

The integrity of PPODA and parylene coatings was evaluated, via a DMA-rheometer (TA Instruments) in the Bioengineering Devices Lab (BDL) at Northern Arizona University (NAU). Shear, wire-on-wire delamination, and bending integrity at physiologically-relevant forces and shear rates were assessed, and SEM verified potential wire-polymer delamination effects.

Results and Discussion SEM images showed variation in continuity among the different surface coatings and the controls (with or without surface modification, PPODA versus parylene). Mechanical testing suggested significant variations in adhesion of different coatings, helping to optimize the coating technique. Future work will finalize coating optimization and assess biocompatibility of control (uncoated) versus coated wires for *in vitro* endothelial cell growth, implantation effects, hemocompatibility, and metal ion leaching (Time-of-Flight Secondary Ion Mass Spectrometry - ToF-SIMS).

Conclusion PPODA polymer coatings can improve biocompatibility and prevent thrombosis on FDs and stents by pre-coating wires for braiding or post-coating laser-cut stent devices. Future work will compare coating integrity and biocompatibility to established devices (i.e Pipeline Shield[®] and Fred-X[®]). Materials like PPODA may provide FDs and stents with a mechanically stable scaffold coating that promotes continuous re-endothelialization over an aneurysm neck, which can eliminate thrombosis and reduce recanalization rates.

Disclosures S. Robertson: 5; C; Northern Arizona University. W. Merritt: 1; C; SNIS Young Investigator Research Grant. 4; C; Anevas Technologies, Inc. 5; C; Anevas Technologies, Inc. T. Becker: 1; C; SNIS Young Investigator Research Grant. 2; C; United Biologics. 4; C; Anevas Technologies, Inc. 5; C; Northern Arizona University. A. Ducruet: 2; C; Medtronic, Penumbra, Oculus, Stryker, Balt, Koswire. 4; C; Anevas Technologies, Inc. 5; C; Barrow Neurological Institute.

O-059

COMPLEX CLINICALLY-RELEVANT SILICONE MODELS CAN BE ENDOTHELIALIZED AND USED TO VISUALIZE AND ASSESS VESSEL INJURY FOLLOWING CATHETER SIMULATED USE

¹A McCulloch, ¹B Yang, ²S Frenklakh, ²P Sah, ¹K Cardinal*. ¹Biomedical Engineering, Cal Poly, San Luis Obispo, CA, USA; ²Stryker Neurovascular Intervention, Fremont, CA, USA

10.1136/jnis-2023-SNIS.59

Introduction/Purpose Neurovascular catheters can be used in numerous ways to treat ischemic stroke. These devices have potential to cause vessel injury by disrupting the endothelium during treatment. Although vessel injury is typically evaluated in animal models, prior work suggests that endothelialized *in vitro* models may be developed as an additional option in the preclinical testing pipeline. The purpose of the current work was to create a complex, clinically-relevant neurovascular silicone model that is fully endothelialized, and to determine the utility of this model for evaluating vessel injury due to catheter simulated-use.

Materials and Methods Complex anatomical models that represented the ICA and MCA were fabricated out of silicone, with an inner diameter tapering from 5.5mm ID to <4mm ID and a total tracking length of 256.3mm. These silicone models were sterilized, rinsed, and coated with fibronectin. Fibronectin-coated silicone models were placed in individual customized bioreactor systems and seeded with human

umbilical vein endothelial cells. After cell injection, vessels were maintained on peristaltic pumps and housed in a large incubator. An initial 'model characterization' study was performed to determine if the complex models could be successfully endothelialized and maintained. For this study, vessels were cultivated under flow for 3 or 7 days, then harvested and analyzed using H&E for cell morphology and PECAM/BBI for cell quantification and phenotype confirmation. Following the characterization study, 'catheter simulated-use' studies were performed. For these studies, vessels were cultivated for 3 days, then treated with a guidewire alone, 'biaxial' approach (guidewire plus microcatheter), or 'triaxial' approach (guidewire plus microcatheter plus aspiration catheter, and treatments were either performed one time (1-pass) or three times (3-pass). There were n=3 vessels per treatment and number of passes, plus controls, for a total of n=24 vessels. Immediately following treatment, vessels were harvested and fixed, then ready for analysis. Vessels were stained with H&E and evaluated for vessel injury, using a quantitative ImageJ approach as well as a visual scoring system. Vessels were stained with PECAM to confirm endothelial cell phenotype.

