Method A 53-year-old male with a remote history of head trauma complicated by posttraumatic right cavernous carotid fistula presented with progressive headaches. He was treated at another facility via trans-superior ophthalmic vein coil embolization several years prior. CT angiography demonstrated recurrence with a complex fistula. Further investigation via cerebral angiogram demonstrated a type A direct high flow cavernous-carotid fistula with cortical venous drainage and multiple venous aneurysms.

Result The fistula was treated by R ICA deconstruction with coil and Onyx embolization after a balloon occlusion test. Follow up MRI after one year suggested a continued low-pressure fistula. He subsequently underwent cerebral angiogram which showed an indirect fistula, with feeders from ethmoidal arteries and branches of the internal maxillary artery. Outflow was through the sphenoparietal sinus. There was a direct fistula communication in between the posterior communicating artery and fistula outflow. Via the R PCommA, the fistula outflow was embolized using coils and Onyx with almost complete obliteration of the fistula and minimal to no reflux into the right posterior communicating artery. The patient did well postoperatively with complete resolution of headaches and was seen recently in clinic for 6 months follow up visit.

Conclusion We present a patient with carotid-cavernous arteriovenous fistula complicated by subsequent fistula between the posterior communicating artery and sphenoparietal sinus successfully endovascularly treated with complete obliteration of the fistula without reflux. To our knowledge, this is the first such report. We present this case to review the multiple challenges of managing complicated traumatic carotid cavernous arteriovenous fistula and to highlight the utility of endovascular intervention in their treatment.

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E-068

TREATMENT OF CAROTID-CAVERNOUS FISTULA PRESENTING WITH CONTRALATERAL EXOPHTHALMOS; SEVERAL EXPERIENCES OF GRAFT STENT

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Object Endovascular detachable balloon occlusion and coil occlusion have been well-established options for the treatment of carotid cavernous fistulas (CCFs). Sporadic treatment of CCFs endovascular covered stent grafting is recently proving an excellent result not only in successful treatment of fistula but also preserving patency of parent artery. In this study, we experienced CCF of a patient who underwent the contralateral exophthalmos in addition to 5 CCF with ipsilateral symptoms treated by graft stent.

Method A 64-year old female presenting with left-sided decreased vision, exophthalmos, injection, and periorbital bruit was found to have a right-sided carotid-cavernous fistula. In addition, we experienced 6 consecutive patients with CCFs underwent the graft stent placement alone at our department during 4 years. Two were direct CCFs with a symptom triad and 4 were indirect CCFs with diplopia or exophthalmos. These patients had periodic clinical follow-up examinations (at 0–29 months) with all receiving angiographic follow-up examination (at 0–15 months).

Results Covered stent placement was technically successful in all 6 patients. Immediate post-procedural complete exclusion of the fistula was achieved in 3 and near complete exclusion with small endo-leak was observed in 3 after stent placement. ICA patency was preserved in all. Symptoms related to CCFs regressed within 1–14 days in all patients after treatment without thromboembolic events. There was no mortality and no immediate post-procedural morbidity related to the procedure. Follow-up cerebral angiography showed complete

Patient sex / age (years)	Sings/symptoms	Stent sizes	Post-procedural angiographic results	Final angiographic FU
F/73	Proptosis, Visual disturbance	Graftmaster 3.5 X 16 mm	Radioanatomic cure without complications	Stable CCF occlusion with ICA patency
*M/28	Conjunctival injection, Mild proptosis	Graftmaster 4.5 X 16 mm	Small endoleak was observed	Stable CCF occlusion with ICA patency
*M/65	Proptosis, Visual loss	Graftmaster 4mm X 12 mm	Radioanatomic cure without complications	Stable CCF occlusion with ICA patency
M/58	Visual disturbance, bruit	Graftmaster 4.8 X 16mm	Radioanatomic cure without complications	Stable CCF occlusion with ICA patency

Abstract E-068 Figure 1

exclusion of 3 included the two with previous small endoleak. However, one who had complete exclusion immediately recur the filling during follow-up. This patient treated with re-dilation of the stent using balloon. Final follow-up angiography showed complete exclusion of all CCFs and revealed good stent patency of the ICA without intra-stent stenosis.

Conclusion Graft-stents should be considered as an alternative option of treating CCFs and preserving the parent artery by arterial wall reconstruction especially in patients with a fistula that cannot be successfully occluded with detachable balloons or coils. Although a larger sample and expanded follow-up are needed, our series shows that covered stents can be used in the treatment of CCFs with symptomatic relief as experience.

