Case report

Migration of n-BCA glue as a complication of venous malformation treatment in children ☆,☆☆,★,★★,†

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ABSTRACT

Preoperative n-butyl cyanoacrylate (n-BCA) embolization of venous malformations facilitates surgical resection. Although embolization is generally well-tolerated, central venous n-BCA migration can occur. The purpose of this article is to describe 3 cases of glue migration requiring glue embolectomy. Strategies for prevention and treatment of glue migration during embolization of venous malformations are reviewed.

Introduction

Venous malformations (VMs) are the most common type of pediatric vascular malformation, with a prevalence of approximately 1% [1]. For symptomatic lesions refractory to conservative management, invasive treatment options include sclerotherapy or surgical excision. We have previously described a hybrid approach to treatment of VMs: single stage n-BCA glue embolization followed by immediate surgical excision [2-4].

At our institution, we follow a standard approach to embolization of VMs. Direct percutaneous access is obtained into
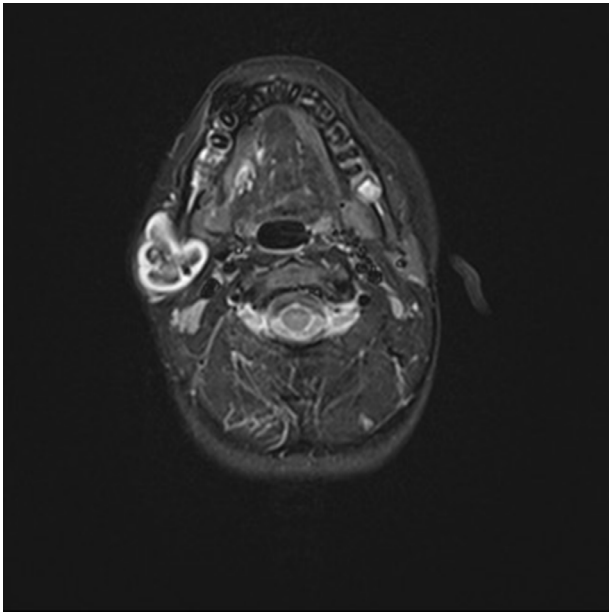

Fig. 1 – Case 1. Axial STIR MRI image showing a 29 x 27 x 32mm parotid hyperintense venous malformation with low signal phleboliths internally.

the lesion with 21-gauge needles and mapping venography is performed to assess lesion angioarchitecture and location of draining veins. Embolization is then performed with n-BCA glue (B. Braun Melsungen AG: Melsungen, Germany) diluted in ethiodized oil (Lipiodol; Guerbet, USA) at a ratio of 1:4 or 1:5, using multiple accesses as needed to perform complete lesion embolization. Subtraction roadmap fluoroscopy is used to monitor injection of the glue mixture.

Possible benefits of a hybrid, single-stage approach include fewer procedures compared to sclerotherapy as well as diminished blood loss and greater probability of total excision compared to stand-alone surgical excision. One potential complication of this technique, however, is nontarget embolization with migration of glue material into central or conducting veins and, in some cases, pulmonary artery thromboembolism. In this case series, we describe 3 cases of glue migration into central or conducting vessels.

Case 1

A nine-year-old female presented with right mandibular soft tissue and oral mucosal swelling. Pre-procedural MRI showed multiple head and neck venous malformations, the largest located in the parotid space and measuring approximately 30 × 30 × 30 mm (Fig. 1). Using previously described technique, access was obtained into the lesion. Initial venography demonstrated filling of the parotid component of the malformation with drainage into a previously unrecognized supraclavicular venous malformation via the right external jugular vein. No opacification was observed of central venous channels. Embolization was then performed with approximately 4

Fig. 2 – Subtraction roadmap fluoroscopy shows egress of n-BCA glue material into the external jugular vein from the initially embolized malformation and into the supraclavicular venous malformation (A). Subsequent further egress of glue material into the right innominate vein is noted (B).

