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Case Report

Successful embolization of an anterior chest wall arteriovenous malformation using combined transfemoral and transradial approaches with onyx ☆

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ABSTRACT

We present a case of successful embolization of an anterior chest wall arteriovenous malformation (AVM) in a 24-year-old male patient. This report aims to highlight the efficacy and safety of using the liquid embolic agent (onyx) as well as the combined approaches (trans-femoral and trans-radial) in managing rare complex chest wall AVMs.

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Introduction

Arteriovenous malformations (AVMs) are abnormal connections between the arteries and veins in the body. While most cases of AVMs in the chest wall are caused by acquired factors like trauma or iatrogenic factors [1,2], they can also be caused by congenital conditions such as neurofibromatosis type 1 [3].

Congenital AVMs are commonly observed in the lower limbs, while their occurrence in the thoracic wall is exceptionally uncommon. In cases where these malformations are of significant size, there exists a potential danger of hemorrhaging. This poses an additional challenge when devising a surgical intervention plan, sometimes necessitating preoperative embolization [4].

Preoperative embolization techniques are usually challenging and might require multiple accesses, and it's difficult to choose which is the best embolization agent.

Here, we describe a challenging case of chest-wall AVM in a young male patient, which was effectively treated using a liquid embolic agent (onyx) using both trans-femoral and transradial approaches.

Case presentation

A 24-year-old male patient presented with a complaint of a painful lesion on the right side of his anterior chest wall that had been gradually getting larger and becoming more painful over the last few months. The patient first noticed the lump when he was 18 years old, but it had remained stable without any symptoms. He denied having a fever, weight loss, or any trauma to the affected area. An MRI was done for the patient outside our hospital, and the report was suggestive of vascular malformation. The patient was referred to our hospital for further investigation and management. On physical examination, a movable lesion was observed on the anterior chest wall.

Laboratory tests, including complete blood count and basic metabolic profile, were within normal limits. Computed tomography (CT) angiography of the chest with intravenous contrast was done, and CT showed tortuous arterial supply to the left anterior chest wall lesion, originating from the left subclavian artery (Fig. 1).

After obtaining informed consent, the decision was made to proceed with endovascular embolization. Allen's test was done before the procedure for the left wrist to prove dual supply.

Under conscious sedation, we accessed the left femoral artery first, inserting a 6F, 11 cm Prelude femoral sheath introducer (Merit Medical, South Jordan, Utah, USA). We then catheterized the left subclavian artery using a C2 catheter, 5F (Terumo, Japan). Cannulating the branches supplying the arteriovenous malformation (AVM) proved very difficult. Eventually, we managed to engage the common trunk of these branches using an IMA catheter, 5F (Merit Medical, South Jordan, Utah, USA). The first branch supplying the AVM was then catheterized, and the angiogram clearly showed the AVM (Fig. 2). Selective catheterization was performed using an Apollo microcatheter, 2.7F (ev3, Minnesota, USA), over a 0.014″ BMW wire (Abbott, Ohio, USA), and a small amount of Onyx 18 (0.5 ml) (ev3, Irvine, CA, USA) was successfully used. Catheterizing the other branch supplying the AVM through the same femoral access was very difficult due to an unfavorable angle, so we switched to radial access using a 6F, 7cm Prelude radial sheath introducer (Merit Medical, South Jordan, Utah, USA). The Hinck headhunter3, 4F catheter (Terumo, Japan), and Progreat microcatheter, 2.7F (Terumo, Japan), were used

