Embolization of a giant pediatric, posttraumatic, skull base internal carotid artery aneurysm with a liquid embolic agent

Case report

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Many endovascular treatments for posttraumatic, skull base aneurysms have been described, but embolization with a liquid embolic agent is a new approach that has not been described as an option in this situation. Liquid embolization appears to have the advantage of more complete volumetric filling, reduced recanalization rates, and lower expense compared with coil embolization or stent-assisted coil embolization. Ethylene vinyl alcohol copolymer mixed with tantalum and dissolved in dimethyl sulfoxide (Onyx HD 500, ev3 Neurovascular) is a liquid embolic agent that has recently received Humanitarian Use Device FDA approval for the treatment of wide-necked, side-wall intracranial aneurysms.

We present the case of a 12-year-old girl who presented with a right-side Horner syndrome caused by a 33 × 19–mm internal carotid artery aneurysm at the C-1 level. On the basis of our previous experience and recent studies, we felt treatment with a liquid embolic agent would result in less morbidity compared with surgery and was less likely to cause occlusion or significant stenosis of the parent artery compared with placement of a covered stent, especially in a smaller artery in a pediatric patient. The use of liquid embolic agents also appear to be associated with a lower chance of recanalization and lower cost compared with stent-assisted coil embolization.

This is the first report of using a liquid embolic agent for treatment of a giant, posttraumatic, skull base aneurysm in pediatric patients.

Case Report

History and Examination. Approval was obtained by the Vanderbilt Institutional Review Board for this retrospective clinical study. The patient was a 12-year-old girl who had been involved in an all-terrain-vehicle accident 8 months prior to presentation. At that time she suffered a mandibular fracture requiring surgical repair. One week
after the accident she noticed that her left pupil was larger than the right pupil. She also noticed after physical activity that only the left side of her face became flushed. She ultimately presented to an ophthalmologist who noted a miotic right pupil and right-side ptosis.

Diagnostic Imaging. A CT angiogram of the neck was performed and the aneurysm was noted, prompting referral to our clinic (Fig. 1). The aneurysm measured 33 mm in the craniocaudal direction and 19 mm in the transverse direction. The patient then underwent diagnostic angiography and BTO, which she successfully passed, in preparation for treatment (Fig. 2). The reason for the BTO was that this case was early in our experience, and the results provided confidence in our options for treatment—specifically, whether CA sacrifice could be considered as an option if the primary treatment plan failed. The BTO was performed with a pediatric anesthesiologist titrating a dexmedetomidine hydrochloride (Precedex, Hospira, Inc.) infusion to allow for a reliable neurological exam every 5 minutes for a total of 30 minutes.

Operation. Prior to the operation, the patient received loading doses of aspirin and Plavix. On the day of the procedure, the patient was taken to the Children’s Hospital operating room, where general anesthesia was induced. After femoral artery access was obtained, a 6 Fr Shuttle Sheath guiding catheter (Cook, Inc.) was inserted and heparin was administered to achieve an activated clotting time > 250 seconds. Next, the aneurysm was embolized with 9 cc of Onyx HD 500 delivered over multiple cycles. Each cycle consisted of 2 minutes of Onyx injection through a Rebar 14 microcatheter (ev3) with parent artery balloon occlusion via a 4 × 30–mm Hyperglide balloon (ev3), followed by 3 minutes of Onyx cast solidification with the balloon inflated, and then 2 minutes of cerebral reperfusion with the balloon deflated (Fig. 3). The total time of the procedure was 392 minutes. At the conclusion, the patient was extubated. No new neurological deficits were observed.

Postoperative Course. The patient was monitored in the pediatric intensive care unit overnight and discharged the following day. Treatment with aspirin and clopidogrel was maintained for 3 months, after which both medications were discontinued. A 1-year follow-up angiogram revealed stable occlusion of the aneurysm with no recanalization or aneurysm regrowth (Fig. 4). Clinically, the
Liquid embolic for treatment of giant skull base aneurysm

The patient did not demonstrate any neurological decline postoperatively. At 3 months’ follow-up there was no change in the Horner syndrome. At 18 months’ follow-up there was significant improvement in the anhydrosis and miosis, with resolution of the ptosis.

Discussion

Treatment of giant posttraumatic, skull base CA aneurysms is controversial because the rate of rupture is unknown. Rupture of this type aneurysm has been reported and likely is associated with a very high morbidity and mortality rate.3,5 Rupture of a giant cervical/skull base aneurysm can cause rapid compression of the trachea and airway obstruction.

Surgical repair of high-cervical skull base aneurysms is technically challenging because of the skull base dissection and need for disarticulation of the mandible. Several different approaches to endovascular treatment of high-cervical skull base aneurysms have been reported, including coil embolization, stent-assisted coil embolization, and placement of a covered stent.3–5,9,11

Coil embolization can only fill a maximum of ~ 30% of the aneurysm volume and adding stent assistance can increase this to ~ 45%. Liquid embolic agents have the potential to completely fill the aneurysm volume and therefore offer the possibility of decreased recanalization.

Embolizing a giant aneurysm with coils can be extremely expensive. Filling an aneurysm of this size with coils could cost up to $100,000 depending on the type of coils used. Additionally, there is a very high risk of recanalization in giant aneurysms, reported to be as high as 90% in some series.7 The cost of Onyx in this case was $41,965 ($5995 × 7 vials), which is less than the estimated cost of coils needed to treat similarly sized intracranial aneurysms with coils at our institution.

Wolfe et al.11 recently reported treating a similar aneurysm with a covered stent. This method is both quick and effective. Nonetheless, we felt a liquid embolic agent was preferable for 2 reasons. A covered stent is unlikely to ever endothelialize, and therefore lifelong antiplatelet therapy is often recommended.11 This is less of a concern when using Onyx, for which there is some evidence to suggest that endothelialization may occur.10 For similar reasons, liquid embolic agents likely entail less risk of CA stenosis or occlusion long term, outcomes that are of serious concern when treating pediatric patients because of the reduced diameter of the CA and relatively longer life expectancy in this population.

There are several disadvantages to using Onyx for embolization of posttraumatic, skull base aneurysms in pediatric patients. Unlike coils, liquid embolic agents cannot be retracted if the placement is not ideal. Second, the use of Onyx requires balloon protection and therefore potentially

Fig. 3. Lateral unsubtracted angiogram obtained near the completion of embolization showing Onyx filling most of the aneurysm, the balloon in the parent vessel (deflated), and the microcatheter entering the aneurysm neck. The balloon microwire can be seen traveling up the petrous CA.

Fig. 4. One-year follow-up subtracted lateral angiographic view showing continued occlusion of the aneurysm with preserved parent vessel flow.
a larger-diameter guide catheter, which can be an issue for pediatric patients who have smaller diameter arteries. Third, the relative inexperience of most interventionalists with liquid embolic products for aneurysm embolization is likely to increase the time required for the procedure, especially during the first 10 cases. Since the procedure described in this case report, we have gained more experience and the average duration of aneurysm embolization with liquid embolic agents has dropped to ~ 100 minutes.

Conclusions

Liquid embolic agents can be used as a safe, efficacious, and cost-effective approach to treatment of selected aneurysms in pediatric patients, including posttraumatic, skull base CA aneurysms.

Disclosure

Dr. Mericle performs physician training courses and physician proctoring for Onyx HD 500 aneurysm treatment for which he receives payment from ev3.

References


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