. The treatment technique demonstrates a high rate of clinical and radiological improvement with manageable complications. Long-term outcome assessment and accumulation of further technical experience during the procedure to reduce complication rates are mandatory.

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