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Balloon-assisted embolization of skull base meningioma with liquid embolic agent

Technical note

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The authors report a novel technique of balloon-assisted embolization of a skull base meningioma supplied by a branch of the cavernous segment of the internal carotid artery using liquid embolic agent. A temporarily inflated balloon distal to the meningioma's feeding vessel may improve the access to this small branch and may reduce the chances of unintended reflux during delivery of the liquid embolic agent. *(DOI: 10.3171/2008.11.JNS08175)*

Key Words • skull base • meningiomas • preoperative embolization • inferlolateral trunk

Although preoperative embolization of convexity meningiomas remains controversial, this procedure is useful in some cases because it makes the tumor softer and less bloody and thus easier to remove at surgery.[3] Blood supply to meningiomas usually comes from branches of the external carotid artery, but in cases of meningiomas of the skull base, supply might come via the meningohypophyseal trunk or the ILT of the cavernous segment of the ICA.[4] Preoperative embolization of these small and tortuous branches is often difficult and dangerous and carries a significant risk of stroke from reflux of embolic material to the ICA territory.[8]

To prevent this complication, we performed a balloon-assisted embolization of a giant left anterior clinoid meningioma mainly supplied by a dilated ILT, using a liquid embolic agent. To our knowledge, the utility of a temporarily inflated balloon and liquid embolic agent have not been previously reported in preoperative embolization of skull base meningiomas.

Technique and Illustrative Case

This 48-year-old patient presented with gradual reduction of visual acuity of the left eye and headache. Magnetic resonance imaging revealed a 5-cm large skull base meningioma centered on the left anterior clinoid process, engulfing the terminal bifurcation of the ICA (Fig. 1A). Digital subtraction angiography with 3D rotational acquisition showed main blood supply via a dilated ILT, which seemed suitable for catheterization (Fig. 1B and C). Subsequent embolization was conducted after induction of general anesthesia and administration of adequate heparin anticoagulation therapy, with a 6 Fr guiding catheter left in the ICA (Envoy, Cordis Neurovascular, Inc.). Our initial intention was to embolize with ethylene vinyl alcohol copolymer (Onyx, Micro Therapeutics, Inc.), whose viscoelastic properties permit improved control of the progression of the embolic agent. Catheterization was unsuccessful using several Onyx-compatible catheters (1.3 Fr Marathon, 1.5 Fr Ultraflow, 1.7 Fr Echelon 10, Micro Therapeutics, Inc.) mounted on different microguidewires (Mirage 008, Micro Therapeutics, Inc.; Synchro 10, Boston Scientific Corp.; and Terumo 0.012, Terumo Corp.), so the idea of using Onyx was abandoned. We then switched to a flow-directed microcatheter (1.2 Fr Magic, BALT Extrusion) to inject modified acrylic glue (Glubran 2, GEM Srl). We also adopted a novel idea of temporarily inflating a balloon (Hyperglide 4 × 10 mm, Micro Therapeutics, Inc.) in the cavernous ICA, distal to the ILT, for 2 reasons: 1) to act as a point of support to the catheter and thus to be able to catheterize and navigate through the inferiorly directed ILT (Fig D); and 2) for safety while injecting the liquid embolic agent. By occluding the cav-

Abbreviations used in this paper: ICA = internal carotid artery; ILT = inferolateral trunk.

