

E-032

PREOPERATIVE EMBOLIZATION OF SPETZLER MARTIN GRADE 3 ARTERIOVENOUS MALFORMATIONS: A MULTI-CENTER PROPENSITY ADJUSTED ANALYSIS

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Background Spetzler Martin (SM) grade 3 arteriovenous malformations (AVMs) are challenging lesions, often treated with preoperative embolization before definitive microsurgical resection. However, no significant difference in outcomes has been reported in patients with preoperative embolization for these lesions.

Objective To compare neurological outcomes of microsurgically treated SM grade 3 AVMs with vs without preoperative resection.

Methods A retrospective analysis of prospectively collected AVM databases from two large tertiary centers for all microsurgically treated SM grade 3 AVMs during 2011–2018 was performed. Comparison of neurological outcome (modified Rankin Scale score [mRS] >2 and change in mRS on last follow-up) between patients with vs without preoperative embolization was performed.

Results Of 102 patients with microsurgically treated SM grade 3 AVMs, 57 (56%) underwent preoperative embolization. Significant differences between patients with vs without embolization were found for eloquence (75% vs 93%, $p=0.02$), diameter ≥ 3 cm (53% vs 27%, $p=0.01$), diffuseness (7% vs 22%, $p=0.04$), and mean follow-up mRS (1.1 vs 2.0, $p=0.005$). A higher percentage of patients without embolization (38%) than with embolization (7%) had an mRS >2 on follow-up ($p<0.001$). A propensity-adjusted analysis matching for age, supplemental grade, hemorrhage, diffuseness, deep drainage, diameter, eloquence, and location was performed, and no embolization (odds ratio, 4.2; 95% confidence interval, 1.1–16; $p=0.03$) was a risk factor for an mRS score >2.

Conclusion Lack of preoperative embolization in SM grade 3 AVMs may be associated with increased risk of poor outcome following microsurgical resection. Hence, evaluation for preoperative embolization is essential for all intermediate-grade lesions.

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E-033

TRANSVENOUS EMBOLIZATION FOR VEIN OF GALEN MALFORMATION USING THE PRESSURE COOKER TECHNIQUE

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Background There are various procedural techniques described in the literature to treat VGAM, including transarterial embolization via a transfemoral or transumbilical approach, transfemoral or transtorcular venous coiling, and

the combined transarterial and transvenous ‘trapping’ of the fistula. The transarterial technique has permitted us to get a total or near total obliteration in close to 80% of cases. However, there is a group of patients in whom the residual arterial supply is through small perforators and in whom transvenous embolization (TVE) is attractive, but safety is unclear. Here, we report the first two VGAM patients treated using the Chapot ‘pressure cooker’ technique (CHPC).

Materials and Methods Two patients, one 5 year old and one 7 year old, were treated beginning in the newborn period with multiple, staged, transarterial embolizations for a choroidal type VGAM using transarterial embolization with NBCA. Initial indication was congestive heart failure, and the goal was progressive reduction in shunting and flow with the ultimate goal of complete closure of the malformation. Both patients progressed to having a small residual with numerous, small perforator feeders. Therefore the decision was made to perform transvenous embolization using the CHPC. In this technique, a guiding catheter is placed transjugular into the straight sinus. 1 or 2 detachable tip microcatheters are advanced into the remaining vein to its origin. Another microcatheter is advanced and the tip placed between the distal marker and the detachment zone of the first. Coils, and if needed NBCA are used to prevent reflux of Onyx, and force the Onyx to occlude the vein, and the most distal segment of the arteries. Results: Both patients had complete occlusion of the malformation after CHPC.

Discussion There has not been any report before, about the TVE to cure the vein of Galen malformation after multiple sessions of TAE. In this study, two issues can be brought up. One, there is a chance to close the fistula completely or incompletely only using coils, even fiber coils. In addition there is the concern of impairing drainage of the normal brain. To improve these two issues, complete closure of the fistula using the Chapot ‘Pressure cooker’ technique with liquid embolic material in TVE, to close the residual vein, and to force the DMSO liquid embolic to close the incoming arterial supply, preventing delayed bleeding.

Conclusion In endovascular treatment of the vein of Galen malformation, TVE is feasible option, once the dilated vein of Galen becomes small enough. To prevent incomplete occlusion or post procedural hemorrhagic complication, the use of the Chapot ‘Pressure cooker’ technique using DMSO liquid embolic material is considered to be necessary.

