

Percutaneous embolization of head and neck paragangliomas with Onyx

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ABSTRACT

Objectives: 1) To report our series of carotid body tumors (CBT) and vagal paraganglioma tumors embolized with Onyx (ethylene vinyl alcohol copolymer) via direct percutaneous tumoral puncture prior to surgical resection 2) Ascertain the safety and efficacy of embolization and subsequent surgical resection utilizing this technique 3) Describe all outcomes and results
Methods: We prospectively collected all CBT and vagal paraganglioma tumors embolized percutaneously with Onyx at our tertiary care academic medical center during a 24-month period. The fluoroscopy time, percent of tumor devascularization, periprocedural complications, and intraoperative blood loss were evaluated and compared to published literature.
Results: A total of 12 patients underwent preoperative embolization via direct tumoral puncture. Tumors included 9 CBT and 3 vagal paraganglioma tumors. The mean percent tumor devascularization was 94%. Overall intraoperative estimated blood loss was 405cc. There were no neurological complications related to the embolization procedures. One CBT excision required repair of the carotid artery with a saphenous vein graft and one CBT excision required ligation of the carotid artery due to tumor invasion of the vessel (there were no post-operative deficits related to repair or ligation).
Conclusions: Percutaneous embolization of carotid body and vagal paraganglioma tumors with Onyx can be performed safely and efficiently, resulting in favorable devascularization and intraoperative blood loss profiles.

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INTRODUCTION

Endovascular therapy has become an important tool in the management of various head and neck tumors. Preoperative embolization of vascular tumors in order to decrease intraoperative blood loss, palliative embolization to control intractable tumor bleeding, and administration of intra-arterial chemotherapy have become common practice. While traditional transarterial embolization is commonly employed, direct tumoral puncture has also been advocated as an alternative (1-2,4). We report our series of preoperatively embolized carotid body tumors (CBT) and vagal paraganglioma tumors with Onyx (ethylene vinyl alcohol copolymer, EV3 Micro Therapeutics Inc., Irvine, CA) via direct tumoral puncture to ascertain the safety and efficacy of embolization and subsequent resection utilizing this technique.

METHODS AND MATERIALS

We prospectively collected all carotid body and vagal paraganglioma tumors embolized with Onyx at our institution during a 24-month period. The fluoroscopy time, volume of Onyx used, percent of tumor devascularization, periprocedural complications, and intraoperative blood loss were evaluated. The percentage of tumor devascularization was then determined by tracing the pre- and post-embolization tumor blushes using ImageJ software (version 1.41o NH Bethesda, MD). The ratio of post-embolization to pre-embolization tracing in pixels was then calculated. The association between the percent of tumor devascularization and the amount of surgical blood loss was determined by using linear regression analysis.

Embolization technique: All patients underwent percutaneous femoral arterial catheterization performed in a single session under general anesthesia. Pre-embolization angiograms were analyzed to determine the extent of tumor blush, feeding arteries, draining veins, and extracranial-to-intracranial anastomoses. Embolizations were carried out using Onyx 18 (lower viscosity), 34 (higher viscosity), or a combination of both. The neck was prepped in a standard surgical fashion and an 18 gauge spinal needle was inserted percutaneously and advanced to the center of the tumor under fluoroscopic roadmap guidance, taking care to avoid the carotid arteries. Once intratumoral access was achieved and the stylet removed, the hub of the spinal needle was connected to a 20 cm luer lock extension tubing (B. Braun, Melsungen, Germany). An intratumoral angiogram was performed through the spinal needle to confirm the position within the tumor and identify dangerous intracranial anastomoses. The dead space within the spinal needle and tubing was then slowly flushed with DMSO followed by Onyx embolization using a subtracted roadmap. Embolization was continued until the desired degree of tumor penetration was achieved. A final post-embolization transarterial angiogram was performed to assess the degree of tumor devascularization and followed by an ipsilateral cerebral arteriogram to ensure that there was no inadvertent embolization into the cerebral vasculature.