mL of a 1:5 n-BCA-ethiodol mixture. Glue mixture was noted to traverse into the external jugular vein. After a brief pause to allow glue polymerization and occlusion of the outflow vein, embolization was resumed. However, further egress of glue into the supraclavicular component with extension into the right innominate vein was noted (Figs 2A and B). The patient

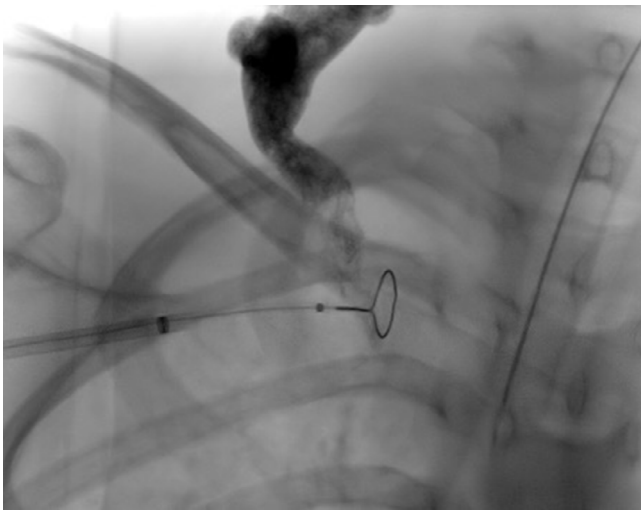**Fig. 3 – Digital subtraction venogram shows glue material extending into the right innominate vein.**

Fig. 5 – After snare retrieval of the glue fragment in the right innominate vein, venography shows improved patency.

Fig. 4 – Snare retrieval was attempted of the glue fragment extending into the right innominate vein.

Fig. 6 – Postoperative US shows residual glue fragment protruding intraluminally into the right innominate vein.

was placed in the Trendelenburg position to prevent further central migration of the glue fragment.

Access to the right basilic vein in the arm was obtained and a 6 French sheath was placed. Contrast injection showed a mobile fragment of glue in the right innominate vein without occlusion of the vessel (Fig. 3). A 12-20 mm trilobe snare (EN Snare, Merit Medical, South Jordan UT) was then used to snare the glue fragment from the innominate vein (Fig. 4). The fragment was partially extracted but fractured during extraction. Next, a 6 × 20 mm balloon (Mustang, Boston Scientific, Marlborough MA) was introduced to macerate the remaining glue fragment at the subclavian-innominate vein junction. After balloon maceration, a small non-occlusive filling defect re-

mained in the right innominate vein (Fig. 5). Digital spot imaging of the chest did not show further glue migration centrally into the pulmonary arteries.

Given the patient's clinical stability and incomplete glue embolectomy, a decision was made to proceed to the operating room where surgical excision of the parotid and supraclavicular venous malformations was performed with attempted surgical extraction of the remaining intravascular glue. Initial follow-up ultrasound 10 days later demonstrated a non-occlusive glue fragment measuring 19 × 3 mm within the right innominate vein (Fig. 6). The patient remained asymptomatic
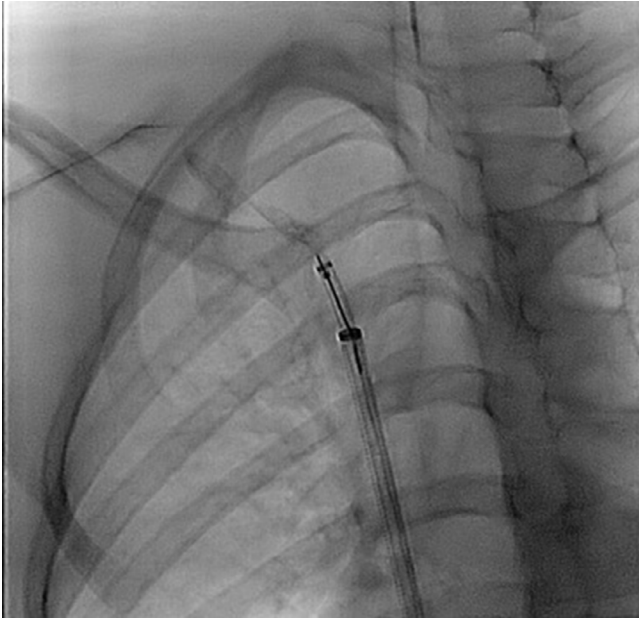
Fig. 7 – Capture of the residual glue fragment with a loop snare introduced through the suction thrombectomy device, which was used to extract the fragment.

