Combined Direct Tumoral Puncture Embolization with Onyx and Transarterial Embolization for Sinonasal and Skull Base Tumors

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Introduction

Juvenile nasopharyngeal angiofibromas (JNA) are rare tumors of the sinonasal cavity that almost exclusively affect adolescent males. JNAs are locally invasive and may extend into and involve adjacent structures. Surgical excision represents the primary treatment; however, the hypervascular nature may limit the extent of resection. Hypervascularization may similarly be an issue in other sinonasal tumors, such as renal cell carcinoma metastasis.

Embolization techniques are utilized pre-operatively to devascularize tumors and facilitate safer resection, but this remains challenging given the complex neovascular architecture of JNA. There is significant variation regarding embolization practices with a wide range of different techniques described and a limited basis for expert recommendations to guide decision making.[1,2]

Direct puncture embolization (DPE) using an elastic polymer comprised of ethylene-vinyl alcohol co-polymer or 'Onyx' (Medtronic, Minneapolis, Minnesota), has been shown to be a safe and effective technique for vascular tumors.[3] As an embolic agent, Onyx offers advantages over n-Butyl-cyanoacrylate (nBCA), including more controlled delivery time, a slower rate of polymerization, and longer working time.[4] In addition, it is more easily visualized under fluoroscopy. Although several small studies have described the use of DPE as an alternative to trans-arterial embolization (TAE) in treating JNA, management with tandem Onyx DPE with TAE has seldom been described. The authors present their experience investigating the efficacy and outcomes of this technique, along with a protocol and technical pearls.

Methods & Materials

Institutional review board approval was obtained. Seven patients presented to an academic tertiary care medical center with vascular tumors. This included six patients with juvenile nasopharyngeal angiofibroma and one with renal cell metastasis to the sinonasal cavity. Computed tomography (CT), magnetic resonance (MR) radiographic studies, and endoscopic examination were obtained to confirm the diagnosis in all patients. All patients were referred to interventional neuroradiology for pre-operative embolization followed by endoscopic surgical resection by an Otolaryngologist within 24 hours. Age, primary symptoms, tumor staging, tumor size, embolization technique, blood loss, and mean fluoroscopy time were recorded. JNA tumors were staged according to the Radkowski grading system. The diagnoses were confirmed with histopathology post-resection

Technique & Protocol

Step 1: Angiography
Diagnostic angiography was performed, with attention given to the Internal Carotid Artery (ICA). When angiography demonstrated ICA supply to the tumor (n = 1 patient), a compliant balloon (Eclipse 2L 6 x 20 mm, BALT USA) was appropriately positioned in the distal ICA for potential inflation to prevent reflux of the embolic agent into the ICA.

Step 2: Direct Puncture Embolization
Under fluoroscopic and endoscopic guidance with a 0-degree rigid nasal endoscope, the otolaryngologist advanced dimethylsufloxide (DMSO)-compatible 20G spinal needles into the mass one at a time to fill each tumor subsite **[Figure 1/Figure 2].** Intratumoral access was confirmed with blood return from the spinal needle. An intratumoral injection of contrast was performed to identify the extent of vascularity and collateral networks. The tubing and needle were slowly primed with DMSO followed by Onyx-18 embolization under fluoroscopic guidance. Once a particular tumoral compartment had been filled, the same procedure was performed on the next needle. If we determined the need for filling in another part of the tumor, a separate needle was introduced under roadmap guidance. Embolization was continued until no significant tumoral blush was seen on angiography. **[Figure 3]**

