

# Preoperative Tumor Embolization



Ramsey Ashour, MD<sup>a,\*</sup>, Ali Aziz-Sultan, MD<sup>b</sup>

## KEYWORDS

- Embolization • Onyx • NBCA • Meningioma • Glomus tumor • Juvenile nasal angiofibroma
- Carotid body tumor • Spinal tumor

## KEY POINTS

- Preoperative endovascular tumor embolization can be used to decrease overall blood loss; to improve visualization at surgery thus facilitating tumor resection; and/or to selectively occlude deep, inaccessible arterial feeders to the tumor.
- Liquid embolic agents (eg, Onyx or NBCA) are the first-line choices for preoperative tumor embolization if distal selective arterial microcatheter access to the tumor is possible; otherwise, particle embolic agents (eg, PVA) can be used.
- Direct tumor puncture with subsequent tumor embolization is an alternative to traditional transarterial embolization for selected tumor types and locations, avoids the need for multiple vessel catheterizations to achieve tumor devascularization, and more reliably achieves intraparenchymal tumor penetration of the liquid embolic agent, which has been suggested but not proven to reduce blood loss at surgery.

## INTRODUCTION

Endovascular surgery has emerged as an important tool in the treatment of a variety of hypervascular head, neck, and spinal tumors. Although the concept and first use of tumor embolization date back several decades, recent improvements in catheter design, enhanced angiographic imaging capabilities, and the development of novel embolic agents have all combined to make endovascular intervention safer, easier, and thus more commonly used in the management of selected tumors. However, deciding when and how to use endovascular therapy requires careful consideration of multiple patient- and tumor-related factors to achieve the greatest benefit while minimizing the risk of potentially dangerous complications, which may occur during or after embolization. Embolization can be used in select cases as a primary

therapy to reduce tumor-related pain, prevent tumor progression, or stop acute tumor-related hemorrhage. This article focuses on preoperative elective tumor embolization, which is used to decrease blood loss and to facilitate surgical resection.

## GENERAL PRINCIPLES

### *Indications*

We are increasingly referred patients with a variety of tumors for consideration of preoperative embolization. In such cases, an *a priori* suspicion exists that the tumor is hypervascular, based on the tumor type, radiographic imaging, or possibly after a biopsy or attempted surgical resection at which time profuse bleeding was encountered. From an anatomic or technical standpoint, if embolization is deemed unfeasible or poses very high risk to a

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<sup>a</sup> Department of Neurological Surgery, Lois Pope LIFE Center, University of Miami Miller School of Medicine, 1095 Northwest 14th Terrace, 2nd Floor, (D4-6), Miami, FL 33136–1060, USA; <sup>b</sup> Department of Neurosurgery, Brigham & Women's Hospital, 75 Francis Street, PBB-311, Boston, MA 02115, USA

\* Corresponding author.

E-mail address: [rashour@med.miami.edu](mailto:rashour@med.miami.edu)

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patient, it obviously should not be attempted. However, more commonly, the relevant question is not whether embolization is feasible but rather whether it is necessary. It is important to recognize that tumor hypervascularity alone is not a good reason to subject the patient to the added risk of preoperative embolization, particularly if the tumor is small, the major blood supply to the tumor is superficial or readily accessible early at surgery (as in most meningiomas), and/or if the extra blood loss anticipated without embolization is not excessive and would be physiologically well-tolerated by the patient. However, if substantial blood loss is anticipated without embolization beyond what would be medically acceptable in a given patient harboring a sizable tumor in a difficult surgical location with numerous deep, surgically inaccessible arterial feeders, the appeal of embolization becomes readily apparent. Embolization to devascularize a tumor may also decrease procedural time, which certainly increases convenience to the surgeon, decreases anesthesia time for the patient, and may or may not reduce the total cost of treatment. Overall, the combined risks of embolization and surgery should be less than that of surgery alone to benefit the patient. In any given case, several factors may impact the decision to offer preoperative tumor embolization (**Box 1**).

### Embolic Agents

#### Particle embolic agents

A variety of agents have been used for tumor embolization including silk, gelatin sponge, fibrin glue, and gelatin spheres (**Box 2**). Particles, such as polyvinyl alcohol (PVA) or Embospheres (Guerbet Biomedical, Louvres, France), may be used to achieve distal tumor penetration when distal,

#### Box 1 Preoperative tumor embolization: relevant factors

Lesion size, location, vascularity, edema  
Surgical accessibility of arterial feeders  
Endovascular accessibility of arterial feeders  
Proximity of important vessels at risk during embolization  
Dangerous vascular collaterals and anastomoses  
Flow dynamics within lesion  
Atherosclerosis, great vessel tortuosity  
Medical condition, anesthetic risk  
Open surgical plan and associated risk

#### Box 2 Embolic agents used for preoperative tumor embolization

Embolic Agent	Indication
Onyx	Intraparenchymal penetration
NBCA	Distal feeding artery occlusion
Particle embolics (PVA, Embospheres)	Flow-directed embolization when unable to achieve distal feeding artery access

selective feeding artery catheterization is not possible. Smaller particles penetrate more deeply but carry a greater risk of inadvertent embolization of normal adjacent arterial feeders; choosing the particle diameter that maximizes the effectiveness of tumor embolization while minimizing the risk of nontarget embolization of adjacent vessels is an important step and requires experience with these agents. A major disadvantage of the particle embolic agents in current use is that they are radiolucent; therefore, the extent of tumor embolization must be determined indirectly by contrast injection. Furthermore, they have a tendency to dissipate over time, allowing for vessel recanalization before surgical resection if the embolization is performed too far in advance of the planned surgical procedure.

#### Liquid embolic agents

Although particle embolic agents remain widely used at many centers as first-line agents for tumor embolization, the use of liquid embolics, such as *n*-butyl cyanoacrylate (NBCA; Codman, Raynham, MA) and Onyx (Covidien, Mansfield, MA), has increased significantly in recent years. They allow for excellent tumor capillary bed penetration but require selective feeding artery catheterization with distal microcatheter placement. NBCA is a radiopaque liquid adhesive glue that polymerizes rapidly on contact with ionic substances, such as blood, and can be injected to achieve permanent vessel occlusion. NBCA can be mixed with varying amounts of Ethiodol to modify the rate at which it polymerizes and to customize the injection flow rate and depth during embolization, which is truly "more art than science." In general, however, NBCA injections must be performed rapidly and continuously and the microcatheter removed in a timely fashion. As injection time increases beyond a relatively short time window, the risk of microcatheter adherence to the glue cast or to the

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