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E-069 SUPER-SELECTIVE FISTULA POINT COIL EMBOLIZATION FOR CAROTID-CAVERNOUS ARTERIOVENOUS FISTULA

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Background/Purpose Endovascular treatment of carotid-cavernous fistula (CCF) has evolved over the past two decades from using detachable balloons to Onyx and coil embolization. Nowadays, transvenous coil embolization is the mainstay of CCF management. Obliteration of the cavernous sinus with coils or liquid embolic agent can be time consuming and costly and potentially lead to cranial nerve injury. We report technical aspects and clinical outcome of a transvenous super-selective fistula point coil embolization.

Methods We retrospectively reviewed consecutive patients with CCF who were treated by a single operator in our institution from January 2016 to December 2018. Patients' demographics, type of CCF, endovascular embolization technique and clinical and angiographic outcome were analyzed. Super-selective fistula point embolization is a technique by which microcatheter exploration allows for definition of the fistula location within the cavernous sinus and targeted coiling at this point.

Results A total of 11 patients were identified. All patients had type D dural arteriovenous CCF. Fifty percent of the patients were female. The mean age ($\pm$ SD) of the patients were 61 $\pm$ 13 years. All patients were treated with transvenous super-selective coil embolization of the fistula point (figure-1). The inferior petrosal sinus was used to access the fistula point at the cavernous sinus and superior ophthalmic vein junction in 9 patients. In the remaining 2 patients, the facial vein was used to access the fistula point. Ten patients had complete fistula obliteration in the final angiographic run at the end of the embolization procedure. One patient had small residual fistula which was completely obliterated by further super-selective coiling during follow up angiography. No procedure related morbidity or mortality was observed. All 11 patients had complete resolution of their clinical symptoms. A total of 7 patients had follow up cerebral angiography and 3 patients had follow up MRI/MRA at the 6 to 12 month timepoint which were all indicative of complete obliteration of the CCF.

Conclusions Super-selective transvenous coil embolization of a focal fistula point in patients with CCF is safe and feasible and is associated with excellent durable clinical and angiographic outcome.

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E-070 CURATIVE TREATMENT FOR LOW GRADE ARTERIOVENOUS MALFORMATIONS

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Introduction Low grade, Spetzler Martin (SM) grade I and II arteriovenous malformations (AVM) are often considered safe for surgical resection or radiosurgery. The use of preoperative arteriography with endovascular embolization to reduce surgical risk in these AVMs remains controversial. The authors assessed the safety of combined treatment of SM I and II AVMs with preoperative embolization followed by curative treatment with surgical resection or radiosurgery. Long term functional outcomes were also studied.

Methods Under IRB-approved protocol, retrospective analysis was carried out on all patients with ruptured and unruptured SM I and II AVMs from 2002 to 2017 using a quality assurance database. Details of the endovascular procedures including arterial supply to the AVM, number of branches embolized, embolic agent(s) used, and complications were studied. Baseline clinical and imaging characteristics were compared, and functional status using the modified Rankin Scale (mRS) before and after endovascular and microsurgical/radiosurgery treatments were compared.

Results 258 SM I (36%) and II (64%) AVMs were identified (mean age 38.3 years). 48% of patients presented with hemorrhage, 21% with seizure, 16% with headache, 10% asymptomatic and 5% with a clinical deficit. 90 patients (68%) in the unruptured group and 74 patients (59%) in the ruptured group underwent presurgical embolization ($p = 0.0013$). The mean number of arteries supplying the AVM was 1.44 and 1.41 in the unruptured and ruptured groups respectively. The mean number of arteries embolized was 2.51 in the unruptured group compared to 1.8 in the ruptured group ($p = 0.003$). nBCA and Onyx were the two most commonly used embolic agents. Pre-embolization and post-embolization mRS are shown in tables 1 and 2. Four complications were seen in

Abstract E-070 Table 1 Preoperative embolization outcome in low grade unruptured AVMs

Overall mRS (%)	Pre-embolization	Post-embolization
0-2	90 (100%)	90 (100%)
3	0	0
4	0	0
5	0	0
6	0	0

Abstract E-070 Table 2 Preoperative embolization outcome in low grade ruptured AVMs

Overall mRS (%)	Pre-embolization	Post-embolization
0-2	64 (93.9%)	63 (93.3%)
3	7 (4.3%)	7 (4.3%)
4	3 (1.8%)	4 (2.4%)
5	0	0
6	0	0