Fig. 8 – Completion venogram showing improved and now wide patency of the right innominate vein.

with no complaint of arm swelling, shortness of breath, or diminished oxygen saturation.

Due to fragment size and potential for later development of symptomatic central venous obstruction or pulmonary thromboembolism, the patient was started on aspirin therapy and the decision was made to proceed with glue embolectomy 27 days later. Access was obtained via the right common femoral vein and a 10 French sheath was placed. A 10 mm gooseneck snare (Medtronic, Dublin, Ireland) was used to grasp and dislodge a portion of the fragment, which was then retracted into an 8 French CAT8 Indigo catheter (Penumbra Inc, Alameda, CA) (Fig. 7). Suction was engaged to remove the fragment. Post-aspiration venography demonstrated patent right subclavian, innominate, and external jugular veins, with a persistent filling defect in the right innominate vein that had significantly decreased in size (Fig.8). Given the wide patency of major vessels, the remaining glue fragment was left in place. Follow-up ultrasound 3 weeks later demonstrated a 3 × 13 mm glue fragment which had become adherent to the right brachiocephalic vein without occlusion of flow. An ultrasound 3 months later was unchanged and aspirin therapy was discontinued.

Case 2

A 13-year-old female was referred to the vascular anomalies clinic for fullness and swelling of the right shoulder. MRI demonstrated a 40 × 80 × 30 mm right supraclavicular venous malformation (Fig. 9).

The malformation was accessed using standard technique and mapping venography was performed. Notably, no egress
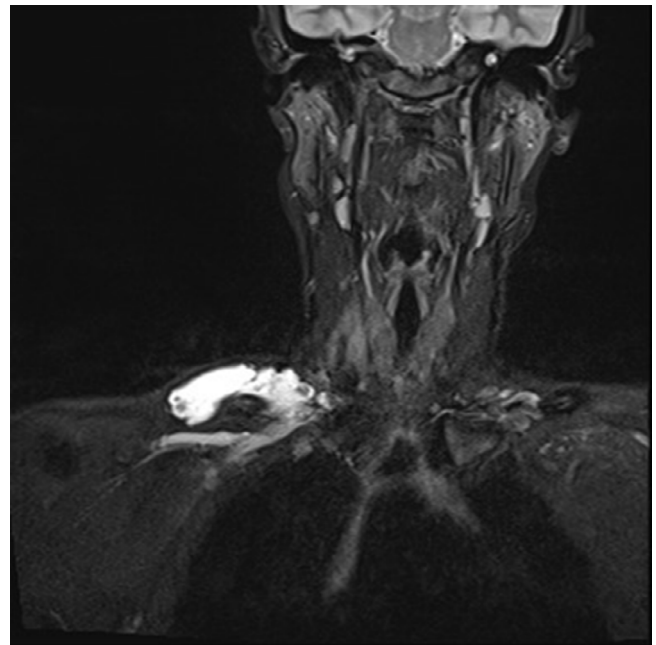
Fig. 9 – Case 2. Coronal STIR MRI shows a 60 × 35 × 38 mm right supraclavicular hyperintense lesion consistent with venous malformation.

of contrast into the subclavian vein was noted during initial venography. Three milliliters of the 1:4 n-BCA-ethiodol mixture were injected into the malformation and immediate sheet-like extrusion into the right innominate vein was noted. Venous access was obtained via the right internal jugular vein with placement of an 8 French sheath followed by introduction of a 12-20 mm trilobe snare (EN Snare, Merit Medical,

Fig. 11 – Intraprocedural cone beam CT showing bilateral segmental pulmonary arterial thromboembolism of glue material.

