

Thursday Platform 1

Vertebral Artery Origin Treatment by Endovascular Techniques Registry (VOTER): Safety in the First 20 Cases

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Introduction:

Background: Stenosis of the vertebral artery origin (VAOS), while under-diagnosed, is common and may cause up to 25% of posterior circulation infarction. Stenting is widely employed as a secondary prevention strategy, but prospective clinical studies of safety and efficacy are limited.

Objective: To report periprocedural and 30-day outcomes after stenting of the vertebral origin in the first 20 patients of the Vertebral Artery Origin Treatment by Endovascular Techniques Registry (VOTER).

Methods:

VOTER is a prospective, multicenter, cohort study of patients with symptomatic vertebral artery stenosis $\geq 50\%$. Demographic, clinical, and procedural data is collected via a RedCap constructed, cloud-based, data entry portal. In addition, there is clinical follow-up data collected at 30 days and 1 year. Lesion stenosis[OGS1] percentage along with representative images are collected pre-stent, post-stent, and at 1 year for validation by an independent core laboratory. The primary outcome is stroke and death at 30 days. The secondary outcome is restenosis $\geq 50\%$ at 1 year follow-up.

Results:

A total of 10 sites have been activated to enroll in the study. Of these, 3 sites have enrolled a total of 20 subjects. The median age was 64 (range 47-87) years; 14 (70%) were male, and 16 (80%) were white. 19 patients (95%) were hypertensive, with 5 patients (25%) having a history of ischemic heart disease. The median Modified Rankin score (mRS) at admission was 1 (range 0-3). Presenting symptoms included dizziness/vertigo (43%), visual field defects (14.3%), hemiparesis (14.3%), dysarthria (19.0%), diplopia (4.8%), ataxia (4.8%), and dysphasia (4.8%). All patients were treated with dual antiplatelet therapy. All stents utilized were drug eluting. The median pre-stent stenosis was 80% (range 60-99%) with a median of 15% (range 0-33%) post-stent residual. There were no periprocedural strokes, death, or technical complications. One month follow up was available in 15 patients (75%), with 2 reporting new neurological symptoms: 1 with blurred vision and 1 with dizziness and facial numbness. No new imaging confirmed infarctions occurred. Symptomatic improvement was noted in 40% of subjects although there was no change in the median 30 day mRS.

Conclusions:

VOTER is the first large prospective registry of vertebral origin stenting in North America. These early results from the first 20 subjects are consistent with procedural safety and the importance of continued

study of stenting as a secondary prevention strategy for posterior circulation infarction in the setting of VAOS.

Keywords: Vertebral, Stenting, Endovascular

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Thursday Platform 2

Safety and Efficacy of Surpass Streamline for Intracranial Aneurysms: A Multicenter US Real-World Experience (SESSIA)

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Introduction:

Flow diversion has established itself as standard treatment of wide complex intracranial aneurysms (IA). Its recognition has been validated with positive occlusion rates and favorable clinical outcomes. The Surpass Streamline (SS) flow diverter (FD) is a braided cobalt/chromium alloy implant with 72 or 96 wires approved by the FDA in 2018. The aim of this study is to determine the safety and efficacy of the SS in a post-marketing large US cohort.

Methods:

We performed a multicenter, retrospective study for consecutive patients treated with the SS FD for IA between January 2018 and June 2021 in the United States. Inclusion criteria for participants were: 1. Adults (≥ 18 years) and 2. Treatment with SS FD for IA. Primary safety end point was a major ipsilateral stroke (increase in National Institutes of Health Stroke Scale Score of ≥ 4) or neurological death within 12 months. Primary efficacy was assessed using the 3-point Raymond-Roy (RR) occlusion scale on digital subtraction angiography (DSA) at 6-12-month follow-up.

