

**Conclusion** The morphology of saccular brain aneurysms is different among age groups. An irregular morphology is a high-risk feature regardless of age. In younger patients, aneurysms are smaller, tend to be more regular and ruptured aneurysms are mostly located in the MCA and ACOM. In older patients, aneurysms are larger, have a more irregular morphology and ruptured aneurysms are mostly located in the PCOM and ACOM.

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#### STUDY DESIGN AND RATIONALE OF THUNDER: AN ACUTE ISCHEMIC STROKE STUDY WITH THE PENUMBRA SYSTEM INCLUDING THUNDERBOLT ASPIRATION TUBING

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**Introduction** Modulated aspiration is a new technology for endovascular thrombectomy for the treatment of acute ischemic stroke (AIS) secondary to large vessel occlusion (LVO). The primary objective of the THUNDER study (NCT05437055) is to demonstrate the safety and efficacy of a novel modulated aspiration thrombectomy system (Penumbra System<sup>®</sup> including Thunderbolt<sup>™</sup> Aspiration Tubing [Thunderbolt]) in a patient population with AIS secondary to LVO.

**Methods** THUNDER is a multicenter prospective single-arm study involving a clinical events committee and core laboratory for the independent assessment of safety and imaging outcomes, respectively. Adults aged 18 to 80 years with AIS secondary to LVO, pre-stroke modified Rankin Scale (mRS) 0-2, and planned frontline treatment with the Penumbra System including Thunderbolt within 8 hours of symptom onset are eligible for enrollment. Up to 160 participants at up to 25 sites in the United States will be enrolled. Thunderbolt is the aspiration tubing component of the Penumbra System and can modulate the pressure delivered to the aspiration catheter by alternating between connecting the aspiration catheter to the continuous vacuum aspiration pump and ambient pressure saline in a predetermined modulated aspiration sequence. The primary efficacy endpoint is angiographic revascularization (mTICI  $\geq 2b$ ) of the occluded target vessel at immediate post-procedure and the primary safety endpoint is incidence of device related and/or procedure related serious adverse events within 24 hours post-procedure. Secondary efficacy endpoints include first pass angiographic revascularization to mTICI  $\geq 2b$ , immediate post-procedure angiographic revascularization to mTICI  $\geq 2c$ , time to revascularization, and mRS 0-2 at 90 days as determined by blinded assessors. Secondary safety endpoints include all-cause mortality at 90 days and occurrence of symptomatic intracranial hemorrhage at 24 hours.

**Results** The first patient was enrolled August 11, 2022, and as of March 2023 there are 58 patients enrolled. The estimated date for enrollment completion is December 2023.

**Conclusion** We report the design of THUNDER—a multicenter prospective study that examines the use of a novel modulated aspiration thrombectomy system in patients with AIS secondary to LVO.

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#### ASSESSING CONGRUENCY OF FIRST PASS EFFECT ON OUTCOMES IN MECHANICAL THROMBECTOMY FOR LARGE VESSEL OCCLUSIONS VIA UNSUPERVISED MACHINE LEARNING

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**Introduction** The first pass effect (FPE) in mechanical thrombectomy, characterized by successful recanalization of an occluded vessel in the initial thrombectomy attempt, has been demonstrated to predict positive patient outcomes. Unsupervised machine learning (ML) techniques offer a promising approach to analyzing large-scale data without the need for explicit labels or training data, enabling the identification of patterns and relationships that are not readily apparent. In this study, we sought to investigate the predictive value of FPE using unsupervised clustering of outcomes.

**Methods** Consecutive mechanical thrombectomies were retrospectively tabulated at a large volume stroke center. This study was approved by the local institutional review board (IRB). Clustered outcomes to formulate clusters included the number of passes, the final reperfusion obtained, the discharge NIHSS, and complications. FPE was defined as TICI 2C or 3 reperfusion on the first pass. Uniform manifold approximations and projections (UMAP) and K-means unsupervised clustering were done to identify outcome clusters. Logistic regression with and without interaction coefficients was used to determine associated factors with cluster membership or FPE. P-values less than 0.05 were considered significant.

**Results** 287 consecutive patients were identified, of which 187 were used in the final analysis due to missing outcomes data. The average age was 70 years (sD = 15.14), with 81.8% of patients with MCA occlusion. Three outcome clusters were identified in the analysis. Cluster 2 had the greatest congruency with FPE ( $p < 0.001$ ) and was also associated with poor outcomes. Patients in Cluster 2 were more likely to have ICA occlusions and were older ( $p = 0.043, 0.001$ , respectively). Predictors of FPE were analyzed using cluster membership and adjusted for aneurysm properties. Adjusted for other factors, cluster 2 membership was significantly associated with achieving FPE in our cohort (OR = 5.419 (95% CI: 2.349 - 13.464),  $p < 0.001$ ). Next, the predictive value of FPE and cluster membership was compared against Discharge NIHSS. FPE was inversely associated with discharge NIHSS (B (SE) = -4.497 (1.39),  $p = 0.0014$ ). Cluster 2 membership was also