Preoperative Embolization of Juvenile Nasopharyngeal Angiofibromas: Transarterial Versus Direct Tumoral Puncture

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Key words
- Direct tumoral puncture
- Juvenile nasopharyngeal angiofibromas
- Onyx
- Transarterial embolization

Abbreviations and Acronyms
DMSO: Dimethyl sulfoxide
DTP: Direct tumoral puncture
JNA: Juvenile nasopharyngeal angiofibromas
NBCA: *n*-butyl cyanoacrylate
TA: Transarterial

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OBJECTIVE: **Preoperative embolization of juvenile nasopharyngeal angiofibromas (JNA) has been shown to reduce operative times and blood loss. Although traditional transarterial (TA) embolization is commonly used, direct tumoral puncture (DTP) has also been advocated as an alternative. We report our series of JNAs embolized with Onyx and compare the two embolization techniques.**

METHODS: **We retrospectively reviewed all JNAs embolized with Onyx at our institution during a 20-month period. The fluoroscopy time, percent of tumor devascularization, periprocedural complications, and intraoperative blood loss were compared between the two groups.**

RESULTS: **A total of 10 patients with JNA underwent preoperative embolization by a TA route ($n = 5$) or DTP ($n = 5$). Mean fluoroscopy time was 50 and 39 minutes in the TA and DTP groups, respectively. The mean percent tumor devascularization in the TA group was 77% compared with 93% in the DTP group. Intraoperative estimated blood loss in tumors embolized transarterially was higher than those embolized by DTP (862 mL vs. 412 mL); however, this difference did not reach statistical significance. There were no neurological complications related to the embolization procedures in either group.**

CONCLUSIONS: **Embolization of JNAs with Onyx can be performed safely by either method. Direct puncture is associated with shorter embolization procedure times and results in a greater degree of tumor devascularization. Although there was a trend toward lesser blood loss in patients embolized by DTP, it did not reach statistical significance in this small series. Larger series are needed to determine whether the improved tumor penetration achieved with DTP translates into clinical benefit.**

INTRODUCTION

Juvenile nasopharyngeal angiofibromas (JNA) are the most common tumor of the nasopharynx, accounting for approximately 0.05% of all head and neck neoplasms (12). Although several treatment modalities have been used during the past century (1), surgical removal is widely accepted as the primary mode of therapy (15, 18). JNAs are highly vascular lesions, and their excision is frequently accompanied by significant intraoperative blood loss. Preoperative tumor embolization has, therefore, been proposed as an attempt to minimize surgical blood loss (6, 18, 24). Although traditional transarterial (TA) embolization is commonly used, direct tumoral puncture (DTP) has also been advocated as an alternative. We report our series of JNAs embolized with Onyx (ethylene vinyl alcohol copolymer, EV3 Micro Therapeutics Inc.; Irvine, California, USA), and compare the two embolization techniques.

MATERIALS AND METHODS

Embolization Technique

All embolizations were completed in a single session. Percutaneous femoral arterial access was obtained in all patients. Pre-embolization angiograms were performed and analyzed to determine the extent of tumor blush, feeding arteries, draining veins, and extracranial-to-intracranial anastomoses. Embolizations were carried out with Onyx 18 (lower viscosity) alone or in combination with Onyx 34 (higher viscosity).

TA Embolization

Procedures were performed under general anesthesia or with intravenous conscious sedation. Patients were heparinized to maintain activated clotting times between 250 and 300 seconds. A 6 Fr Envoy (Cordis; Miami Lakes, Florida, USA) guide catheter was maneuvered into the appropriate external carotid artery, and the feeding vessels were selectively catheterized with either an Echelon or Marathon microcatheter (EV3 Inc.; Irvine, California, USA). Angiography was performed through the microcatheter to assess the degree of tumor vascularity supplied by the individual pedicle and to identify potentially dangerous anastomoses. To initiate embolization, the microcatheter dead space was first slowly filled with dimethyl sulfoxide (DMSO), and then Onyx was slowly injected through the microcatheter while viewing a subtracted

roadmap. A reference angiogram of the tumor was used to ensure the embolic material remained within the confines of the tumor vascular blush. If the Onyx was seen traveling to an undesirable area, the injection was interrupted for one to two minutes. In most instances the Onyx could be redirected into another region of the tumor once the injection was started. Angiograms through the diagnostic catheter were intermittently performed to assess the extent of embolization. Embolization was continued until the desired degree of tumor penetration or the maximal degree of Onyx reflux along the microcatheter was achieved. Suction was then applied using a 1-mL Onyx syringe, followed by withdrawal of the microcatheter. Embolization of other feeding pedicles was then carried out in a similar manner. A final postembolization arterial angiogram was performed to assess the degree of tumor devascularization followed by an ipsilateral cerebral arteriogram to ensure that there was no inadvertent embolization into the cerebral vasculature.

