



Non-contrast magnetic resonance venography as a preoperative imaging modality for refractory venous malformation: a case description

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Introduction

Venous malformations (VMs) are the most common vascular anomalies caused by developmental defects during the embryonic stage of life. Although the lesions are present at birth, they remain clinically undetectable until later in life and tend to grow under appropriate conditions, causing marked morbidity (1). Although sclerotherapy is one of the most effective treatments for VMs, treatment efficacy varies with the lesion type. Therapy-refractory VMs may expand and thus require more elaborate interventions (2). Enhanced magnetic resonance venography (MRV) and computed tomography venography (CTV) (with contrast) are used for further assessment of the characteristics of lesions and surrounding structures (3). If the lesion is complicated, non-contrast MRV (NC-MRV) aids in treatment planning; the technique exploits differences in the vascular signal intensities over the cardiac cycle and requires no contrast agent (4). Here, we present a report on a patient with a VM treated by percutaneous n-butyl cyanoacrylate (NBCA) embolization followed by excision. The principles of NC-MRV and its application to determine the lesion

structure in a patient with complicated venous disease are described. Finally, we evaluate the short-term outcomes of the treatment.

Case presentation

The study was approved by the Institutional Review Board (IRB) of Chang Gung Medical Foundation (No. 201900448B0), and all procedures involving human participants were performed in accordance with the ethical standards of the institutional and/or national research committee(s) and the Helsinki Declaration (as revised in 2013). Written informed consent was obtained from the patient for publication of this case report and accompanying images. A copy of the written consent is available for review by contacting the editorial office of this journal.

A 40-year-old woman presented with isolated right ankle swelling and pain that had progressed over 1 year. She had not experienced any ankle weakness, paresthesia, pallor, or coldness. Doppler ultrasonography revealed an ill-defined, heterogeneous, hypoechoic cleft surrounded by anechoic fluid and small varicose veins. A poorly circumscribed

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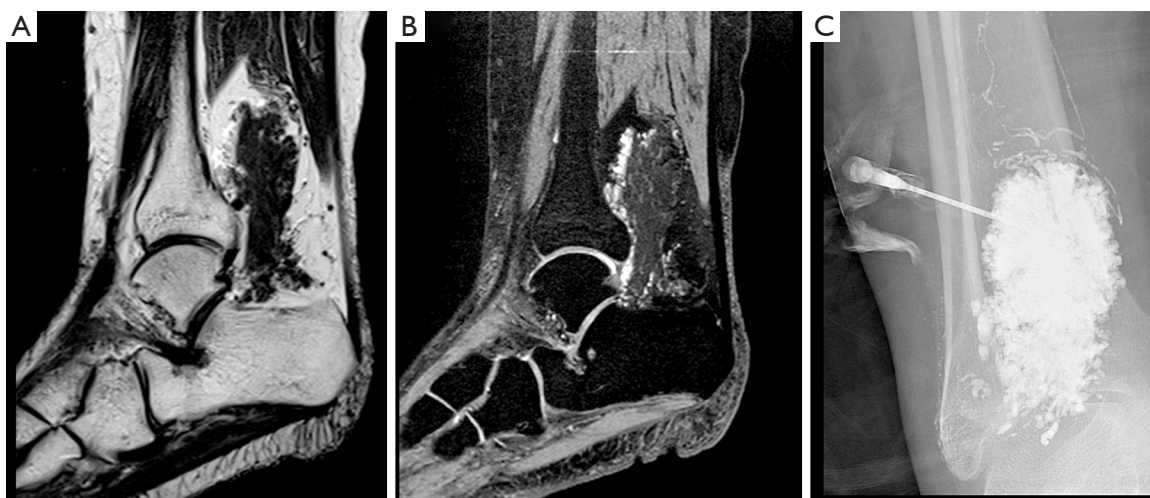


Figure 1 Preoperative magnetic resonance image of the lesion and a radiograph taken during the sclerotherapy. (A,B) T1 and T2 fat-suppressed sagittal images show a mass-like vascular malformation of the lower extremity. Noted the T2 hyperintense signal with internal septation and microcystic structures. (C) The postsclerotherapy radiograph shows a vascular tangle. Note the fine venous drainage appears as dotted and fragmented opacification.

