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Case Report

Endovascular treatment of a deltoid arteriovenous fistula using a combined approach of endovascular intervention and percutaneous embolization ☆

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ABSTRACT

Arteriovenous malformations (AVMs) are congenital, high-flow vascular lesions that can result in serious complications. We report the case of a 31-year-old male with an AVM located in the right deltoid muscle, diagnosed using Doppler ultrasound and computed tomography. The patient was successfully treated with a combined approach of endovascular intervention and percutaneous embolization. The procedure utilized NBCA:Histocryl glue to achieve complete occlusion of the nidus, with post-treatment follow-up demonstrating no residual abnormal flow signals. This report highlights the critical role of imaging in diagnosis and the effectiveness of combined therapeutic strategies in the management of peripheral AVMs.

Introduction

Arteriovenous malformations (AVMs) are congenital, high-flow vascular anomalies characterized by direct connections between arteries and veins. They typically progress slowly but can cause serious complications such as hemorrhage and ischemic ulceration [1,2]. Epidemiological studies have reported the incidence of AVMs to range from 1.12 to 1.42 cases per 100,000 individuals per year [3]. Diagnosis is primarily based on clinical assessment supported by imaging, with Doppler ultrasound enabling detection of arteriovenous shunting within the lesion, while computed tomography (CT) and magnetic resonance imaging (MRI) help assess the extent of the lesion and its relationship with adjacent structures [1,2,4]. Digital subtraction angiography (DSA) serves both diagnostic and

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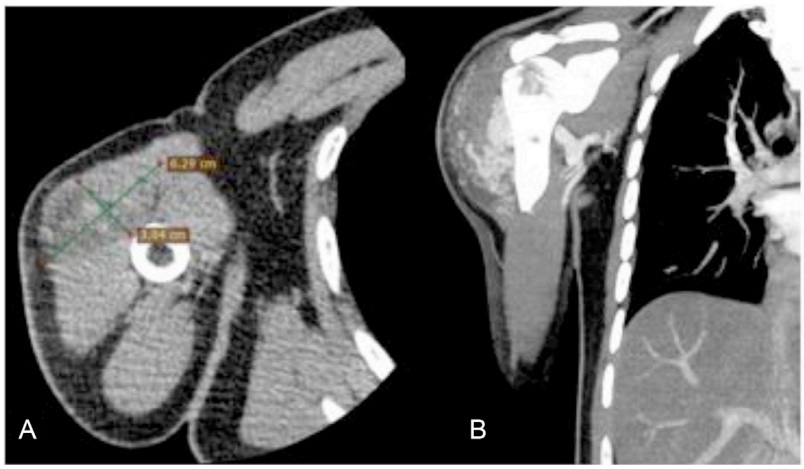

Fig. 1 – Arteriovenous malformation lesion in the anterior shoulder region measuring ~63 x 30mm.

therapeutic purposes, with endovascular embolization currently considered the treatment of choice. Various embolization routes are available, including arterial, venous, direct puncture, or combined approaches [1]. Herein, we present a case of an intramuscular AVM of the right deltoid muscle successfully managed with a combined endovascular and percutaneous embolization technique, aiming to share diagnostic and therapeutic experience with this rare entity.

Case report

A 31-year-old male with no significant past medical history was admitted due to pain and swelling in the right deltoid region that had persisted for approximately 1 month without prior treatment. On physical examination, a tender swelling was noted in the right deltoid muscle. The patient retained normal limb mobility, was afebrile, and remained hemodynamically stable. Doppler ultrasound demonstrated a hyperechoic mass in the right shoulder, measuring 52 × 50 mm, with a tangle of dilated vessels. Color Doppler revealed mixed arterial and venous flow without evidence of thrombosis. Contrast-enhanced computed tomography (CT) confirmed the presence of an arteriovenous malformation (AVM) on the lateral aspect of the right shoulder, measuring 63 × 30 mm. The patient underwent embolization of the nidus under digital subtraction angiography (DSA) guidance, using a combined percutaneous direct puncture and right brachial artery approach. Local anesthesia and sterile preparation were performed prior to the procedure. A catheter was advanced from the right brachial artery to selectively access the feeding arteries of the AVM, while a direct percutaneous puncture was simultaneously made into the nidus. After accurate localization and angiographic assessment of flow, coils were deployed and diluted NBCA:Histocryl (1:2 ratio) was slowly injected into the nidus until complete occlusion was achieved, with no reflux of embolic material outside the lesion. The procedure was completed once final DSA confirmed the absence of abnormal flow signals within the nidus and draining veins. The patient was monitored postoperatively in the ward, remained hemodynamically stable, and no early complications were observed (Figs. 1–4).