Results:

A total of 276 patients with 313 aneurysms were enrolled. The median age was 59 years and 199 (72%) were females. The most common comorbidities included hypertension in 156 (57%) subjects followed by hyperlipidemia in 76 (28%) patients. One hundred and twenty-two (44%) patients were asymptomatic while subarachnoid hemorrhage was present in only 10 (4%) patients. A total of 143 (46%) aneurysms were left-sided. Aneurysms were located as follows: 274 (88%) were in the anterior circulation with paraophthalmic being the most common in 120 (38%) followed by petrocavernous ICA in 81 (26%); 33 (11%) aneurysms were located in the posterior circulation with basilar trunk being the most common in 14 (5%). The mean maximum aneurysm dome width was 5.77 ± 4.7 mm, neck width 4.22 ± 3.8 mm and dome to neck ratio was 1.63 ± 1.3 mm. The mean number of SS FD implanted per aneurysm was 1.06 (range 1-3) with more than one SS FD implanted in 21 (7%) aneurysms. Modified Rankin Scale (mRS) of

0-2 was present in 206/213 (97%) patients at 6-12 month follow-up. The complete aneurysm occlusion (RR 1) rate was 145/175 (83%) among subjects who had angiographic follow-up at 6-12 months. Major stroke and death was encountered in 7 (2%) and 5 (1.8%) of the patients respectively.

Conclusions:

Our data represent the largest real-world study using SS FD. These results corroborate its post-marketing safety and efficacy for the treatment of intracranial aneurysms showing more favorable rates to the initial experience during SCENT trial.

Keywords: Aneurysm, Flow Diverter, Surpass, Interventional Neuroradiology, Endovascular Therapy

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Thursday Platform 3

Incidence and predictors of delayed functional independence in the TREVO retriever registry

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Introduction:

Chronological heterogeneity in the neurological improvement after endovascular thrombectomy (EVT) for large vessel occlusion (LVO) stroke is commonly observed in clinical practice. Understanding the temporal progression of functional independence after EVT, especially delayed functional independence in patients who do not experience early improvement, is essential for prognostication and rehabilitation. We aim to determine the incidence of early and delayed functional independence and identify associated predictors after EVT.

Methods:

Demographic, clinical, radiological, treatment, and procedural information were analyzed from TREVO registry (patients undergoing EVT in the setting of anterior circulation LVO using the Trevo stent-retriever). Incidence and predictors of early functional independence (EFI, modified Rankin Scale (mRS) score 0–2 at discharge) and delayed functional independence (DFI, mRS score 0–2 at 90 days in non-EFI patients) were analyzed.

Results:

A total of 1757 patients met study criteria. EFI was observed in 45% (785) of patients. Among non-EFI patients (972), DFI was observed in 34% (332) of patients. Younger age ($p<0.001$), lower blood glucose ($p<0.001$), mTICI $\geq 2B$ ($p=0.01$), and lower total number of thrombectomy passes ($p=0.004$) were independent predictors of DFI.

Conclusions:

Approximately 45% of patients experience early functional independence. One-third of non-early improvers experience delayed functional independence. Younger age, lower blood glucose, better collateral grade, and lower total number of passes were independent predictors of DFI among non-early improvers. Further studies are required to improve our understanding of DFI.

No upload

Keywords: Endovascular Therapy, Ischemic Stroke, Treatment

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Thursday Platform 4

ANA Catheter System, Combined With a Stent Retriever in Acute Ischemic Stroke Trial (SOLONDA)

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Introduction:

The ANA™ (Anaconda Biomed) thrombectomy system is a novel stroke thrombectomy device comprising a self-expanding funnel designed to reduce clot fragmentation by locally restricting flow while becoming as wide as the lodging artery. Once deployed, ANA allows distal aspiration in combination with a stent retriever (SR) to mobilize the clot into the funnel where it remains copped during extraction. We investigate safety and efficacy of ANA™ in a first-in-man study.

Methods:

The SOLONDA study was prospective, multicenter (9 centers in Spain) with blinded assessment of the primary outcome by an independent core lab. Patients with an acute occlusion of terminal internal carotid artery (TICA), M1 or M2 segments of the middle cerebral artery (MCA) admitted within 8 hours from symptom onset were eligible. The primary endpoint was successful reperfusion, defined as mTICI_{2b} in the target vessel with ≤3 passes of the ANA device in combination with a SR, without the use of rescue therapy in the intention to treat population. Primary predefined analysis was non-inferiority as compared to performance endpoint observed in HERMES (71.1%). Secondary outcome measures included per-pass reperfusion scores, symptomatic intracerebral hemorrhage (sICH), NIHSS at day 5, and mRS at 90 days.

