Introduction 20% of treated unruptured giant intracranial aneurysms (GIAs) will undergo delayed aneurysm rupture (DAR). Flow-diversion procedures used to treat GIAs produce a mechanically unstable thrombus inside the aneurysm that does not eliminate blood flow effects in the sac. Thrombus also activates vessel remodeling collagenases, matrix metalloproteinases (MMPs), and other inflammatory enzymes that can predictably weaken the aneurysm wall. The purpose of this study is to create a physiologically relevant in vitro DAR model, with a predictable rupture rate, for testing new medical device efficiency at reducing flow effects in the aneurysm sac.

Materials and Methods Ten 8 mm biopsy punches from swine carotid vessels were evaluated for changes in material properties before and after collagenase enzyme treatment (1U/ml). The treatment group (n=5) was exposed to collagenase for 30 min at 37°C. The untreated control group (n=5) was kept at 4°C. Material properties (shear and compression moduli) were determined at physiological frequencies (1–3 Hz) using the Bioengineering Devices Laboratory (BDL) rheometer (HR-2, TA instruments) at Northern Arizona University (NAU). Material property data was verified with histological imaging of treated and control vessel samples (Van Geison’s stain). Vessel properties were compared to flexible UV-cured, 3D-printed (Objet260 Connex3, Stratasys) biomaterial samples. Prior to testing, the biomaterials were soaked in phosphate buffered saline (PBS), at room temperature for 4 days, to simulate physiological flow conditions.

Results Histological analysis confirmed collagen digestion in the treated vessels. The biomaterial shear modulus was 5–8X higher than the arterial samples while the compression modulus was 4X lower than the arterial samples after the PBS soak (Table 1). These properties show the models can be designed to withstand flow stresses (shear) and programmed to predictably rupture at a pre-determined aneurysm location (circular defect) by reducing the thickness of the aneurysm wall. The rupture model was 3D-printed (aneurysm dome: 25 mm, neck: 12 mm) with a 1 mm wall thickness, except at the circular defect location (0.1 mm wall thickness). The model was connected to BDL’s pressure- and flow-matched Super Pump AR (NiVitro Labs) neurovascular flow system. Preliminary results show the model can be tuned to predictably-rupture in a 1-week to 1-month window (via accelerated testing) by varying the circular defect thickness (0.05 – 0.5 mm), flow system pulse rate (60 – 360 BPM), and pulsatile pressure (120/80 – 360/240 mmHg).

Conclusion Data from this study can be used to create anatomically accurate, patient-specific, in vitro DAR models within a predictable time window, when left untreated. These models can be useful to neuro-interventional surgeons and device manufacturers for comparing new medical devices and their ability to prevent delayed aneurysm rupture.

<table>
<thead>
<tr>
<th>Sample</th>
<th>Shear Modulus (SD)</th>
<th>Compression Modulus (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control Vessel</td>
<td>12.0 KPa (SD = 2.6 KPa)</td>
<td>663 KPa (SD = 111 KPa)</td>
</tr>
<tr>
<td>Collagenase Vessel</td>
<td>8.00 KPa (SD = 2.4 KPa)</td>
<td>696 KPa (SD = 96 KPa)</td>
</tr>
<tr>
<td>PBS-soaked biomaterial</td>
<td>67.0 KPa (SD = 1.5 KPa)</td>
<td>160 KPa (SD = 17 KPa)</td>
</tr>
</tbody>
</table>

Disclosures H. Sodawalla: 1; C; Center for Materials Interfaces in Research & Applications (Northern Arizona University). M. Alyami: None. O. Fischer: None. H. Berns: None. S. Robertson: None. T. Becker: 1; C; Center for Materials Interfaces in Research & Applications (Northern Arizona University).

P-013 DESIGNING AND PROTOTYPING A NOVEL BALLOON-STENT DEVICE FOR MINIMALLY INVASIVE TEMPORARY ANEURYSM OCCLUSION AND EMBOLIZATION

Introduction Unruptured intracranial aneurysms affect 6.5 million people in the United States. Ruptured intracranial aneurysms are fatal in 50% of cases, and of those who survive, 66% suffer permanent neurological morbidities. Although neu-rointerventional device technology is advancing rapidly, temporary balloons still occlude parent artery blood flow during adjunctive delivery, increasing ischemic stroke risk. In addition, balloon inflation and deflation can result in diffuse vessel trauma.

Materials and Methods The Balloon-Stent device is an alternative to temporary balloon occlusion. The deployable and retrievable Balloon-stent is an ultra-compliant polyurethane balloon encasing a self-expandable nitinol stent that allows blood to perfuse through the stent. The prototyping of the balloon-stent design and alternative designs are under development. The balloon component is a flat ultra-compliant design constructed to inflate from one side. The balloon will then cover a stent device, providing support and allowing blood to perfuse through the device (Figure 1b). Another alternative design in development is an ultra-compliant coating over a braided stent (Figure 1c). The design is composed of a retrievable nitinol braided stent mesh coated with an ultra-compliant polyurethane film. Fractional Pressure Ratio (FPR) – the ratio of proximal/distal pressure across a neurovascular stenosis – is used to determine the optimal inner diameter (ID) of the device. FPR during balloon-stent deployment was simulated using Computational Fluid Dynamics (CFD) and validated using sophisticated benchtop modeling in a physiologically relevant 3D-printed circle of Willis model.