RESULTS

A total of 12 patients (11 males and 6 females; age range 28 – 70 years) underwent preoperative embolization via direct tumoral puncture. Tumors included 9 CBTs and 3 vagal paraganglioma tumors. The average volume of Onyx used per case was 8.8 cc. The mean percent tumor devascularization was 94%. There were no neurological complications related to the embolization procedures. There were no cases of inadvertent embolization of the parent arteries or development of symptomatic post-embolization tumor swelling. The mean time to surgical resection following embolization was 3.1 days (range 0-11 days). Carotid body and vagal paraganglioma tumor resections were performed using a standard neck dissection. One CBT excision required repair of the carotid artery with a saphenous vein graft, and one CBT excision required ligation of the carotid artery due to tumor invasion of the vessel (there were no post-operative deficits related to repair or ligation). There were no other major operative complications. The overall mean estimated intraoperative blood loss including cases necessitating excision of a portion of the carotid artery due to tumor invasion was 405 cc. Gross total surgical resection was achieved in all cases.

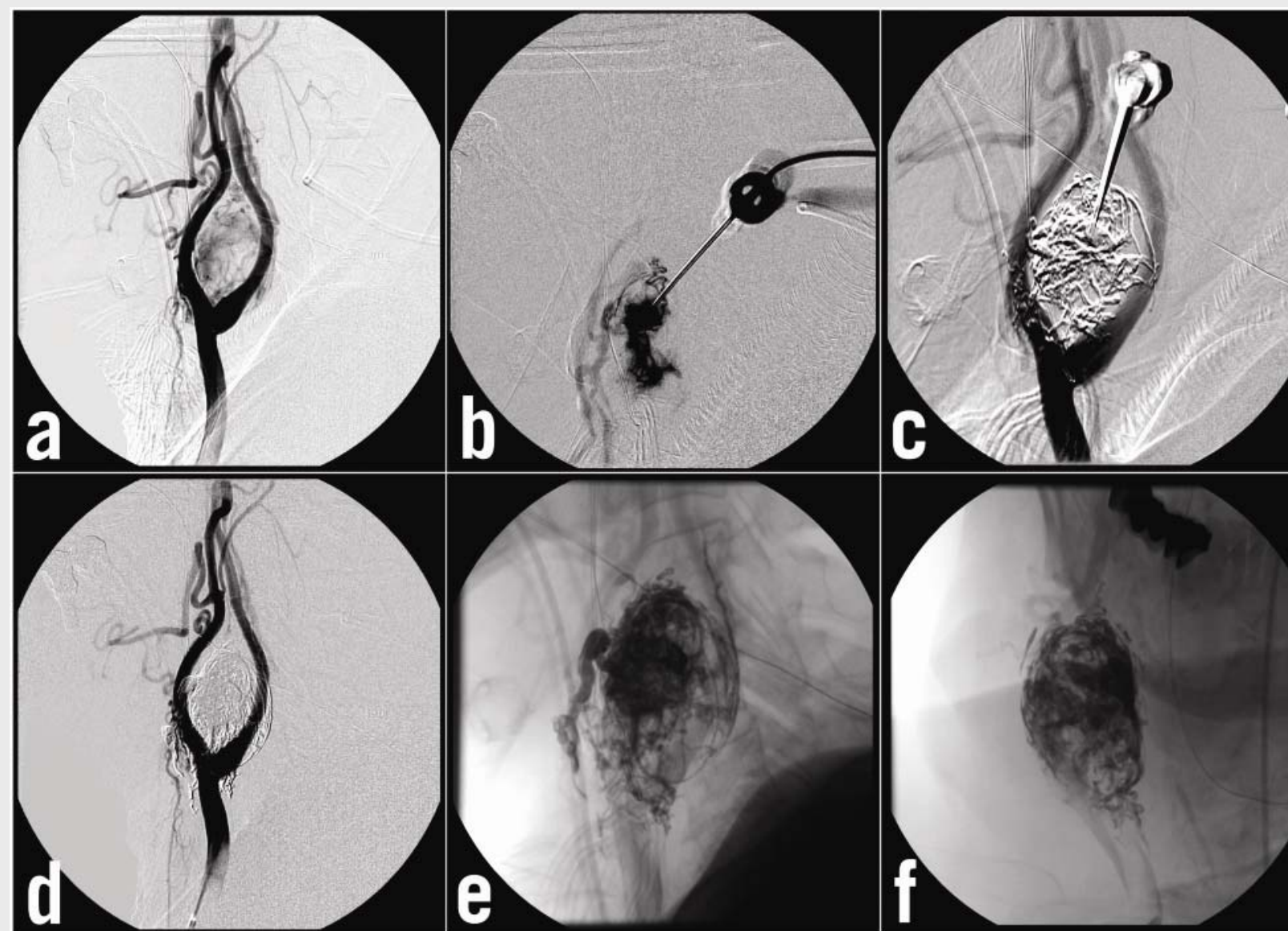


Figure 1. A 70-year-old male presented with a right sided soft, pulsatile neck mass. MRI demonstrated a salt-and-pepper lesion and an octreotide scan demonstrated marked uptake consistent with a CBT. The patient underwent a diagnostic angiogram demonstrating a highly vascular tumor splaying the internal and external carotid arteries (Figure 1 a). Tumor embolization was then performed via direct puncture using Onyx 34 (Figure 1b and c). Post-embolization angiography demonstrated complete devascularization of the tumor (Figure 1 d-f).



Figure 2. Close-up of Onyx after tumor resection.

DISCUSSION

There are two main decisions to be made when faced with a tumor embolization: route of embolization and embolic agent to be used. The optimum combination combines maximal benefit and minimal risk to the patient.

Route of Embolization: traditionally, tumor devascularization has been achieved via transarterial embolization of the main feeding vessels. Although this method has proven to be highly beneficial, it has several disadvantages. Catheterization of multiple feeding arteries is time consuming, and embolizations are frequently incomplete due to inability to catheterize certain feeding arteries (with unfavorable angles of origin, small caliber or excessive tortuosity) or early reflux along the microcatheter which precludes further penetration within the tumor parenchyma. Finally, there is an increased risk of inadvertent embolization into the cerebral circulation due to the presence of dangerous extracranial-to-intracranial anastomoses. Thus, devascularization via direct tumoral puncture has been proposed. In 1994, Piérot et al. and Casasco et al. independently described embolization of various head and neck tumors via direct puncture (1-2). In addition to avoiding the previously described disadvantages of transarterial embolization, direct puncture appears to achieve greater degrees of tumor