Direct Tumoral Puncture

All embolizations were carried out after induction of general anesthesia. A single dose of preoperative antibiotics was administered because of the theoretical but low risk of infection from nasal flora (2, 10). A 5 Fr diagnostic catheter was used to obtain a pre-embolization angiogram. The tumor was then localized using a 5-mm zero degree rigid endoscope (Karl Storz, Germany), which was introduced either endonasally or intraorally. All percutaneous injection instruments were tested with DMSO ex vivo and confirmed to be DMSO compatible before use in this series. Under direct vision, an 18-gauge spinal needle (Portex Inc.; Keene, New Hampshire, USA), pretested for DMSO compatibility (by the authors), was inserted into the tumor. The needle was subsequently advanced to the center of the lesion under fluoroscopic roadmap guidance. Once intratumoral access was achieved, the hub of the spinal needle was connected to a 20-cm leur lock extension tubing (B. Braun; Melsungen, Germany). An intratumoral angiogram was performed through the needle to confirm the position of the spinal needle within the tumor and to 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. Occasionally in large heavily vascularized tumors, the needle was redirected under roadmap guidance into a different region of the tumor to allow a more thorough penetration of Onyx. Embolization was continued until the desired degree of tumor penetration was achieved. A final postembolization TA angiogram was performed to assess the degree of tumor devascularization, followed by an ipsilateral cerebral arteriogram to ensure that there was no inadvertent embolization into the cerebral vasculature.

Data Collection and Analysis

We retrospectively reviewed all JNAs embolized with Onyx at our institution during a 20-month period. The fluoroscopy time, percent of tumor devascularization, periprocedural complications, and intraoperative blood loss were compared between JNAs embolized transarterially and by DTP. The percentage of tumor devascularization was then determined by tracing the pre-embolization and postembolization tumor blush using ImageJ software (version 1.410 NH; Bethesda, Maryland, USA). The ratio of postembolization-to-pre-embolization tracing in pixels was then calculated.

RESULTS

A total of 10 patients with JNAs underwent preoperative embolization by a TA route ($n = 5$) or DTP ($n = 5$). All procedures were performed under general anesthesia except for two TA embolizations performed with intravenous conscious sedation. Of the five patients who underwent TA embolization, a total of eight vessels were selectively catheterized. Onyx 18 was used in all but one tumor, which was embolized with both Onyx 18 and Onyx 34. The average amount of Onyx used in patients embolized transarterially was 0.8 mL compared to 7.1 mL in patients embolized by DTP. The mean fluoroscopy time was 50 and 39 minutes in the TA and DTP groups, respectively. The mean percent tumor devascularization in the TA group was 77% compared with 93% in the DTP group. Patients were further divided into tumors with or without intraparenchymal penetration based on whether the Onyx material reached the tumor capillary bed or remained in the feeding arterial pedicle. Significant intraparenchymal penetration of embolic material was possible in all percutaneously embolized tumors and in none of the tumors embolized by a TA route. There were no neurological complications related to the embolization procedures in either group. There were no cases of inadvertent embolization of the parent arteries or development of symptomatic postembolization tumor swelling. One patient in the TA group developed a 1-cm area of superficial skin ischemia over the buccal region; however, at 3 months, the area had resolved with residual pigmentation due to the Onyx. The mean time to surgical resection after embolization was 2.2 days (range 1–4 days). All resections were performed using an endoscopically assisted transnasal approach. Complete resection was possible in all patients. Intraoperative estimated blood loss in tumors embolized transarterially was higher than those embolized by DTP; however, this difference did not reach statistical significance (862 vs. 412 mL, Mann-Whitney test: two-tailed P value = 0.3429). Similarly there was no significant difference in length of hospital stays between the treatment groups. Five patients (3 TA, 2 DTP) developed transient facial numbness in the V-2 distribution, which had completely resolved at two-month follow-up.

Illustrative cases

TA embolization. A 16-year-old male teenager with a history of nasal obstruction and epistaxis was found to have a JNA. Diagnostic angiogram demonstrated a tumor blush fed by branches of the right internal maxillary artery, the artery of foramen rotundum, the mandibulovidan artery, and an aberrant artery from the cervical internal carotid artery (**Figure 1A**). TA embolization of the three major feeding pedicles was performed using Onyx 18 without significant penetration of the tumor capillary bed. Final angiogram demonstrated 70% tumor devascularization (**Figure 1B–D**). An uneventful resection was performed the following day.

Direct tumor puncture. A 13-year-old male teenager who presented with nasal congestion was found to have a JNA. The patient underwent a diagnostic angiogram, demonstrating a highly vascular tumor fed by