Discussion

Epidemiological studies have reported the incidence of AVMs to range from 1.12 to 1.42 cases per 100,000 population per year [3]. According to the ISSVA classification, vascular malformations are divided into 2 main groups: high-flow lesions (including AVMs and fistulas) and low-flow lesions such as venous or lymphatic malformations. AVMs belong to the high-flow category, tend to be more aggressive, and require distinct treatment strategies compared to low-flow lesions [5,6]. Soft-tissue AVMs are high-flow vascular malformations with variable clinical manifestations, ranging from local symptoms such as erythema, swelling, pain, and superficial varicosities, to more severe late-stage complications including bleeding, ulceration, and infection secondary to ischemia. Clinical examination may reveal soft tissue swelling, tortuous veins, warmth over the lesion, thrill, and bruit [1]. AVMs of the deltoid muscle are exceedingly rare and often difficult to diagnose early because of their deep location and nonspecific initial symptoms. The literature has reported very few cases of deltoid muscle AVMs, including 2 cases described by Mohammad Zaid in 2025 and Mehmet Dadaci in 1970 [7,8]. In our case, the patient presented with a 1-month history of painful swelling in the deltoid muscle without systemic symptoms, making clinical diagnosis challenging without imaging support.

From a diagnostic imaging perspective, Doppler ultrasound is a simple first-line tool that can identify mixed flow with the characteristic “mosaic” signal, suggestive of a high-flow lesion [4]. However, for accurate anatomical delineation and treatment planning, contrast-enhanced computed tomography (CT) and digital subtraction angiography (DSA) are indispensable. CT provides information on lesion extent, whereas DSA demonstrates the feeding arteries, nidus, and venous

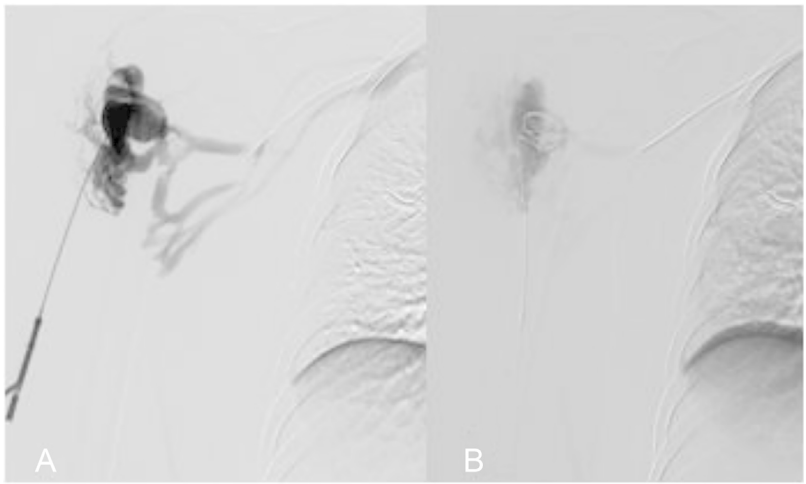

Fig. 2 – Direct puncture of the deltoid muscle AVM nidus (A), followed by coil embolization into the nidus via the direct puncture approach (B).

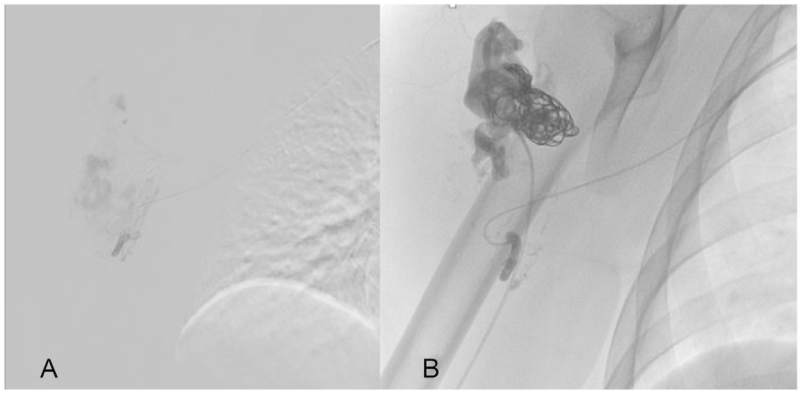

Fig. 3 – Brachial artery angiography to assess the AVM nidus (A), followed by transarterial embolization with glue into the feeding pedicle supplying the nidus (B).

drainage, thereby guiding the choice of interventional strategy [1,2]. Importantly, DSA plays a dual diagnostic and therapeutic role: it allows precise identification of the feeding arteries and nidus and facilitates embolization through arterial, venous, or direct percutaneous routes [5].