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HIGH-RESOLUTION CONTRAST-ENHANCED CONE BEAM CT IN PLANNING OF ENDOVASCULAR TREATMENT FOR COMPLEX DURAL ARTERIOVENOUS FISTULAE

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Purpose Treatment of dural arteriovenous fistulae (DAVFs) is based on obliteration of the fistula via trans-arterial/transvenous approaches or a combination thereof. In complex cases it can be difficult to determine the fistulous point, and large segments of normal vascular structures are sacrificed to cure

the fistulae. High-resolution intraoperative contrast-enhanced cone beam CT (CE-CBCT) allows visualization of arteriovenous vascular structures and their relationship with bony structures and the dura. We present 2 cases of complex DAVFs in which CE-CBCT, by clearly showing the fistulous point, allowed a targeted treatment that avoided unnecessary venous sacrifice and maintained/restored functionality of normal venous structures.

Materials and Methods In two patients who presented with complex DAVFs, DSA was insufficient in clarifying the anatomy of the shunt. CE-CBCT was obtained on a last generation biplane Neuroangiography system infusing a 69 mL bolus (30% Visipaque 270) at a rate of 3 mL/second into the main arterial feeder (22 cm FOV; 23 second 200-degree rotation). High-resolution volumetric data generated was reconstructed using an FBP algorithm and post-processed on a dedicated workstation for final treatment strategy.

Results A 90-year-old man with progressively slurred speech, had a petrosal/tentorial Cognard 4 DAVF fed by multiple left ECA feeders. CE-CBCT demonstrated an enlarged draining petrosal dural venous pouch draining in the basal vein of Rosenthal. Access route to the pouch was planned on CE-CBCT reconstructions (Image A, dotted line), allowing selective occlusion with coils and Onyx with complete resolution of the DAVF and preservation of normal deep venous structures. The patient's symptoms resolved shortly following the procedure. The second subject, a 49-year-old man presented with debilitating right-sided pulsatile tinnitus, blurred vision and headaches. A DSA demonstrated a complex, Cognard 1 fistula of the right sigmoid sinus with innumerable external carotid artery (ECA) feeders and loss of drainage functionality of the right transverse-sigmoid sinus. CE-CBCT showed feeders converging in a dural venous pouch adjacent to the postero-lateral wall of the sigmoid sinus (Image B, stars). Similarly to prior case, a CE-CBCT-planned microcatheterization was performed with targeted obliteration of the pouch with coils and Onyx followed by DAVF resolution and restoration of normal antegrade venous flow. Tinnitus resolved, but blurred vision and headaches persisted. Venous pressure measurements demonstrated a 10-mmHg gradient across the narrowed

sigmoid sinus. Venous stenting led to complete symptom resolution.

Conclusion High-resolution CE-CBCT allows identification of fistulous connections in complex DAVFs and supports an accurate and minimally-destructive treatment with sparing of normal venous structures.

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E-035

3D ROTATIONAL ANGIOGRAPHY OF PERSISTENT TRIGEMINAL ARTERY ANEURYSM CONNECTING TO THE SUPERIOR CEREBELLAR ARTERY

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Introduction Carotid-Basilar Anastomoses were original described in London in 1844 by Quain's. They are named using the cranial nerves and there are different persistent fetal anastomoses between the carotid and basilar artery including the primitive trigeminal, otic (acoustic), hypoglossal, and pro-atlantal intersegment arteries.

Persistent trigeminal artery (PTA) is an anatomic anomaly that result of failure the trigeminal artery to regress. PTA is the most common of these that persist into adulthood. Uchino *et al*, reported an incidence of 0.76% in a study done with MR angiographic. Luh *et al*, described in 1999, these fetal anastomoses emerge at the 4 to 5 mm embryonic stage, persist for approximately one week, and regress by the time of posterior communicating and vertebral arteries develop. The first to disappear is the optic artery, followed by the hypoglossal artery, the trigeminal artery, and then the pro-atlantal intersegmental artery.

We present a patient in whom a variant of PTA aneurysm was incidentally found terminating in the superior cerebellar artery (SCA), Saltzman classification type IIIa.

Methods A review of the medical literature using standard search engines was performed to locate articles regarding