penetration. Elhammady et al found that transarterial embolization frequently did not result in intratumoral penetration of the embolic material, and this lack of penetration precluded effectiveness of the embolization in terms of reducing intraoperative blood loss, despite the angiographic appearance of devascularization from pedicular occlusion (3). Another theoretical advantage of embolization via direct tumoral puncture is the reduced likelihood of inadvertent embolization through extracranial-intracranial anastomoses or penetration of nutrient vessels feeding cranial nerves. However, the operator must remain vigilant to avoid inadvertent transtumoral embolization of intracranial arteries which has been reported with direct puncture (4).

Embolic Agent: since the first descriptions by Piérot and Casasco (1-2), there have been several reports of direct intratumoral embolizations most of which have been performed with either n-butyl cyanoacrylate (NBCA) or polyvinyl alcohol (PVA) (4-5).

DISCUSSION

The use of Onyx for direct tumor embolizations has not been well documented and is largely limited to case reports. Onyx, an ethylene vinyl alcohol copolymer, is a relatively new liquid embolic agent that was initially approved by the FDA in 2005 for the treatment of cerebral arteriovenous malformations. Successful use of Onyx in cranial and spinal arteriovenous malformations and fistulas has fostered interest in its use for tumor embolization (3, 6-7). The benefits of Onyx over NBCA have been well described, and are primarily due to the slower precipitation properties of Onyx (6) which allows deep penetration within the tumor vasculature. Furthermore, the injection may be interrupted several times during the procedure to allow assessment of the embolization pattern and early recognition of dangerous intracranial anastomoses. Although particulate embolics such as PVA and Embospheres (Guerbet Biomedical, Louvres, France) are inexpensive and may achieve penetration within the tumor capillary bed, they have several distinct disadvantages when compared to Onyx. Particulate embolics are radiolucent and require contrast solution to indirectly determine the extent of tumor embolization, adding to the overall contrast load during the procedure. Furthermore, the particles dissipate over time allowing revascularization of the tumor if tumor resection is not achieved in a timely fashion. Finally, we have found embolizations using particles more time consuming when compared to liquid agents.

Surgical resection of carotid body and vagal paraganglioma tumors may be aided by pre-operative percutaneous embolization with Onyx. Previous reports have suggested that tumor borders are obscured by pre-operative embolization (8), but this was not noted as an issue during our resections. The two patients who had high blood loss were expected, since carotid body tumors were invading the carotid artery, thus necessitating ligation or repair after excision. No differences in ease of resection based on mean time to surgical resection after embolization were noted. Larger series are necessary to determine whether embolization with Onyx provides measurable clinical benefit.