Endovascular treatment combined with direct percutaneous puncture, as in our reported case, enables accurate delivery of embolic agents such as NBCA into the nidus, particularly for complex or difficult-to-access lesions [6]. AVMs with complex angioarchitecture (type IIIB according to Do's classification) often require multimodal embolization techniques, including arterial, direct puncture, and venous approaches [9]. The treatment strategy should be tailored based on angiographic findings and anatomical accessibility. Arterial approaches are favored when the main feeding artery can be safely catheterized, followed by embolization of draining veins with coils or manual compression, and selective intra-arterial ethanol injection. Direct puncture is preferred when there are dilated draining veins with multiple small arterial feeders inaccessible via the arterial route [9]. The combined approach offers the advantage of achieving more complete nidus occlusion while limiting non-target embolization, thereby reducing risks such as ischemia of adjacent tissues or reflux of embolic material. Several embolic agents are available for AVM treatment. Absolute ethanol induces complete nidus sclerosis with the lowest risk of recanalization, but its high toxicity may cause tissue necrosis, neurological complications, and requires general anesthesia. Onyx (ethylene-vinyl alcohol copolymer) allows controlled injection, deep nidus penetration, and excellent fluoroscopic visibility, but is costly and time-consuming. Polyvinyl alcohol (PVA) particles are inexpensive and easy to use, suitable for temporary or adjunctive embolization, though less effective long-term because they do not achieve complete nidus destruction. Metallic coils are effective in occluding large feeders or draining veins but do not address the nidus and may hinder subsequent interventions. The choice of embolic material depends on nidus location, size, flow dynamics, operator experience, and available resources. NBCA (n-butyl cyanoacrylate) is widely used due to its rapid polymerization upon contact with blood,

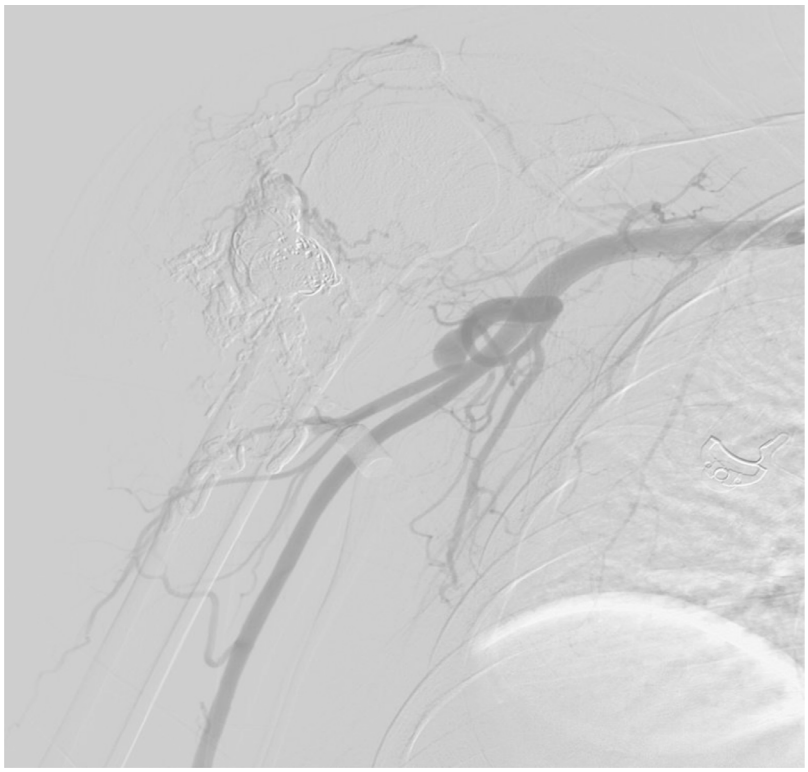

Fig. 4 – Complete removal of the AVM nidus after treatment.

providing durable occlusion with deep nidus penetration, and can be applied via arterial or direct puncture routes. Its advantages include high efficacy in achieving complete nidus embolization and reduced risk of recanalization, especially in high-flow AVMs. Limitations include difficulty in controlling glue propagation in high-flow settings, risk of reflux causing unintended embolization, and the need for operator expertise and careful adjustment of dilution with Lipiodol to control polymerization time [10]. In our case, the patient was successfully treated using a combined right brachial arterial approach and direct percutaneous puncture, with coil deployment and NBCA:Histocryl glue injection (1:2 ratio), achieving complete nidus occlusion. Following treatment, the patient experienced complete resolution of pain, and follow-up ultrasound demonstrated no abnormal findings. This case underscores the pivotal role of diagnostic imaging and the effectiveness of combined embolization strategies in the management of AVMs in general, and peripheral AVMs in particular.

Conclusion

This case of an AVM in the right deltoid muscle demonstrates the effectiveness of a combined endovascular and percutaneous puncture approach in the treatment of high-flow vascular malformations. This technique allows complete nidus occlusion, minimizes complications, and improves therapeutic outcomes. The multimodal embolization strategy reflects a comprehensive and contemporary interventional approach to the management of peripheral AVMs.

Patient consent

The patient have consented to the publication of all information to be published in this article.

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