Given the patient's clinical stability, a decision was made to proceed with embolization. Access was obtained to more lateral segments of the malformation and complete embolization was performed with the remainder of glue remaining intra-lesionally.

Cone-beam CT performed post-procedure demonstrated several subsegmental pulmonary emboli bilaterally (Fig. 11). She was then taken to the operating room for excision of the embolized malformation. The patient was hospitalized overnight for clinical monitoring; she remained hemodynamically stable and was breathing comfortably on room air throughout the hospitalization. A follow-up chest radiograph demonstrated multiple pulmonary emboli bilaterally. Hematology and pulmonology services were consulted to assist in decision making regarding outpatient management; given clinical stability and lack of glue remaining within the central vessels, a decision was made to discharge the patient without anticoagulation. At follow-up in clinic 3 weeks later, she was doing well and reported no respiratory symptoms.
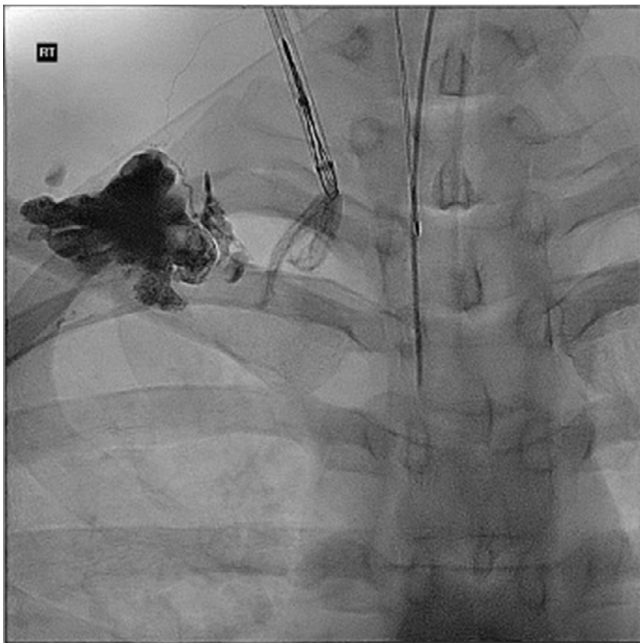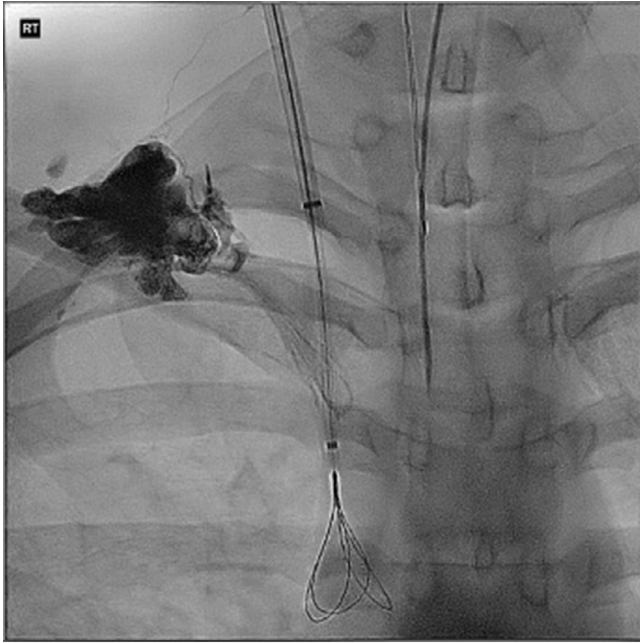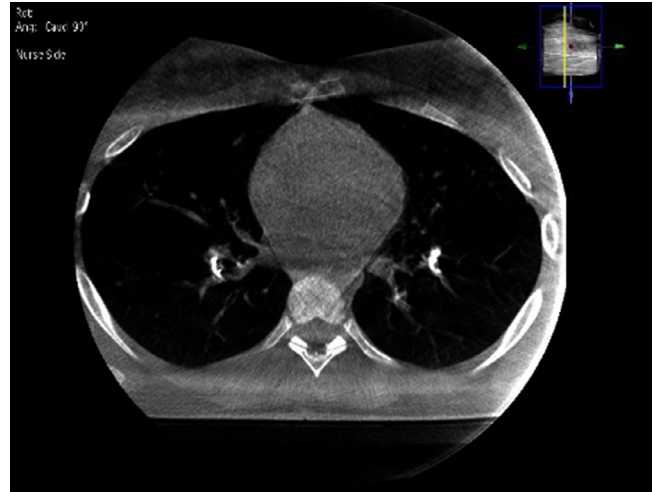
Fig. 10 – Fluoroscopic spot image shows glue embolization of the right supraclavicular venous malformation with sheet-like extrusion into the right innominate vein (A). Right internal jugular vein access was obtained with introduction of a trilobe snare to capture the extruded material (B).