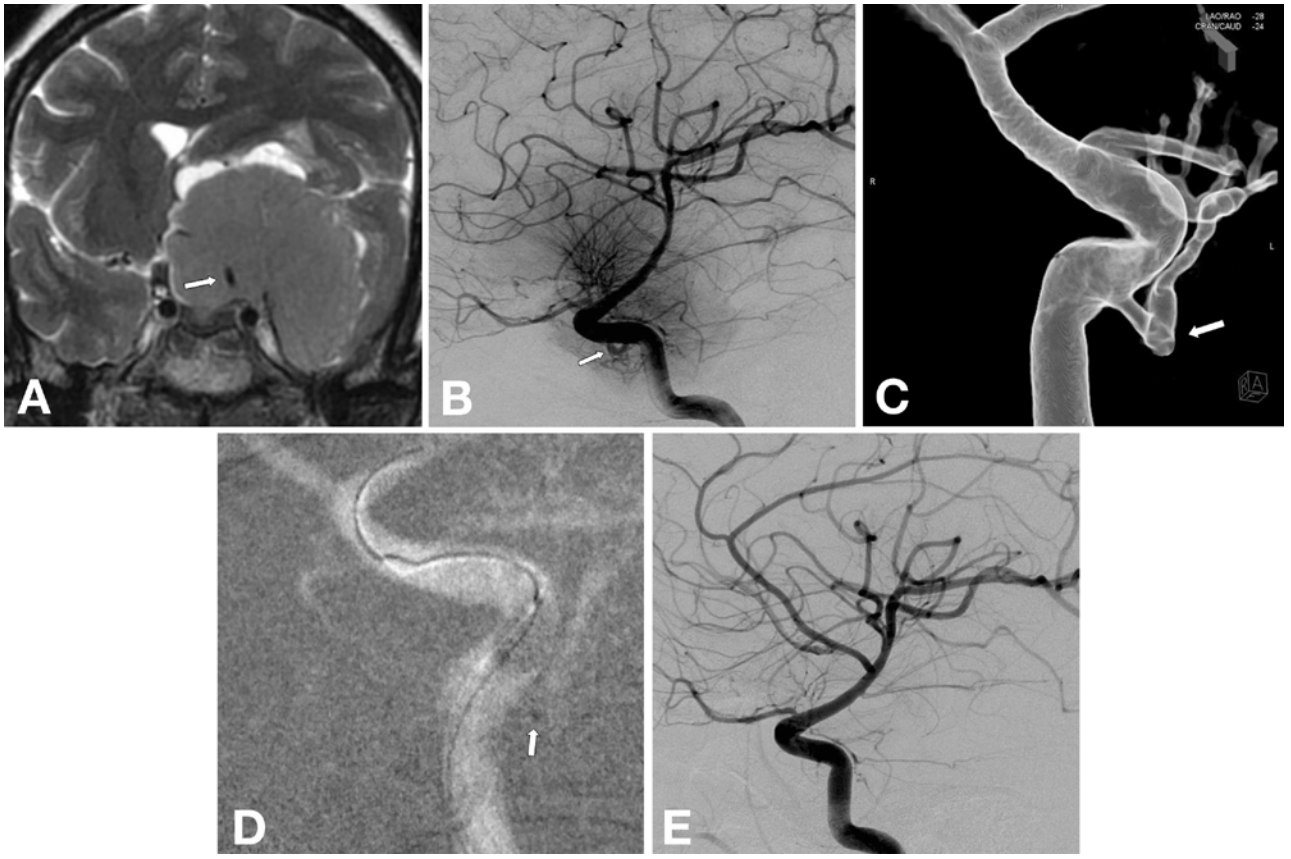

Fig. 1. A: Coronal T2-weighted MR image showing a large left anterior clinoid meningioma, encasing the terminal portion of ICA *(arrow)*. B: Lateral view angiogram obtained in midarterial phase after left ICA injection showing dilated ILT *(arrow)* and the blush of the meningioma. C: Right oblique view 3D angiogram demonstrating the inferiorly directed origin of the dilated ILT *(arrow)*. D: Road map image in the working projection, similar to Fig. C, showing the temporarily inflated balloon distal to the origin of the ILT. Note the tip of the microcatheter *(arrow)* within the ILT. E: Lateral view angiogram obtained in midarterial phase after left ICA injection confirming near-complete disappearance of the blush of the meningioma.

ernous ICA distal to the ILT, we wanted to redirect the entire ICA flow toward the ILT and thereby diminish the risk of reflux of the liquid embolic agent back to the ICA and its cerebral branches. Thus, we achieved successful catheterization and under protection of the temporarily inflated balloon, we delivered 0.3 ml of a 25% solution of modified acrylic glue (Glubran 2) in iodized oil (Lipiodol, Guerbet) resulting in near-total reduction of the tumor blush (Fig. 1E). Subsequent resection was uncomplicated; total tumor resection was accomplished with minimal blood loss. The patient recovered fully after an uneventful postoperative course.

Discussion

Only a few studies address the feasibility and safety of direct selective catheterization and embolization of the small branches of the cavernous segment of the ICA in skull base meningiomas.[5,8] The primary problem remains the difficult access to these branches due to their small sizes, acute angle of origin, and geometric orientation relative to the ICA.[8] For cases in which the branch of interest is oriented inferiorly, as in our patient, some authors have proposed using a Simmons-like curve on a shapeable microguidewire. After forming the curve within the ICA, passing the wire beyond the target, the microcatheter is directed into the origin of the target vessel by withdrawing the wire.[8] Others have navigated the catheter through the contralateral ICA, then the anterior communicating artery for final retrograde catheterization of the ipsilateral ICA cavernous branch.[1]

In our case, direct catheterization was only achieved with the help of a temporarily inflated balloon in the cavernous ICA. The balloon gave mechanical support to the catheter and assisted entry into the ILT. Additionally, while inflated, it diverted the entire ICA flow to the ILT and helped the flow-directed catheter to advance farther within the ILT, to a safer and more stable position required for liquid embolic agent delivery.

The nature of the embolic material used in meningiomas is a second concern. Embolic particles are usually favored not only because of their relative ease of use, but also because the permanence of liquid adhesive is unnecessary in the preoperative setting.[4] For embolization of skull base meningiomas supplied by branches of the cavernous ICA, the use of particles[6,8] or coils has been reported.[7] The majority of authors remain conservative about using liquid embolic agents because of a possible risk of permanent cranial nerve injury if the agent reaches the vasa nervosum.[2] Aware of this potential hazard, and

weighing the expected benefits of embolization of a 5-cm meningioma engulfing the ICA, we cautiously undertook this embolization. Our aim was to perform the embolization with a liquid embolic agent due to its superior visualization and control compared with particles, especially with respect to reflux. To the best of our knowledge, no other report of liquid embolic agent embolization of a meningioma supplied by the ILT exists. We effectively embolized the main trunk and the proximal meningiomatous vasculature with only 0.3 ml of liquid tissue adhesive, thus avoiding distal embolization of the vasa nervosum, possible cranial nerve injury, or opening of anastamoses. Overall, we were concerned about the potential damage from reflux of liquid agent into the ICA. By inflating the balloon distal to the ILT, we directed the entire ICA flow into the ILT, creating a flow pattern that would theoretically prevent the carefully delivered liquid embolic agent from refluxing in the ICA.

Conclusions

Balloon-assisted preoperative embolization of skull base meningiomas supplied by the cavernous branches of the ICA may provide improved vascular access and redirect ICA flow toward the lesion's feeders, thus reducing the chances of unintended reflux embolization during liquid embolic agent delivery.

Disclaimer

The authors report no conflict of interest concerning the materials or methods used in this study or the findings specified in this paper.

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