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Direct intralesional *n*-butyl-cyanoacrylate embolization for intractable vertebral hemangioma bleeding: a salvage technique. Illustrative case

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BACKGROUND Surgical resection of vertebral hemangiomas in the setting of cord compression can be technically difficult and has the potential for life-threatening hemorrhage. The authors report a case of intraoperative direct intralesional *n*-butyl-cyanoacrylate embolization for intractable vertebral hemangioma bleeding.

OBSERVATIONS A 53-year-old woman presented for repeat surgery of a residual vertebral hemangioma after a previous debulking, laminectomy, and fixation that were without problems with bleeding. The second surgery was complicated by intractable hemorrhage. Bleeding was controlled with direct intralesional *n*-butyl-cyanoacrylate embolization after fluoroscopy without accompanying endovascular embolization.

LESSONS Aggressive vertebral hemangiomas should ideally be managed in centers where transarterial embolization is available. If such centers are not available or there is still intractable intraoperative bleeding despite preoperative embolization, direct intralesional embolization may be considered as a potential salvage technique.

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KEYWORDS vertebral hemangioma; direct embolization; bleeding; hemorrhage; *n*-butyl-cyanoacrylate; NBCA; Histoacryl

Despite their benign nature, aggressive vertebral hemangiomas can breach the vertebral cortical wall, which may result in column instability, myelopathy, or radiculopathy. Surgical treatment generally involves either indirect decompression, debulking, or en bloc resection with instrumented fusion. Surgical complications include vertebral collapse, intraoperative bleeding, and postoperative hematoma. A preoperative angiogram assists with intraoperative planning and the identification of feeder vessel embolization potential. Preoperative embolization for aggressive vertebral hemangiomas has been shown to indirectly decrease surgical morbidity and intraoperative bleeding,[1,2] particularly in situations in which all feeder vessels can be embolized. Preoperative transarterial embolization is a relatively safe procedure; however, complications include transient postembolization syndrome, tumor swelling, and cord compression, as well as embolic stroke,[3,4] which has an incidence of approximately 5%.[5]

A variety of intraoperative systemic and topical agents can be used in spinal surgery to control intraoperative and postoperative bleeding. Systemic treatments include tranexamic acid, desmopressin, and aminocaproic acid, whereas local treatments include bone wax, hemostatic sponges, gelatin matrix sealants, bipolar electrosurgery, and surgical clips.

To augment surgical management of intractable intraoperative bleeding of a vertebral hemangioma, the authors present a case of intraoperative embolization via direct intralesional *n*-butyl-cyanoacrylate (NBCA) and lipiodol (Histoacryl; B. Braun, Melsungen, Germany) as a strategy that can be considered for surgical salvage in centers not equipped with transarterial embolization.

Illustrative Case

This is a case of a 53-year-old woman with no significant past medical history. Fifteen months previously, she had undergone an L1 laminectomy with surgical debulking and T12-to-L2 pedicular screw fixation for an L1 hemangioma causing cord compression, during which there were no surgical bleeding problems (Fig. 1). Fourteen months later, the patient reported left radicular pain in the left L1–2 dermatome. Repeat

ABBREVIATIONS MRI = magnetic resonance imaging; NBCA = *n*-butyl-cyanoacrylate.

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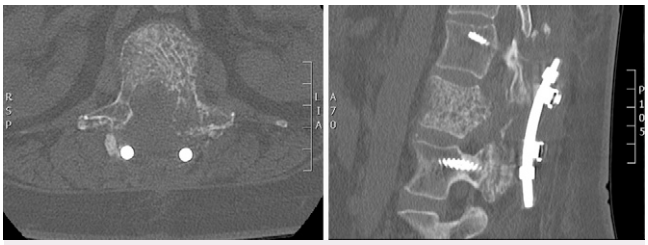

FIG. 1. Computed tomography after first debulking procedure.

magnetic resonance imaging (MRI) showed extensive hemangiomatous infiltration of the L1 vertebral body and T12–L1 and L1–2 neuroforamina causing high-grade foraminal stenosis (Fig. 2).

Further surgical management was decided with the removal of the posterior instrumentation, vertebral hemangioma debulking at L1, and T11–L1 laminectomy with refixation. After a midline excision, bilateral rods and x-links were removed, and the dorsal aspect of the lesion was partially debulked using a transpedicular approach. Persistent, slow ooze was encountered around the left side of the L1 vertebra at the level of the pedicle, which, despite usual surgical methods, including $\times 6$ prefilled syringes of Floseal (Baxter Healthcare Corporation, Fremont, CA) and compression, remained intractable. Eight hours into the operation (after 6 units of fresh frozen plasma, 3 units of cryoprecipitate, 1 unit of platelets, and 10 units of packed red blood cells), the wound was packed and closed, and the patient was transferred to a tertiary hospital theater while intubated and ventilated for consideration of transarterial embolization.