Case 3

An 18-year-old male presented to the orthopedic surgery clinic with several months of intermittent throbbing and discomfort in the right posterior thigh. Diagnostic ultrasound and MRI demonstrated a 40 × 20 × 70 mm intramuscular lesion compatible with a venous malformation (Fig. 12). Given the patient's discomfort, he was referred for glue embolization and excision.

In the IR suite, the malformation was accessed via standard technique and initial venography demonstrated a vascular lesion with drainage into the femoral vein via deep perforating veins; rapid outflow was noted, suggesting a possible mixed fast-flow component to the lesion (Fig. 13). The lesion was accessed at multiple locations with injection of the 1:4 n-

South Jordan UT). The snare was used to engage the distal end of the glue fragment (Fig. 10A), successfully detaching it from the larger intralesional component (Fig. 10B). Fracture of the glue fragment during removal however, resulted in distal embolization of small glue fragments into the pulmonary arteries bilaterally. The patient did not experience increased oxygen requirement or oxygen desaturation. No hemodynamic changes were noted.
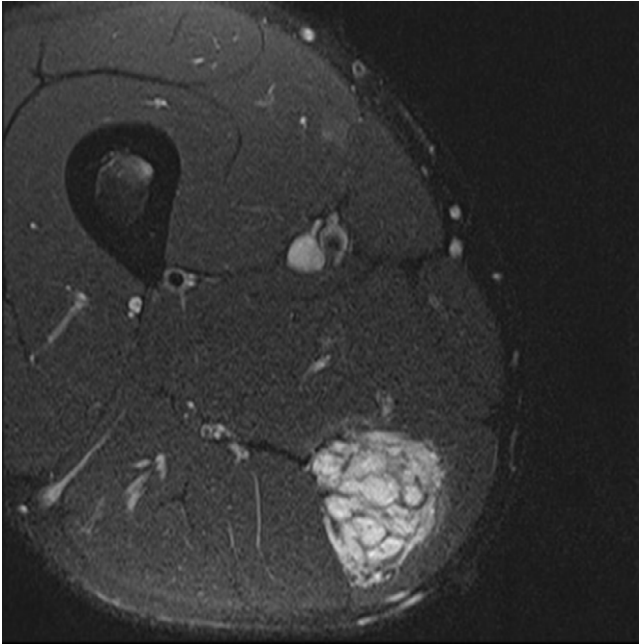
Fig. 12 – Case 3. Axial STIR MRI image showing a 40 x 20 x 70 mm circumscribed hyperintense intramuscular lesion compatible with a venous malformation.
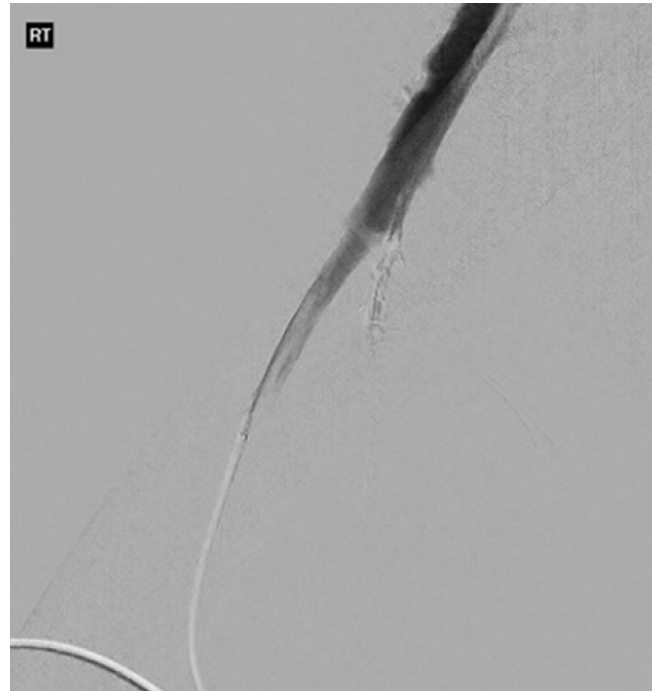
Fig. 14 – Digital subtraction venogram showing string-like extension of glue material into the femoral and iliac veins.