After enrollment of 74 patients, an interim analysis was conducted. The trial Steering Committee decided to terminate recruitment due to overwhelming evidence that safety and performance objectives were reached.

Results:

Mean age was 71.6 (SD 8.9) years, 46.6% women and median NIHSS on admission 14 (IQR 10-19). Sites of primary occlusion were: TICA 10 (13.7%), M1-MCA 37 (50.7%) and M2-MCA in 26 (35.6%) patients. The independent imaging corelab determined that successful reperfusion within 3 passes without rescue therapy was achieved in 60/72 (83.3%) with a rate of complete reperfusion (TICI 2c-3) of 60% (43/72 patients). After non-inferiority was confirmed (p<0.01), the ANA device also showed superiority in the primary outcome analysis (p=0.02). Median procedural time from first angiogram to recanalization or final angiogram was 38(±28) minutes. First pass successful recanalization rate was 56% with a rate of first pass complete recanalization of 39%. Rescue therapy to obtain a mTICI_{2b} was needed in 12/72 (17%) patients. At 90 days, the rate of favorable functional outcome was 57.5% and the rate of excellent functional outcome (mRS 0-1) 45.2%. The rate of severe adverse device-related effects

as adjudicated by the data safety monitoring board was 1.4% (one patient suffered an arterial dissection).

Conclusions:

In this first-in-man clinical experience, the ANA device achieved a high rate of complete recanalization with a good safety profile and favourable 90 days clinical outcomes. ClinicalTrials.gov Identifier: NCT04095767

Keywords: Endovascular Therapy, Mechanical Thrombectomy, New Innovation

Financial Disclosures: Marc Ribo is the co-founder of Anaconda Biomed

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Thursday Platform 5

Hospital Cost of DTAS Compared to ED Transfers for LVOs Undergoing Mechanical Thrombectomy

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Introduction:

Direct-to-angiography-suite (DTAS) transfer for patients with large vessel occlusions (LVOs) undergoing mechanical thrombectomy is associated with decreased workflow times and improved neurological outcomes. Herein, we sought to demonstrate a decrease in hospital cost associated with DTAS compared to emergency department (ED) transfers for patient undergoing mechanical thrombectomy for an LVO.

Methods:

A retrospective analysis was performed on all patients who underwent mechanical thrombectomy for an LVO at a single comprehensive stroke center between January 1st, 2017, and March 31st, 2021. All patients who were either transferred DTAS or ED were included and compared. Total hospital cost (sum of overhead, professional, diagnostic, and room charges throughout the entire index patient admission) was obtained from the hospital financial department for the index treatment admission. A propensity adjusted (matched for age, sex, vessel occluded, co-morbidities, BMI, admission NIHSS, access site, and use of a stent retriever) was implemented. Mean difference in hospital cost following adjustment was the primary outcome.

Results:

During the study period, 341 patients underwent mechanical thrombectomy for an LVO. Of these patients, 140 (41%) were transferred DTAS and 96 (28%) to the ED. There were no significant differences between cohorts in terms of age, sex, vessel occluded, admission NIHSS, co-morbidities, number of passes, TICI score, access site, stent retriever, major complications, or in-hospital mortality. The DTAS cohort (\$33,061, sD \$17,258) had a significantly lower hospital cost compared to ED transferred patients (\$38,030, sD \$18,572) ($p=0.04$). There was no significant difference between the ED (12.2, sD 11.8) and DTAS (11.6, sD 11.1) cohorts in discharge NIHSS. Following propensity score adjustment, linear regression analysis found DTAS (compared to ED transfer) to be significantly associated with a decrease in hospital cost (\$-6,344; 95% CI: \$-11,067 to \$-1,623; $p=0.009$).

Conclusions:

DTAS transfer for patients undergoing an acute mechanical thrombectomy for a LVO was associated with a greater than \$6,000 decrease total hospital cost compared to patients first transferred to the ED. The present study further supports DTAS transfer for patients undergoing mechanical thrombectomy for LVO.

Keywords: Interventional Neuroradiology

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Thursday Platform 6

Mobile Stroke Unit Process Metrics in Large Vessel Occlusion Stroke Patients: BEST-MSU Substudy

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Introduction:

Mobile Stroke Units (MSUs) speed thrombolytic treatment for acute ischemic stroke and improve clinical outcomes compared to standard management by Emergency Medical Services (EMS). However, MSU process metrics in the subset of patients with large vessel occlusions (LVOs) having endovascular thrombectomy (EVT) have yet to be optimized.