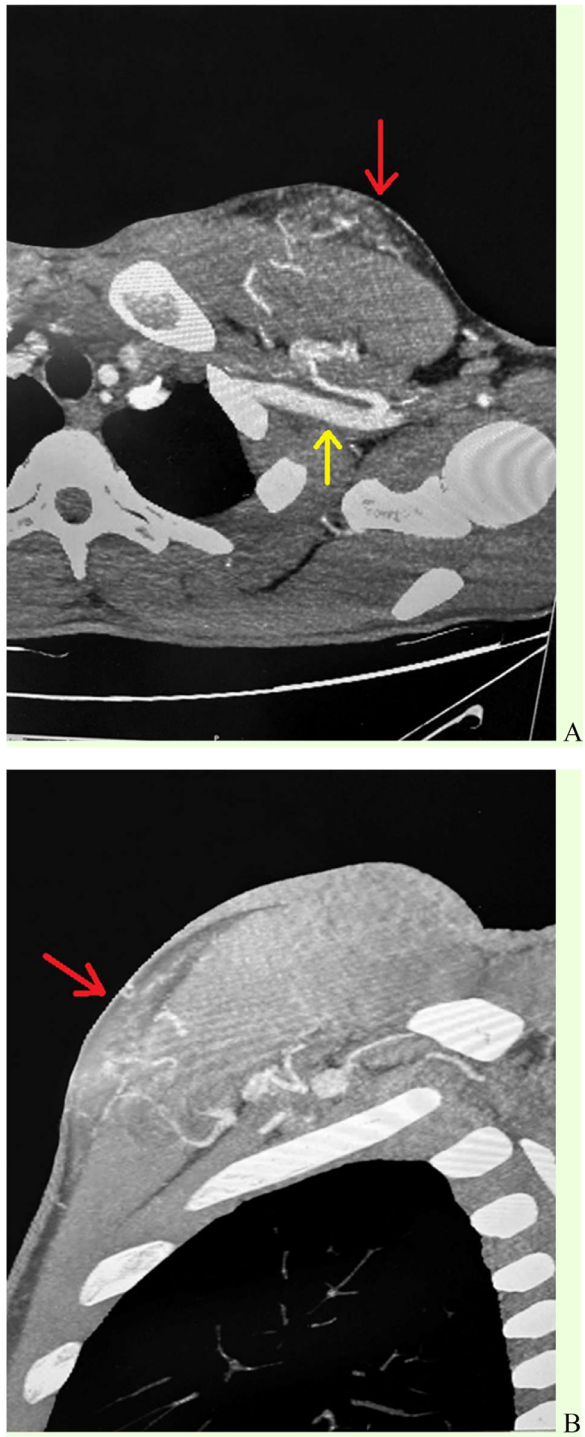

Fig. 1 – CT angiogram in axial (A), and sagittal (B) planes, showed the tortuous arterial supply of the left anterior chest wall lesion (red arrow), originating from the left subclavian artery (yellow arrow).

Fig. 2 – (A) Angiogram after selective catheterization of the common trunk (blue arrow) of the branches supplying the AVM (yellow circle). (B) Late arterial phase of the angiogram in A, showing early filling of the draining veins (red circle) of the AVM, confirming the diagnosis. Selective catheterization of the two branches supplying the AVM that shared a common origin. (C) from the left femoral access and (D) from the left radial access.

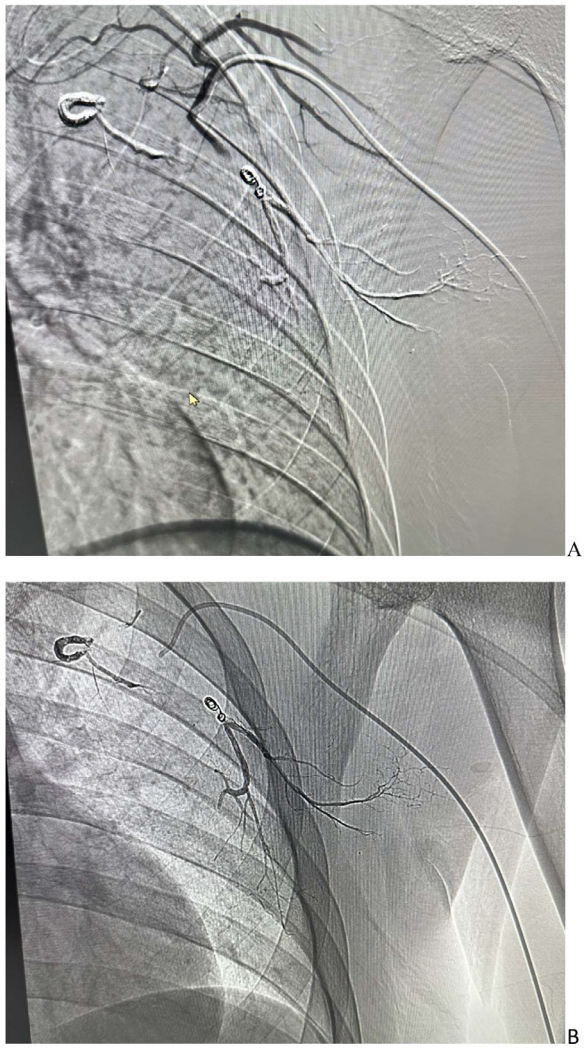

Fig. 3 – Post embolization (A) angiogram and (B) single shot x-ray, showing no flow in the branches supplying the AVM, as well as the coil and onyx used for embolization.

to achieve successful catheterization. After positioning the catheter distally, we initially used a single MicroNester Pushable coil (size: 5 x 5 cm) to reduce flow, followed by the application of approximately 1 ml of Onyx 18, achieving very good results.