BCA-ethiodol mixture with some egress into draining veins. Postembolization venography showed egress of glue into the right femoral vein with a string-like extension to the right iliac vein (Fig. 14). Access was obtained via the right femoral vein at the mid-thigh, and a 4 French sheath was placed. A gooseneck snare was then used to extract the glue fragment, resulting in fragment fracture and embolization of small glue fragments into the central venous circulation and subsequently into subsegmental pulmonary arteries. Chest imaging demonstrated small subsegmental right lower lobe and left upper lobe pulmonary emboli; the external and common iliac veins were widely patent. The patient was taken to the operating room for resection of the malformation. He remained hemodynamically stable without additional respiratory requirements and was discharged home the same day. By patient report several weeks later, he was feeling well without any respiratory symptoms and did not return for additional follow-up. Pathology from the lesion demonstrated both venous and arterial components, suggestive of a mixed malformation, predominantly venous but with some high flow components.

Discussion

In this series, we describe our experience with inadvertent central venous migration and asymptomatic pulmonary embolization of n-BCA glue material during treatment of venous malformations. Non-target embolization has been described in treatment of arteriovenous malformations, particularly in the brain, and has resulted in severe clinical consequences including symptomatic pulmonary emboli [5,6], and end-organ
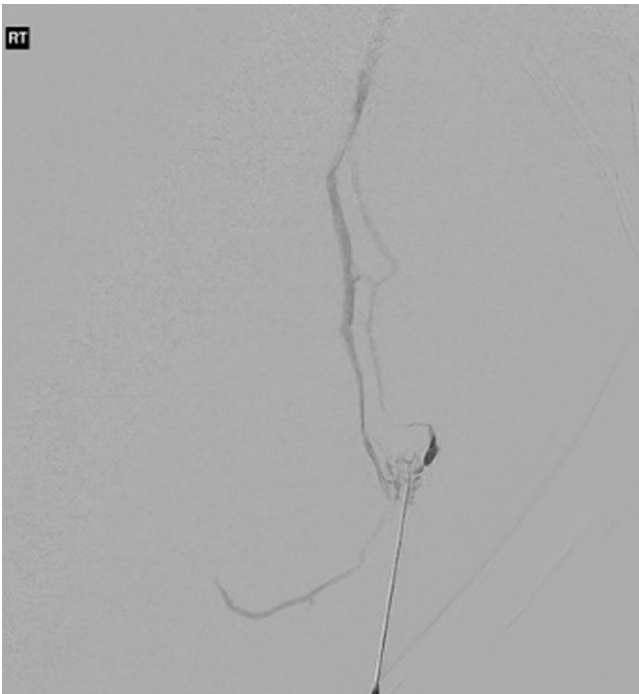

Fig. 13 – Digital subtraction venography after access into the venous malformation shows a possible fast-flow component with egress into ascending draining veins.

damage [7-9]. Another theoretical risk is that retained fragments in major vessels could promote central thrombus formation and venous outflow obstruction. While venous malformations are slow-flow lesions that typically confer a lower risk of glue migration, non-target embolization can still occur.