Methods:

A pre-specified Benefits of Stroke Treatment Using a Mobile Stroke Unit (BEST-MSU) substudy of tPA-eligible stroke patients with imaging evident LVOs was conducted. The primary outcome was process metrics related to treatment times from stroke onset and first medical alert. Safety outcomes included rates of symptomatic intracerebral hemorrhage and procedural complications. Groups were compared using Chi-square or Fisher's exact tests for categorical variables, and Wilcoxon rank-sum tests for continuous variables.

Results:

A total of 295 patients were included, 169 in the MSU group and 126 in the EMS group. Baseline characteristics were comparable between the groups, with the exception of baseline NIHSS (MSU mean 19.0 [IQR 13.0,23.0] vs EMS 16.0 [11.0, 20.0], $p=0.003$). 92% of MSU and 87% of EMS LVO patients received tPA, and 78% and 85% went on to have EVT. Process metrics are detailed in Table 1. MSU LVO patients had faster tPA bolus from 911-alert (MSU 45.0 minutes [40.0, 53.5] vs EMS 76.0 [64.0, 87.8], $p<0.001$), however the two groups had similar alert to groin puncture (MSU 142.5 [116.8, 171.0] versus EMS 131.5 [114.0, 159.8], $p=0.15$). MSU patients spent more time on-scene, (EMS arrival to ED arrival, 53.0 [45.0, 62.0] vs 27.0 [22.0, 33.0], $p<0.001$) however less time prior to EVT (door to groin puncture, 76.5 [54.8, 108.5] vs 94.0 [72.0, 123.0], $p<0.001$) with variable use of field CTAs and direct cath lab admission with ED bypass, yielding a net neutral result. The variability among site protocols is reflected in the range of median alert to groin puncture times (minimum 107.0 minutes, maximum 152.0). In the 222 patients undergoing EVT, median alert to recanalization time was 181.5 minutes [146.8, 225.5] in the MSU group and 190.5 [157.5, 227.5] in the EMS group ($p=0.47$). Recanalization (Thrombolysis In Cerebral Infarction [TICI] 2b/3) was achieved in 76% of MSU and 70% of EMS ($p=0.32$) with comparable rates of EVT complications (including hemorrhage, perforation, dissection, hematoma). 54% MSU and 44% of EMS LVO patients achieved good functional outcome (modified Rankin Scale [mRS] ≤ 2) at 90 days ($p=0.11$).

Conclusions:

In tPA-eligible LVO stroke patients, MSU management did not increase or expedite EVT treatment times as compared to standard EMS management. Future MSU processes should include field CTA with direct admission to cath labs to maximize the early treatment advantage this technology provides.

Table 1: Process Metrics According to Treatment Group			
Interval minutes (median, [IQR])	MSU (N=169)	EMS (N=126)	P-value
Last known normal to alert	14.0 [5.0, 46.5]	18.0 [8.0, 48.0]	0.231
Alert to EMS arrival	9.0 [6.0, 13.0]	9.0 [6.0, 13.0]	0.821
Alert to tPA bolus	45.0 [40.0, 53.5]	76.0 [64.0, 87.8]	<0.001
Alert to ED arrival	63.0 [54.0, 73.0]	37.0 [31.0, 43.8]	<0.001
EMS arrival to ED arrival	53.0 [45.0, 62.0]	27.0 [22.0, 33.0]	<0.001
Alert to CT scan	35.0 [26.0, 43.0]	49.0 [41.0, 57.0]	<0.001
Alert to CTA scan	73.0 [56.0, 89.0]	57.0 [48.8, 72.0]	<0.001
Alert to groin puncture	142.5 [116.8, 171.0]	131.5 [114.0, 159.8]	0.154
Door to groin puncture	76.5 [54.8, 108.5]	94.0 [72.0, 123.0]	<0.001
Alert to recanalization	181.5 [146.8, 225.5]	190.5 [157.5, 227.5]	0.466

Keywords: Ischemic Stroke, Acute Ischemic Stroke Intervention, Clinical Trial, Door To Needle, Door To Groin Puncture