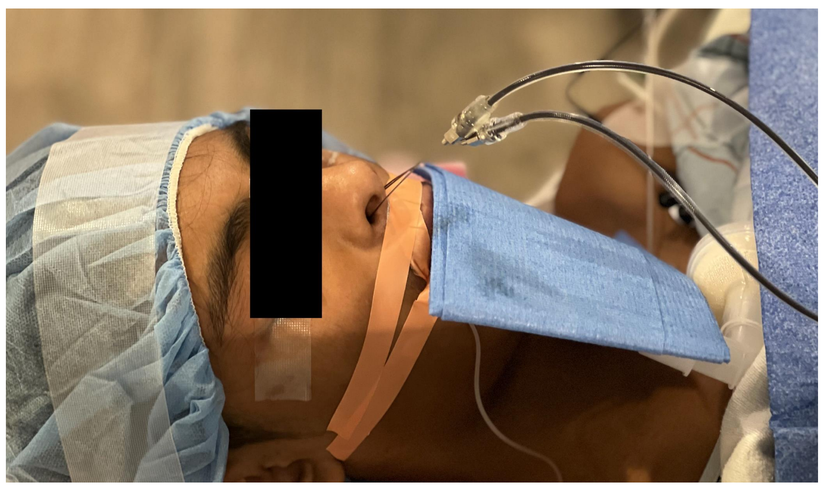

Figure 1. Needle placement

Figure 2. Needle depth under fluoroscopy

Figure 3. Direct puncture embolization under fluoroscopy

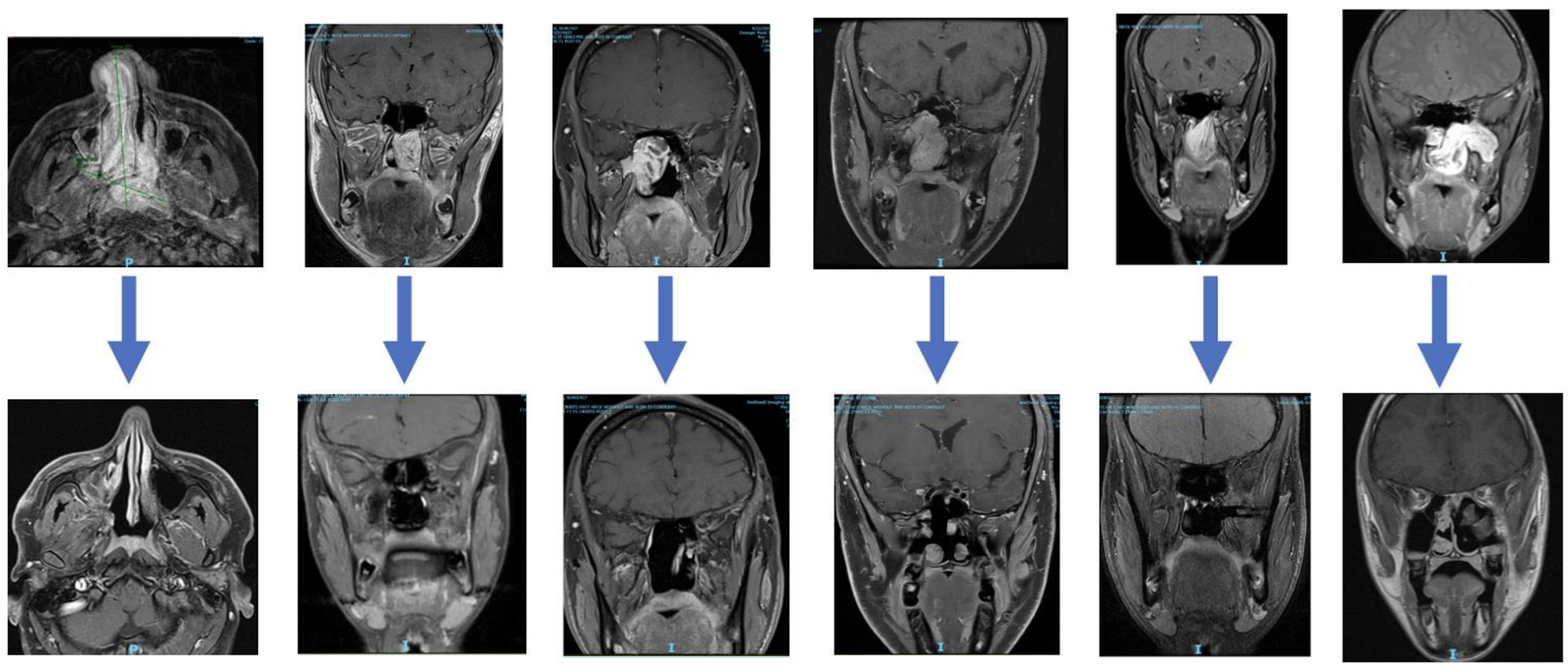

Figure 4. Pre and post operative MRI images

Technique & Protocol

Step 3: TAE
A 5F catheter was navigated into the external carotid artery. Angiography was performed to map the arterial pedicles of the tumor and any residual vascularity. A microcatheter was navigated over a microguidewire to the distal internal maxillary artery (IMAX). The distal segment of the IMAX was embolized with multiple bare platinum coils to decrease residual blood flow and demarcate the lateral margin of the tumor.

Step 4: Needle removal
The needles were slowly removed. Onyx was injected slowly during withdrawal to help control bleeding. Minor bleeding from the puncture sites was controlled using direct pressure with oxymetazoline-soaked pledgets under endoscopic guidance. Dissolvable packing was placed to aid in hemostasis. No bleeding required the use of monopolar electrocautery.
A final post-embolization angiogram was performed to determine the degree of tumor devascularization and ensure the patency of intracerebral vessels.

Results

All patients presented with epistaxis as their primary compliant prior to diagnosis. JNA tumors included in this study were Radkowski grade IIa (2), IIb (2), or IIc (2). One tumor was a renal cell carcinoma metastasis to the sinonasal cavity. The largest AP dimension among all tumors was 86mm (range 37-86mm). The average amount of Onyx injected into each tumor was 15.1 mL (range 3-33 mL). Average estimated blood loss was 380 mL (range 60-700 mL). All patients underwent coil embolization of the internal maxillary artery, and the renal cell carcinoma patient underwent coil embolization of the facial in addition to the internal maxillary artery. There were no direct tumor puncture or embolization related complications in any patient. Surveillance MRI and physical exam have showed no evidence of recurrence in any patient to date.

Discussion/Conclusions

Pre-operative devascularization with TAE and onyx DPE is a safe and effective tandem technique for vascular sinonasal tumors, and it may facilitate dissection. Overall, the existing literature is limited, especially in regard to Onyx. Pooled data does not demonstrate a statistically significant benefit; however, few studies have described a combination technique involving DPE with TAE.

Surgeons should consider use of this tandem technique prior to resection of not only vascular tumors such as JNA, but also malignant tumors s in which excessive blood loss is anticipated.

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