Steps can be taken intra-procedurally to mitigate the risk of non-target embolization. Careful venography after initial access to the VM is necessary to characterize the lesion, with a particular focus on assessing draining veins and identifying any components of arterial flow, as was later recognized in our third case. Presence of arterial flow might alter treatment approaches including less dilute glue mixtures (1:1 or 1:2) to promote quicker polymerization. Slow injection with careful monitoring is paramount, as this can help ensure that polymerization occurs intralesionally. Efforts should be made to prevent lesion overdistention, as the increased pressure may predispose to glue migration. If draining vessels are large, they can be coil embolized prior to glue injection. Though we typically do not utilize tourniquets due to unpredictable flow dynamics, external compression may be considered in these cases to occlude outflow veins. While these strategies may reduce the risk of embolization, the complex nature of VMs may still result in incomplete characterization and thus a risk for glue migration.

In cases in which nontarget embolization into deep venous structures does occur, we suggest that efforts be made to retrieve glue fragments at the time of the procedure. Changes can be made in patient positioning, as described in the first case, to slow the rate of glue migration and promote intralesional polymerization to anchor any extra-lesional components. Techniques to retrieve the glue fragments via snare embolectomy have been previously described [7]. We suggest that when retrieval is attempted, initial access should be made which allows for engagement with the exposed end of the fragment without traversing the fragment; for example, this may necessitate femoral venous access in cases in which the fragment extends into the brachiocephalic vein from a superior lesion. Snaring of glue can result in further fragmentation, as experienced in these 3 cases, which may be the desired outcome as smaller fragments are less likely to cause clinically significant effects. For cases in which retrieval is not successful in removing or sufficiently reducing the size of remaining glue fragment(s), suction thrombectomy using simple catheter aspiration or a suction thrombectomy device can be utilized. In our experience, this approach was partially successful and did not cause central fragment embolization; however, complete fragment retrieval was not possible, perhaps due to adherence of the fragment to the vessel wall. Relocation of the fragment to a location of less clinical significance has also been suggested [7]. In one case, we utilized balloon maceration in order to reduce glue fragment size to decrease the risk of ischemia after glue fragment migration. Finally, surgical retrieval may be indicated when a single-stage procedure is performed. However, complete extraction intra-operatively may be technically challenging and, in our experience, was only partially successful.

The need for long-term evaluation and management of these patients is unclear. Regular monitoring with ultrasound may be warranted in cases in which a large fragment remains to assess for any changes in fragment size, location or asso-ciated thrombus, as was performed in the first case. There is no standard approach for anticoagulation or antiplatelet therapy for this patient population. In consultation with hematology and pulmonology, we chose to initiate aspirin therapy in the first patient in which a significant fragment remained; in the other patients with only small asymptomatic pulmonary emboli and no changes in respiratory status at the end of the procedure, no additional therapy was initiated. We suggest that clinicians facing similar scenarios similarly consider antiplatelet therapy based on the size of fragment, fragment location, and underlying patient risk factors. While central embolic events were clinically silent in all 3 patients, the complication of pulmonary embolization is serious and potentially life threatening. Long-term sequela of small volume pulmonary glue embolism remains unknown. Furthermore, pulmonary embolic volumes were subjectively defined, limiting prediction of clinical significance in future events.

Conclusions

Central migration and pulmonary embolization of n-BCA glue is a rare complication of embolization of venous malformations. Risk of this complication can be further reduced however, by accurate pre-procedural diagnosis of lesion type and careful lesion mapping intraprocedurally to identify outflow veins. Clinicians should be aware of strategies to treat this complication when it does occur, which may range from clinical monitoring to glue embolectomy. Further research is needed to identify optimal management strategies.

Patient consent

For this type of study formal consent was not required.

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