The Role of Pre-operative Embolization for Intracranial Meningiomas: Lessons from a Contemporary Series

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Introduction

Preoperative embolization has been an option for adjunctive treatment of intracranial meningiomas for almost four decades, but remains utilized only in a minority of cases. Meningiomas are commonly supplied by branches of the ECA, which are easily accessible by selective microcatheterization. Branches of the ICA and pial feeders supplying the tumor may also be embolized, although these vessels are typically more difficult to access and are associated with a higher risk of parenchymal infarct. The potential advantages of preoperative embolization include decreased operative duration, reduced operative blood loss, and alteration of tumor consistency, all of which decrease the technical difficulty of surgical resection and increase the likelihood of achieving a more complete resection. However, embolization changes the histologic characteristics of meningiomas and carries with it the risk of procedural complications including large vessel dissection, microcatheter fracture, and unintended arterial or venous occlusion resulting in hemorrhagic or ischemic infarct.

Learning Objectives

Understand the efficacy, technical nuances, and limitations of preoperative embolization for intracranial meningiomas

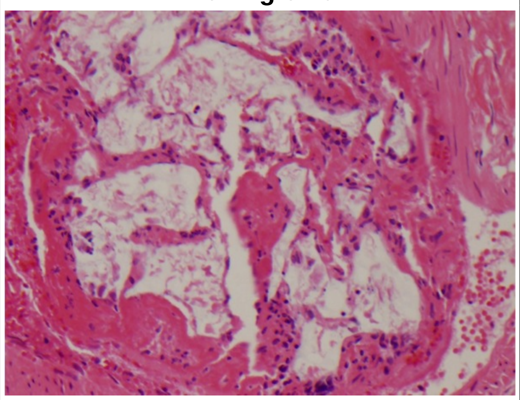
Abbreviations

EBL - estimated blood loss, ECA - external carotid artery, ICA - interntal carotid artery, IMA - internal maxillary artery, MMA - middle meningeal artery, OA - occipital artery, PVA - polyvinyl alcohol

Methods

Retrospective review of patients undergoing intracranial meningioma resection at UVA Hospital 03/2001-12/2012. Comparisons were made for embolized vs non-embolized patients, including method of embolization, complications, operative blood loss, and tumor characteristics. Statistical analysis was performed using chi-square and Fisher's exact tests.

Figure 1. Histopathology of Embolized Meningioma



Pathologic slide of embolized meningioma demonstrating PVA particles and tigroid pattern of intravascular embolization material and clot

References

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[2] Dowd CF et al. Neurosurg Focus 2003;15(1):Article 10
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Results

470 patients underwent resection of meningioma during the study period. 224 patients were referred for embolization, of which 174 patients received embolization. PVA particles were used alone in 67 (39%); together with Gelfoam pledgets in 75 (43.6%); with coil embolization in 26 (15.1%); and with both Gelfoam and coiling in 1 (0.6%). Coiling alone was used in 3 patients. Among the 177 embolized cases, MMA or branches were used most commonly for access (157 cases), followed by OA (21 cases), STA (14 cases), and IMA (14 cases). Following embolization, >75% tumor devascularization was achieved in 107 cases, with 50-74% embolization achieved in 27 cases, 25-49% in 12 cases and <25% in 10 cases. The mean time from embolization to surgery was 1.6 days (median: 1 day, range: 0-31 days).

Table 1. Embolization Characteristics

Referred for Embolization: 224
Successful Embolization: 177 (79.0%)
Mean time to Surgery (days, range): 1.6 (0-31)

Method of Embolization (%)
PVA: 67 (39.0)
PVA & Gelfoam: 75 (43.6)
PVA & Coil: 26 (15.1)
Coil (%)3 (1.7)
PVA & Gelfoam & Coil: 1 (0.6)

Embolized Vessel (%)
Middle meningeal: 157 (67.4)
Occipital: 21 (9.0)
Internal maxillary: 14 (6.0)
Superficial temporal: 14 (6.0)
Other: 27 (11.5)

Tumor Devascularization
>75%: 107 (68.6)
50-74%: 27 (17.3)
25-49%: 12 (7.7)
<25%: 10 (6.4)

No complications were seen in 97.1% of embolized patients; there were one case of stroke (0.6%) and two of dissection (1.1%). There were no significant differences in operative duration, extent of resection, or complications between the embolized and non-embolized groups. EBL at surgery was larger in the embolized group (410mL) than the non-embolized group (315mL, $p = 0.007$), but was attributable to difference in baseline patient and tumor characteristics as history of embolization was not a predictor of operative blood loss in multivariate analysis. Independent predictors of surgical blood loss included decreasing degree of tumor embolization ($p = 0.037$), skull base location ($p = 0.005$), and male gender ($p = 0.034$).

Conclusions

Preoperative embolization continues to be a valuable adjunct to surgical resection for selected intracranial meningiomas. In our series of embolized meningiomas, the degree of embolization was correlated with lower operative blood loss in multivariate analysis. The benefits of preoperative embolization appear to be similar to previously reported series, despite a shorter interval between embolization and surgery.

Preoperative angiography and embolization should be considered in the following situations:
1) Tumors >3-4cm in diameter, with at least 50% of supply to the tumor originating from accessible branches of the ECA
2) Tumors that appear hypervascular or have deep-seated vascular supply difficult to surgically access based on neuroimaging
3) Tumors without extensive calcification

Embolization should be considered on a case-by-case basis depending on imaging, location and patient-specific factors.