CONCLUSIONS

Embolization of hypervascular head and neck tumors with Onyx via direct tumoral puncture can be performed safely and efficiently. Larger series are needed to determine if the improved tumor penetration achieved with direct puncture translates into clinical benefit.

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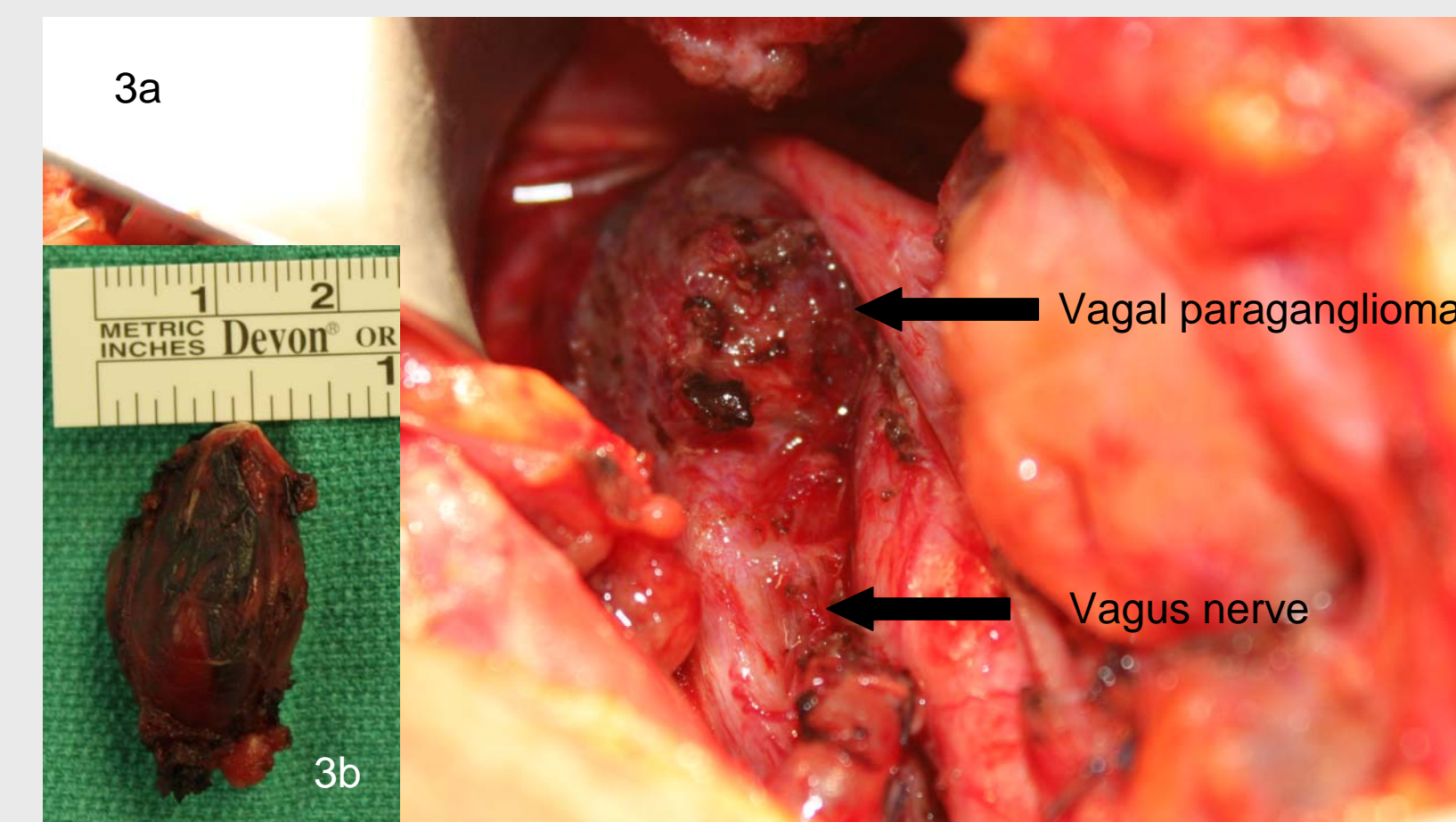


Figure 3a and 3b. Resection of a vagal paraganglioma.