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Thursday Platform 7

Integrated Geomapping Tool of Certified Stroke Centers in United States: A SVIN MT2020+ Committee Collaboration

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Introduction:

Stroke is a leading cause of morbidity, mortality and healthcare spending in the United States. Acute management of ischemic stroke is time-dependent and evidence suggests improved clinical outcomes for patients treated at designated certified stroke centers. There is an increasing trend among hospitals to obtain certification as designated stroke centers. A common source or integrated tool providing both information and location of all available stroke centers in the US irrespective of the certifying organization is not readily available. The objective of our research is to generate a comprehensive and interactive electronic resource with combined data on all geographically-coded certified stroke centers to assist in pre-hospital triage and study healthcare disparities in stroke including availability and access to acute stroke care by location and population.

Methods:

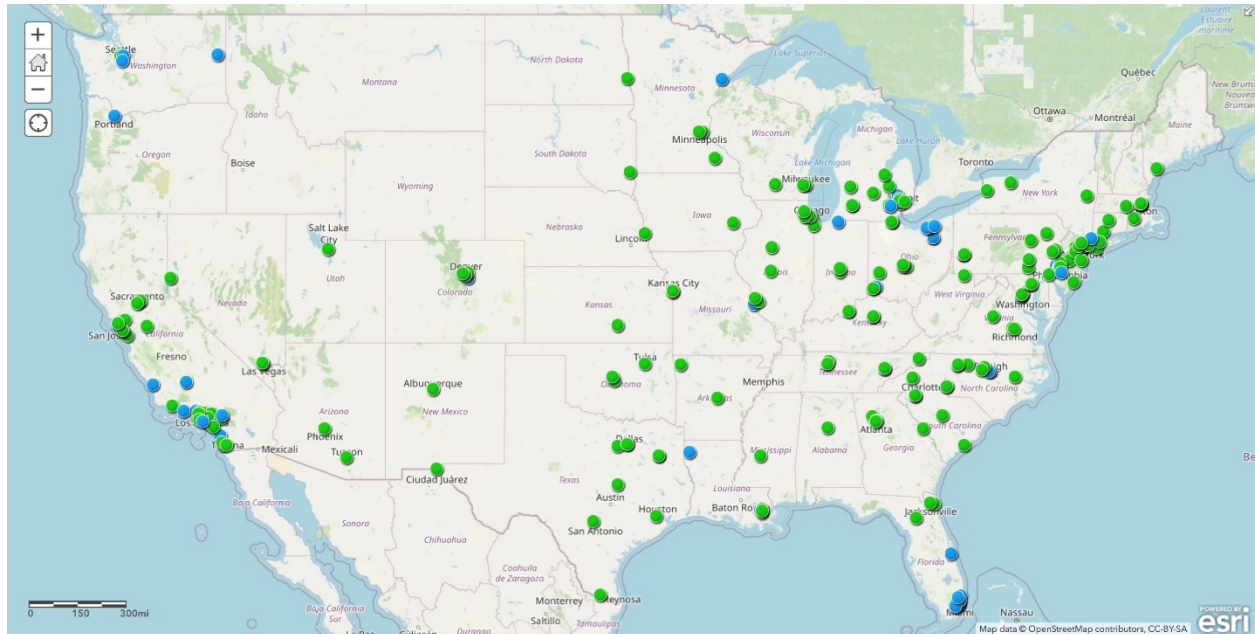
Data on stroke center certification was primarily obtained from each of the three main certifying organizations: The Joint Commission (TJC), Det Norske Veritas (DNV) and Healthcare Facilities Accreditation Program (HFAP). Geographic mapping of all stroke center locations was performed using the ArcGIS Pro application. The most current data on stroke centers is presented in an interactive electronic format and the information is frequently updated to represent newly certified centers. Utility of the tool and its analytics are shown. Role of the tool in improving pre-hospital triage in the stroke systems of care, studying healthcare disparities and implications for public health policy are discussed.