mass-like lesion was evident in the posterior right ankle on magnetic resonance T1 (*Figure 1A*) and T2 fat-suppressed images (*Figure 1B*); the lesion measured 7 cm and exhibited microcystic structures and internal septation. After multidisciplinary consultation, a VM was diagnosed. Prior to planned transarterial sclerotherapy, digital subtraction angiography was performed which revealed no opacification of the abnormal vascular structure. Subsequently, sclerotherapy was performed using an ethanol–lipiodol mixture (1:3 ratio) via a direct-puncture approach. The technical end point of the procedure was the apparent influx of fluid into the connecting vessels of the lesion projection (*Figure 1C*).

One month after treatment, the patient complained of worsening pain and swelling of the right ankle. Follow-up radiography revealed near-total washout of the sclerosant. As the symptoms indicated that surgical resection was required, 3-dimensional (3D)–rendered images were needed to assist with preoperative planning. As no artery fed the lesion directly, flow assessment was difficult via enhanced CTV or MRV (with a contrast agent). We therefore performed NC-MRV, which revealed a residual ill-defined lesion in the right ankle, connected to small collateral veins, suggestive of a VM with venous drainage (*Figure 2A*). Direct-puncture embolization was performed using a 1:3 mixture of NBCA and lipiodol. Postembolization NC-MRV showed no sign of the VM (*Figure 2B*), indicating that

complete lesion casting was achieved (*Figure 3A*). One week later, we removed the lesion via surgical excision (*Figure 3B*). The patient was satisfied with the treatment. At the 1-year follow-up, Doppler ultrasonography revealed near-complete lesion regression.

Discussion

The management of VMs differs greatly with the lesion type. Sclerotherapy yields fairly satisfactory results for treating well-circumscribed VMs lacking venous drainage (5). However, our initially incorrect definition of the lesion was associated with a limited therapeutic effect, and thus surgical resection was required. Contrast-enhanced MRV and CTV are essential when planning surgery; however, if a lesion lacks a feeding artery, optimal contrast enhancement is difficult. In such a case, NC-MRV can reveal isolated, vascular structures (arteries or veins) and facilitate reasonable lesion mapping to aid in preintervention assessment and surgical planning (*Video 1*).

NC-MRV images were acquired using a 1.5 T magnetic resonance imaging (MRI) scanner (Philips Ingenia; Philips Healthcare, Best, the Netherlands). The patient underwent imaging and contemporaneous electrocardiography while supine. The abdominal aortic flow was quantitatively determined to identify appropriate trigger times for the systolic and diastolic phases. Images of the venolymphatic

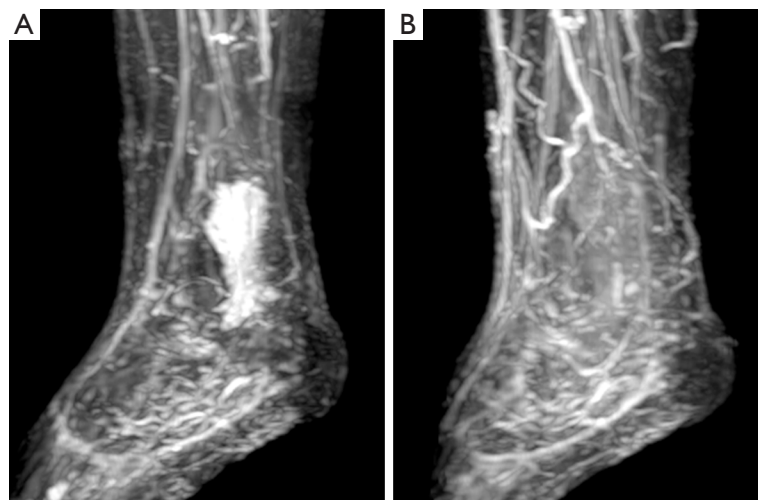


Figure 2 Comparison of pre-embolization and postembolization non-contrast magnetic resonance venography (NC-MRV) images. (A) Pre-embolization NC-MRV reveals an amorphous venous lesion in the posterior right ankle, connected to small collateral veins. (B) Postembolization NC-MRV shows exclusion of the venous malformation with patency of the deep and superficial venous return. Note the lymphedema appears as subcutaneous ground-glass signals.