On arrival, the patient's hypertension (220/120 mm Hg), bradycardia (30 beats/minute), and hypothermia (92.84°F) were corrected. Coagulopathy was reversed with rotational thromboelastometry assistance (with a further 9 units of cryoprecipitate transfused).

The surgical midline wound was reopened, and the thecal sac was identified at T12 and L2. After the removal of a sponge tamponade, bleeding ooze was encountered from the pedicle lesion, which was initially slow but progressively became faster. A 21-gauge needle was placed directly into the lesion, and 2 ml of Ultravist 300 (Schering AG, Berlin, Germany) was used to confirm the intratumoral position with biplanar localization. Direct intralesional embolization with 4.5 ml of 33% NBCA and lipiodol was then performed, and good hemostasis was achieved (Fig. 3). A small ooze adjacent to the lesion was controlled with Floseal and Gelfoam. The wound was closed with two drains under medium suction.

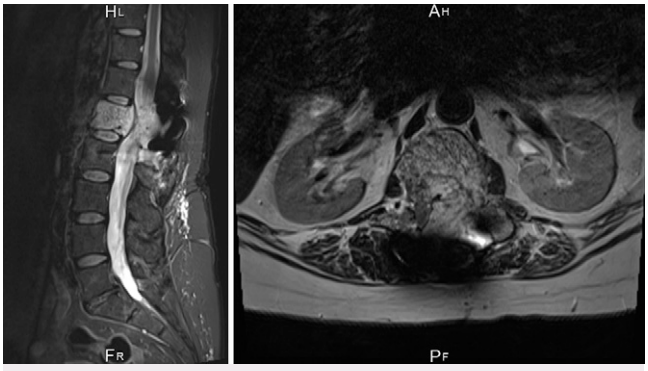

FIG. 2. MRI scans at L1 showing vertebral hemangioma recurrence before surgical revision.

On day 1 postoperatively, the patient had a small left pleural effusion and atelectasis. The patient was successfully extubated after an MRI of the spine, which showed that a majority of the tumor had been debulked and satisfactory decompression of the spinal canal had been achieved. Residual tumor was present within the left L1 pedicle with an adjacent small epidural hematoma (Fig. 4).

Six months after surgery, the patient reported a significant improvement in lower limb pain and numbness. Repeat computed tomography showed significant involution of the glue cast within the left lateral body, laminar and posterior element, with the anterior part of the vertebra free of embolic material (Fig. 5). MRI suggested there was persistent extraosseous tumor extending laterally and posteriorly causing dural sac indentation with mild to moderate central canal stenosis.

One year after direct intralesional embolization, definitive surgery with a staged L1 vertebrectomy, titanium cage, and bone graft was planned. Interventional radiology performed presurgical endovascular embolization with NBCA to the areas of hemangioma not previously embolized, during which the original glue cast set prevented access to the anterior body. During stage 1 of the vertebrectomy, there was continual ooze (despite the preoperative endovascular embolization), and intraoperative direct transcatheter embolization with NBCA under fluoroscopy was necessary to slow bleeding. Two dural tears occurred during surgical debulking caused by adhesion of the tumor to the dural sac. The larger tear underwent primary repair, and the smaller tear was patched with an autologous fat graft and revision of the posterior screws to T10–L4. One month later, during stage 2, a left thoracoabdominal approach was used to remove the residual L1 hemangioma and cage, with revision of the posterior lumbar pseudomeningocele.

Discussion

Observations

In 2000, Trystram et al.[6] first described a technique of preoperative devascularization that combined transarterial embolization and direct percutaneous vertebral NBCA embolization in a case of vertebral metastasis. These days, preoperative direct percutaneous embolization for hypervascular spinal lesions is usually reserved for cases in which transarterial embolization is deemed too high a risk (due to proximity to spinal feeder vessels) or insufficient.

Direct embolization is advantageous in that occlusion occurs at the level of the capillary bed rather than the more proximal occlusion of the blood supply seen with a transarterial approach.[7] A mixture of NBCA and lipiodol slows the polymerization reaction time and improves handling predictability, whereas preinjection arteriography delineates tumor blood supply and identifies collateral and overlapping blood supply with neural elements. Schirmer et al.[7] previously described the use of preoperative NBCA direct percutaneous embolization in five cases of hypervascular spinal metastases. Although preoperative embolization was a preoperative treatment option in this case, it was not used before the second surgery, based on surgeon choice. Direct intralesional embolization with NBCA was used as a surgical salvage technique for intractable intraoperative bleeding.