Results A balloon-stent with a stent ID > 34% of parent artery ID maintained FPR > 0.75 during deployment and minimized risk of ischemia. Benchtop and CFD results show a 33% reduction in diameter compared to the theoretical estimation of the balloon-stent critical dimension (Figure 1a). A balloon-stent device can temporarily provide aneurysm neck protection during complementary device deployment while maintaining blood flow in the parent artery. The prototype maintained safe FPR in the parent vessel during in vitro and CFD simulations.

Conclusion A balloon-stent device allows for longer neuro-interventional procedures by providing continuous perfusion without arresting blood flow during balloon inflation. In addition, this novel medical device provides a smooth surface at the aneurysm neck for consistent device placement, minimization of parent vessel trauma, elimination of ischemic effects distal to the parent artery, and minimization of intra-saccular flow remnants pre- and post-treatment.
Abstract P-013 Figure 1  a) FPR results from theoretical estimation, benchtop modeling, and Computational Fluid Dynamic (CFD) simulation. B) balloon component of the balloon-stent design c) Ultra compliant coated stent.

Disclosures O. Asgari: 1; C; 2021 Flinn Foundation Medical Technology Seed Grant. B. Fennell: None. N. Norris: None. A. Ducruet: 2; C; Medtronic, Stryker, Oculus, Koswire, Cerenovus. 4; C; Aneuvas Technologies Inc. 5; C; Barrow Neurological Institute. T. Becker: 1; C; 2021 Flinn Foundation Medical Technology Seed Grant. 4; C; Aneuvas Technologies Inc. 5; C; Northern Arizona University.

Implementation of a Cognitive Dysfunction Screening Protocol After Aneurysmal Subarachnoid Hemorrhage

Background Implementation of a standardized cognitive assessment strategy after aneurysmal subarachnoid hemorrhage (aSAH) has not been reported in the literature, despite frequency of post-aSAH cognitive impairment and recommendations to perform cognitive assessment on all stroke patients. The aim of this study is to implement an evidence-based protocol for cognitive dysfunction screening and management after aSAH.

Methods A cognitive dysfunction screening protocol was developed, which included the Montreal Cognitive Assessment (MoCA) tool. Patients with identified cognitive dysfunction defined as MoCA score <26 were referred to neurocognitive rehabilitation and those with MoCA score 26–29 were referred for neuropsychological evaluation. The modified Rankin scale (mRS) was also used to assess functional status. Following a peer-led education session with nurses and physicians, the protocol was implemented over a six-month period in the Cerebrovascular Clinic associated with a large academic medical center.

A10-YEAR SINGLE-CENTER EXPERIENCE WITH FLOW DIVERSION FOR TREATMENT OF ANTERIOR CHOROIDAL ARTERY ANEURYSMS

A Kuhn, J Singh, F Massari, A Puri*. Division of Neurointerventional Radiology, Department of Radiology and New England Center for Stroke, University of Massachusetts, Worcester, MA

Introduction/Purpose Flow diversion represented a paradigm shift in the treatment of cerebral aneurysms. Previously considered ‘difficult to treat’ aneurysms could be successfully treated endovascularly. Coverage of side branches with subsequent thromboembolic complications or even vessel occlusion remained a concern. We here present our 10-year experience with flow diversion for treatment of anterior choroidal artery aneurysms.

Materials and Methods Retrospective review of a prospectively maintained neurointerventional database and identification of all patients who underwent flow diverter placement for treatment of an anterior choroidal artery aneurysm between April 2012 and March 2022. Patient demographics, procedural data, imaging follow up results and clinical outcome information was collected.

Results A total of 19 patients (15 females) were identified. Patient age ranged from 17 to 72 years (mean 55 years). Two aneurysms were previously treated with coil embolization but showed recanalization. Mean aneurysm diameter (largest dimension) was 3.5 mm. Eighteen patients were treated with a pipeline embolization device and 1 patient with a Surpass Streamline flow diverter. One single flow diverter was implanted 18 cases. One case required placement of a second device in telescopic fashion due to distal foreshortening of the device and uncovering of the aneurysm neck. Additional coiling was performed in one case. All patients were maintained on dual antiplatelet therapy for at least 6 months. No thromboembolic complications were encountered. Two patients did not have any follow-up exam. Six-month follow-up angiogram was available in 17 patients and showed complete occlusion in 12 cases (70.6%), near complete occlusion in 4 cases (23.5%) and partial occlusion in 1 case (5.9%). One patient with near complete occlusion progressed to complete aneurysm occlusion at 6 months. Another patient with near complete occlusion at 6 months showed stable occlusion status at 1 year follow up. Two patients with near complete and one patient with partial aneurysm occlusion at 6 months are not yet due for another follow up. Nine patients underwent a 12-month follow-up and 4 patients were seen for a 3-year diagnostic angiogram follow-up. No delayed complications were observed.

Conclusion Flow diversion for anterior choroidal artery aneurysms is a safe and effective treatment options.

Disclosures A. Kuhn: None. J. Singh: None. F. Massari: None. A. Puri: 1; C; NIH, Microvention, Cerenovus, Medtronic Neurovascular and Stryker Neurovascular. 2; C; Medtronic Neurovascular, Stryker NeurorvascularBalt, Q’Apel Medical, Cerenovus, Microvention, Imperative Care, Agile, Merit, CereVasc and Arsenal Medical. 4; C; InNeuroCo, Agile, Perfuze, Galaxy and NTI.