Results H&E images from vessels in the characterization study revealed a consistent and confluent monolayer of endothelial cells throughout the length of the vessels at both 3 and 7 days. PECAM/BBI results further illustrated the expected cell morphology, while nuclei quantification illustrated cellular coverage at densities consistent with native endothelium. Results from the catheter simulated-use studies demonstrated that vessel injury can be successfully visualized and characterized using quantitative and visual scoring methods. Results specifically revealed that injury increased with the number and size of devices and with the number of passes. The differences and trends were consistent with expected outcomes.

Conclusion This work demonstrates that complex, clinically-relevant silicone models can be successfully endothelialized and used to visualize and assess injury following catheter simulated-use. Results were consistent with expected trends based on number of passes and treatment approach, which supports future use of the model to evaluate and compare a variety of neurovascular devices. Overall, this provides a cost-effective, early-stage *in vitro* model that can precede or complement standard animal testing.

Disclosures A. McCulloch: 1; C; This work was funded by Stryker Neurovascular. B. Yang: 1; C; This work was funded by Stryker Neurovascular. S. Frenklakh: 5; C; Employee of Stryker Neurovascular. P. Sah: 5; C; Employee of Stryker Neurovascular. K. Cardinal: 1; C; This work was funded by Stryker Neurovascular.

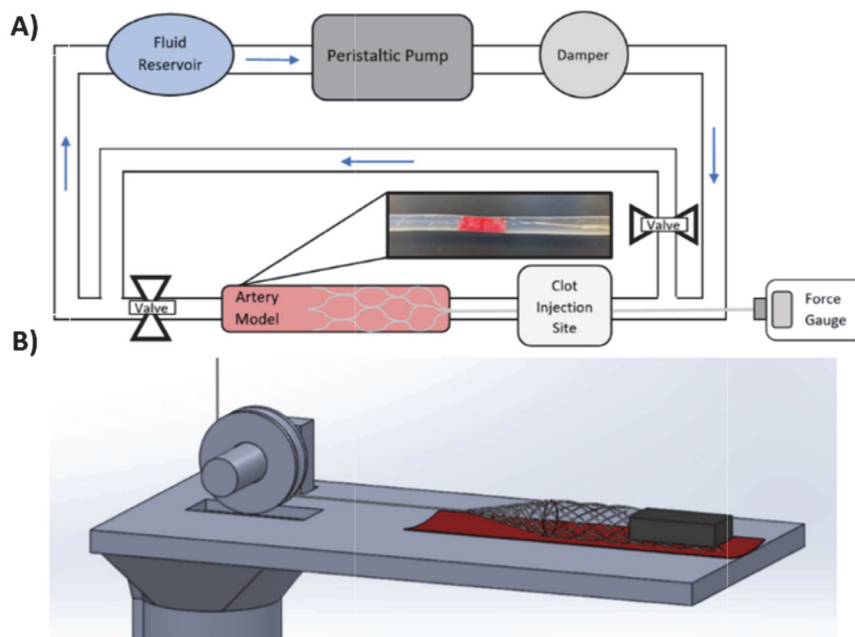
O-060

EVALUATION OF EXPERIMENTAL ACUTE ISCHEMIC STROKE MODELS FOR MEASURING STENT RETRIEVER REMOVAL FORCES

¹D Poulos, ¹O Elkhayyat, ²M Froehler, ¹B Good*. ¹Mechanical, Aerospace, and Biomedical Engineering, University of Tennessee, Knoxville, TN, USA; ²Cerebrovascular Program, Vanderbilt University Medical Center, Knoxville, TN, USA

10.1136/jnis-2023-SNIS.60

Introduction/Purpose Despite improved acute ischemic stroke (AIS) outcomes with mechanical thrombectomy (MT), treatment still frequently fails to achieve recanalization on the first attempt and fails altogether 20-30% of the time. Additionally, experimental MT studies commonly report 100%



Abstract O-060 Figure 1

recanalization, highlighting clear differences between *in vivo* and *in vitro* scenarios. To more accurately represent MT in benchtop models, and to determine the factors underlying recanalization discrepancies, stent retriever (SR) removal forces and surface frictional forces will be investigated in models of varying geometry and material and compared with bovine carotid arteries.