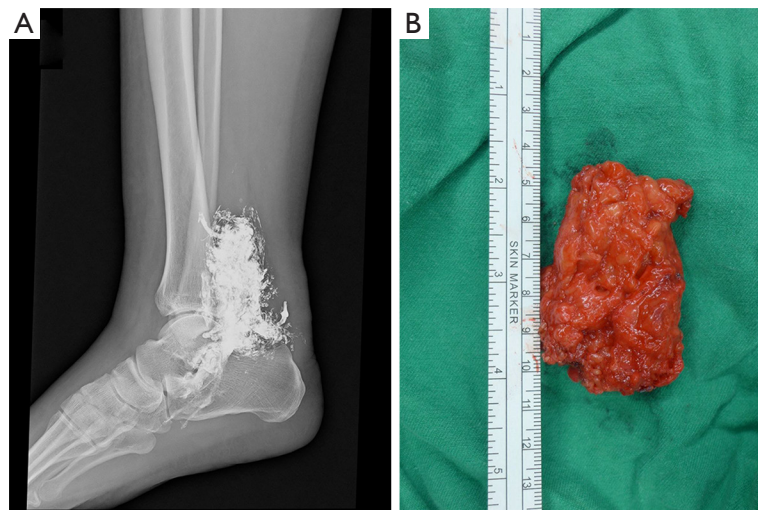


Figure 3 A side-by-side comparison of the postembolization radiograph and the resectate. (A) A postembolization radiograph of the right ankle shows complete casting of the lesion cavity, with minimal egress of injection between the deep fascia layers. (B) An intraoperative photograph shows a gross specimen of glue-filled venous malformation, which was resected en bloc. The lesion measured 5.0 cm × 4.0 cm × 3.2 cm.

structures were acquired using a 3D turbo spin-echo, short-tau inversion recovery (STIR) sequence acquired during the systolic phase. STIR imaging facilitated background suppression of fatty and bony tissue, and the arteries were dark during cardiac systole (6). Thus, the 3D data set contained only the venolymphatic structures.

NC-MRV revealed an extensive VM with venous drainage; the substantial venous outflow explained the sclerosant washout. Stand-alone excision is associated with significant technical challenges, including intraoperative bleeding, poor margin delineation, and infiltrative lymphedema. We considered NBCA embolization



Video 1 The video demonstrates the 3-dimensional non-contrast magnetic resonance venography of lower limb venous malformation.

followed by excision, as described previously (7). NBCA tightly seals the lesion cavity and thus completely blocks outflow, transforming a blood-filled VM into a hemostatic mass. After performing NBCA embolization, the surgeon reported that the lesion margin was well-defined and removed the lesion entirely with minimal blood loss.

NC-MRV exhibits certain drawbacks, the first of which is false-positive indications when vascular complexes are suffused with different inflows from various directions (8). Second, NC-MRV imaging is time-consuming and thus inappropriate for patients with critically ill or claustrophobia. Finally, NC-MRV is expensive and therefore not widely available. We hope that presenting these findings may encourage future research.

In conclusion, NC-MRV is a useful tool for assessing complicated VMs that lack feeding arteries. For the planning of surgical interventions, percutaneous NBCA embolization followed by lesion excision is a safe and effective strategy.

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Footnote

Conflicts of Interest: All authors have completed the ICMJE uniform disclosure form (available at <https://dx.doi.org/10.21037/qims-21-670>). The authors have no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. The study was approved by the Institutional Review Board (IRB) of Chang Gung Medical Foundation (No. 201900448B0), and all procedures involving human participants were performed in accordance with the ethical standards of the institutional and/or national research committee(s) and the Helsinki Declaration (as revised in 2013). Written informed consent was obtained from the patient for publication of this case report and accompanying images. A copy of the written consent is available for review from the editorial office of this journal.

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