The patient was admitted to the hospital for overnight observation and discharged home the next day. He was prescribed a short course of oral prednisolone and oral analgesics. A follow-up CT scan with contrast was done one month after the procedure, showing embolization of the feeding vessel with around a 50% reduction in the size of the AVM "Fig. 3".

Discussion

AVMs are abnormal connections between arteries and veins, lacking a capillary network [5]. They can occur in various organs but are most commonly found in the peripheral vas-

cular system [6]. AVMs are typically present from birth, but symptoms usually appear in adulthood, often in the second or third decade of life. Acquired AVMs can result from trauma, cirrhosis, tumors, or infections [7]. Depending on their location, AVMs may be asymptomatic or cause severe symptoms. There have been rare cases of chest wall compression caused by hematomas resulting from ruptured arteriovenous (AV) fistulas. While AV fistulas are related to AVMs, they involve a simpler, single, direct connection [8]. Pulmonary AVMs are the most common type within the thoracic cavity and are occasionally associated with Osler–Weber–Rendu syndrome [5].

AVMs can lead to symptoms when they become infected, cause compression of nearby structures, or bleed. Published cases have reported symptoms involving arteries such as the brachiocephalic, intercostal, and internal mammary arteries [9].

Chest wall AVMs are uncommon and usually do not need medical treatment. However, if symptoms like pain or discomfort persist despite conservative management, clinical intervention such as surgery or endovascular procedures may be required. Endovascular treatment offers significant advantages, including reduced risk of bleeding and infection compared to open surgery. It also allows for a less invasive approach [10]. Surgical procedures alone may result in severe bleeding during the operation. Nevertheless, the feasibility of resecting AVMs relies on their specific location. If an AVM affects joints, ligaments, or blood vessels, it is crucial to assess whether total excision and reconstructive surgery are viable options [11].

Peripheral vascular interventions are typically performed using transfemoral access (TFA) [10]. However, as in our case, this approach was very challenging. The AVM was supplied by two tortuous branches sharing a common trunk, which was very difficult to catheterize. We managed to engage only one of the two branches through the femoral access. The other branch supplying the AVM was successfully catheterized using left radial access. The use of the radial artery for transcatheter intervention has also been well-documented in interventional cardiology since 1989 [10].

Onyx, which is a copolymer-based embolic agent, was the first one introduced and extensively studied. The initial use of an ethylene-vinyl alcohol copolymer-based embolic agent, which is the precursor substance of Onyx, was reported by Taki in 1994 [12].

Cerebral AVMs and distal fistulae are the primary recognized uses for Onyx. It has been observed that the precipitation of Onyx occurs from the outer to the inner portion. This results in a harder circular outer layer and a softer or liquid inner layer which helps reduce the risk of catheter trapping during embolization [13].

In the reported case by Lekperic, a successful trans radial approach was utilized to treat a posterior chest wall AVM [14]. In Kilani's retrospective study involving 19 patients with high-flow peripheral AVMs, Onyx embolization demonstrated success in all cases, with 12 patients achieving complete devascularization and nine undergoing subsequent surgical excision. Minimal adverse events were noted, with only one patient experiencing a stroke. The study suggests that Onyx is a viable option for managing peripheral high-flow AVMs, either as a preoperative measure or a standalone treatment [15].

In our presented case, we initially chose to employ a single coil to mitigate arterial flow, followed by the application of Onyx. The utilization of Onyx enhanced distal embolization within the AVM nidus [16]. Our method incorporates a combined transfemoral and trans radial strategy, utilizing a coil to decelerate arterial flow and Onyx for the comprehensive management of an anterior chest wall AVM.

Conclusion

In conclusion, our case report demonstrates that a combined transfemoral and trans radial approach using Onyx liquid material is an effective and safe method for treating anterior chest wall AVMs. This approach showed successful occlusion with minimal complications.

Author contribution statement

Concept and design: I.M.R, M.I.K. **Literature search and interpretation**: A.A, I.M.R, M.I.K. **Writing the paper**: I.M.R, M.I.K. **Writing - Review & Editing**: A.R.M.S, I.M.R.

Ethical approval

Ethical approval is exempt/waived at our institution.

Provenance and peer review

Not commissioned, externally peer-reviewed.

Patient consent

A written informed consent was obtained for the publication of this case report and accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal upon request.

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