Materials and Methods A flow loop was developed (figure 1A) with a peristaltic pump, fluid reservoir, and various cerebral artery models (straight tubes, 90 and 180° bends, and a silicone MCA). To mimic MT, an SR and microcatheter was passed through a hemostatic valve and deployed across lodged blood clots. The SR, connected to a force gauge, was pulled at a constant speed while recording the removal forces. Three SRs were evaluated: Solitaire Platinum (4x20mm) and Solitaire2 (4x15 and 6x30mm). Frictional tests were performed between 0-40% hematocrit clots, bare nitinol, and common artery model materials (glass, silicone, PVC, and bovine carotid). Additional tests were performed with nitinol SRs and the same model materials. To evaluate frictional forces, blood clots and unfolded SRs (figure 1B) were pulled across each material surface via an Instron machine. Tests were performed on dry and wetted material surfaces and compared to bovine carotid samples.

Results SR removal forces were found to increase with model tortuosity (0.56N in straight and 1.38N in 180° models). A comparison of clot properties found that diameter correlated slightly with removal force, while clot hematocrit showed no significant correlation. In frictional testing, wetted material surfaces displayed lower forces compared to dry surfaces (0.19 vs 0.86N for silicone) but were still significantly lower than those between SRs and bovine carotids (0.47N). SR frictional forces were also significantly higher between all tested materials compared to those of blood clots (0.19 vs 0.08N for silicone).

Conclusion Clot hematocrit did not influence SR removal forces, while model tortuosity positively correlated. Testing

concluded that common AIS model materials underpredict the frictional forces that likely occur *in vivo* by 2-4x. Additionally, it was determined that SR-artery frictional forces are much larger than clot-artery frictional forces and are the primary driver of overall removal force. The decreased forces between clots/SRs and experimental materials could explain the higher recanalization rates observed in *in vitro* models.

Disclosures D. Poulos: None. O. Elkhayat: None. M. Froehler: 1; C; Siemens, Medtronic, Genentech, Stryker, NIH. 2; C; Cerenovus, Balt, The Jacobs Institute, Oculus. B. Good: 1; C; Medtronic.

0-061 MORPHOMECHANIC ANALYSIS OF INTRACRANIAL ANEURYSMS

¹J Miller, ¹S Sanchez, ²A Galloy, ²M Nino, ¹D Ojeda, ¹L Noboa, ³D Hasan, ¹E Samaniego*. ¹Neurology, University of Iowa, Iowa City, IA, USA; ²Biomedical Engineering, University of Iowa, Iowa City, IA, USA; ³Neurosurgery, Duke University, Durham, NC, USA

10.1136/jnis-2023-SNIS.61

Introduction Aneurysm morphology is a determinant factor that influences risk of rupture. Aneurysmal wall enhancement (AWE) has also been associated with increased risk of rupture. Emerging tools including finite element analysis (FEA) and computational fluid dynamics (CFD) may provide insights about aneurysm dynamics. We analyzed AWE, CFD, and FEA to identify the interaction between various metrics in aneurysm morphology.

Methods Only unruptured saccular aneurysms were included. 3T MRI was used to image aneurysms. Two sequences were performed: T1 and T1 after administering gadolinium (Gd). 3D segmentations were produced using 3D slicer. Signal intensity heat maps were generated to quantify AWE. AWE uptake was calculated as the difference between T1+Gd and T1 signal intensity. Wall tension (WT) was calculated using FEA. The time averaged wall shear stress (TAWSS) and the wall