Preoperative endovascular embolization of meningiomas: update on therapeutic options.

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Abstract
In this review paper the authors analyze new therapeutic options for the embolization of meningiomas, as well as the future of meningioma treatment through recent relevant cohorts and articles. They investigate various embolic materials, types of meningiomas amenable to embolization, imaging techniques, and potential imaging biomarkers that could aid in the delivery of embolic materials. They also analyze perfusion status, complications, and new technical aspects of endovascular preoperative embolization of meningiomas. A literature search was performed in PubMed using the terms "meningioma" and "embolization" to investigate recent therapeutic options involving embolization in the treatment of meningioma. The authors looked at various cohorts, complications, materials, and timings of meningioma treatment. Liquid embolic materials are preferable to particle agents because particle embolization carries a higher risk of hemorrhage. Liquid agents maximize the effect of devascularization because of deeper penetration into the trunk and distal tumor vessels. The 3 main imaging techniques, MRI, CT, and angiography, can all be used in a complementary fashion to aid in analyzing and treating meningiomas. Intraarterial perfusion MRI and a new imaging modality for identifying biomarkers, susceptibility-weighted principles of echo shifting with a train of observations (SW-PRESTO), can relay information about perfusion status and degrees of ischemia in embolized meningiomas, and they could be very useful in the realm of therapeutics with embolic material delivery. Direct puncture is yet another therapeutic technique that would allow for more accurate embolization and less blood loss during resection.

KEYWORDS: ECA = external carotid artery; ICA = internal carotid artery; MMA = middle meningeal artery; NBCA = N-butyl cyanoacrylate; Onyx; PVA = polyvinyl alcohol; SW-PRESTO = susceptibility-weighted principles of echo shifting with a train of observations; biomarkers; direct puncture; embolization; meningioma; therapeutics

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