Direct embolization with NBCA has the risk of unintended embolization of feeder and collateral branch arteries via retrograde flow of embolic material. Previously reported complications with direct embolization of hypervascular tumors include the embolization of the middle cerebral artery and ophthalmic artery after direct embolization of a juvenile

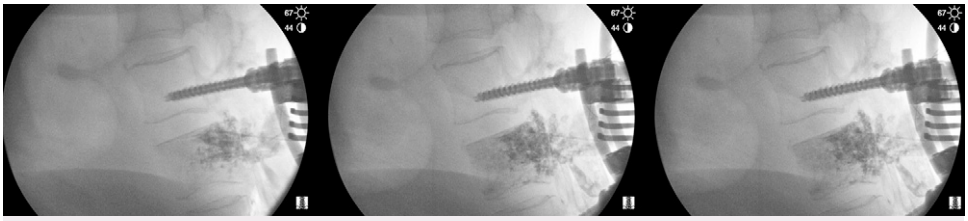

FIG. 3. Intraoperative screening showing intralesional needle position and injection of NBCA under fluoroscopy.

nasopharyngeal angiofibroma[8] and spinal cord ischemia/infarction after endovascular embolization of spinal metastasis.[9]

In this case, the ooze persisted despite the usual surgical methods, which prompted a novel approach to gain hemostatic control in a hemodynamically compromised patient. The intraosseous source of bleeding meant point source control was not possible. Reported complications from the intraosseous administration of hemostatic gelatin matrix agents include anaphylaxis and neurological deficits.[10,11] In the latter, Floseal entered the spinal canal after intrapedicular application during pedicle screw insertion, which, upon its expansion (due to the imbibing of water), applied compression on the epidural spinal cord.[11]

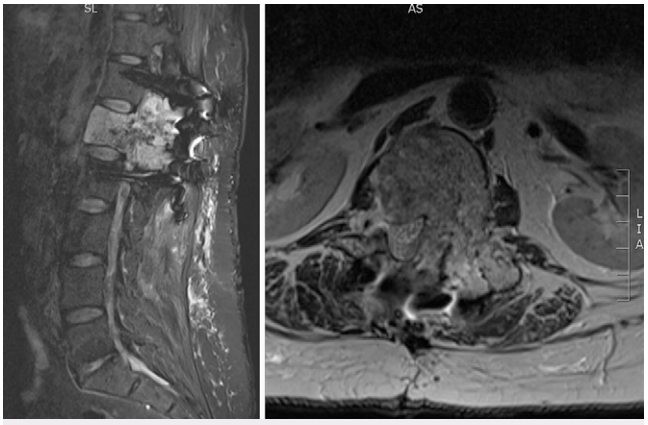

FIG. 4. Postoperative MRI scans showing decompression of the central canal.

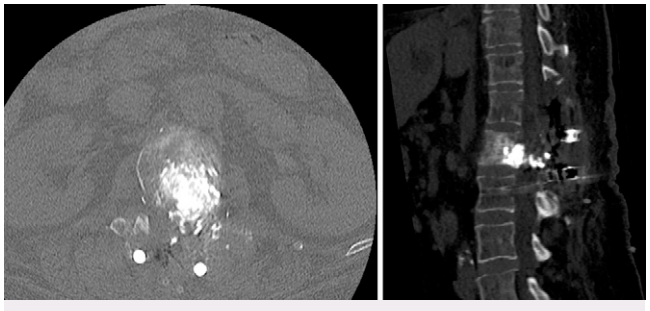

FIG. 5. Postoperative computed tomographic scans showing embolic NBCA material.

Lessons

Aggressive vertebral hemangiomas can be prone to significant intraoperative bleeding. Such lesions should ideally be managed in centers where transarterial embolization is available and surgeons are able to perform a definitive resection and stabilization involving vertebrectomy as either a single or staged procedure. If such centers are not available or despite preoperative embolization there is intractable intraoperative bleeding, direct intralesional embolization may be considered as a potential salvage technique.

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Disclosures

The authors report no conflict of interest concerning the materials or methods used in this study or the findings specified in this paper.

Author Contributions

Conception and design: Kenworthy, Bakmeedeniya. Acquisition of data: Kenworthy, Narula. Analysis and interpretation of data: Kenworthy, Bakmeedeniya. Drafting the article: Kenworthy, Bakmeedeniya. Critically revising the article: Kenworthy, Bakmeedeniya, Wong. Reviewed submitted version of manuscript: all authors. Approved the final version of the manuscript on behalf of all authors: Kenworthy. Administrative/technical/material support: Kenworthy. Study supervision: Wong.

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