Results:

Aggregate data analysis at the time of submission revealed 1,806 total certified stroke centers. TJC-certified stroke centers represent the majority with 106 Acute Stroke Ready (ASR), 1,040 Primary Stroke Centers (PSCs), 49 Thrombectomy Capable Centers (TSCs) and 197 Comprehensive Stroke Centers (CSCs). A total of 341 DNV-certified programs including 36 ASRs, 162 PSCs, 16 PSC Plus (thrombectomy capable) and 127 CSCs were identified. HFAP-certified centers (75) include 16 ASRs, 49 PSCs, 2 TSCs and 8 CSCs. A preliminary map of all TJC-certified CSCs and TSCs is shown in the figure (1). Geospatial analysis reveals distinct areas with currently limited access to certified stroke centers and currently, access to certified stroke centers is extremely limited to non-existent in few States (for example: Idaho, Montana, Wyoming, New Mexico and South Dakota).

Conclusions:

Stroke treatment and clinical outcomes are time-dependent and prompt assessment and triage by EMS directly to appropriate designated stroke centers is therefore critical. A readily available electronic platform providing location and treatment capability for all nearby certified centers will enhance regional stroke systems of care, including enabling more rapid inter-hospital transfers for advanced intervention. Identifying geographic areas of limited access to treatment can also help improve policy and prioritize the creation of a more equitable and well-distributed network of stroke care in the United States.



Test test Keywords: Acute Stroke

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Friday Platform 1

Analysis of Protein Network to Predict Cognition Among Emergent Large Vessel Occlusion Undergoing Mechanical Thrombectomy

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Introduction:

Emergent Large Vessel Occlusion (ELVO) strokes are devastating ischemic vascular events that can cause severe and permanent impairment. The purpose of the current study is to investigate interactions among different proteins at the time of mechanical thrombectomy (MT) which correlates to Montreal Cognitive Assessment (MOCA) scores at discharge and at 90-day follow-up.

Methods:

The Blood And Clot Thrombectomy Registry And Collaboration (BACTRAC) study is a continually enrolling tissue bank (clinicaltrials.gov NCT03153683) and registry from stroke patients undergoing mechanical thrombectomy. Blood samples from systemic arterial blood (internal carotid artery) of twenty-three patients were collected and sent to Olink Proteomics (Olink Proteomics, Boston, Massachusetts, USA) for analysis of protein expression of 92 cardiometabolic proteins and 92 inflammatory proteins. To determine which proteins had the most significant changes based on MOCA scoring, a series of 184 paired t-tests were performed. Within each panel, proteins were then ranked based on the associated p values. Benjamini and Hochberg's linear step-up procedure was used to control the false discovery rate at 0.05. Pearson Correlation revealed proteins that were significantly related to the patients' s discharge MOCA score as well as 90-day follow-up MOCA. Data and network analyses were performed using IBM SPSS Statistics, SAS v 9.4, and STRING V11. Common proteins between the discharge day miniMoCA and 90 days MOCA were identified. Network of these protein associations was created and biological processes correlating with these networks were identified.

Results:

Twenty-two patients (15 with discharge day MiniMOCA and 7 with 90 days MOCA) were included in the analysis. Of these patients, 14 were females, and 9 were obese (BMI>30). 2 had minor stroke (NIHSS: 1-4), 13 had moderate stroke at admission (NIHSS: 5-15), 4 had moderate to severe stroke (NIHSS: 16-20), and 2 patients had severe stroke (NIHSS > 21). 19 patients had associated comorbidities (hypertension, diabetes, and hyperlipidemia). Mean last known normal to thrombectomy completion time was 621 + 333 minutes and mean infarct volume was 18,271 + 16,534 mm³. The 9 overlapping proteins from discharge to 90-day follow up were later analyzed using interconnected STRING to determine association network and proteomic biological functions. Nine proteins include: DPP4, NCAM1, TGFBI, PRCP, APOM, TIE1, QPCT, MEGF9, and IGFBP3. Biological processes relating to the network of 9 proteins are depicted in table 1.

Conclusions:

This study uncovers network proteins that play a significant role in cognitive outcomes following ischemic stroke. This will allow future studies to develop predictive biomarkers for treatment and proteomic targets for adjunctive therapies to thrombectomy to improve our ability to treat cognitive dysfunction in ELVO stroke patients.

Biological Process	Strength	False discovery rate	Matching proteins in your network (labels)
Protein metabolic process	0.59	1.32E-05	ST8SIA4,ST8SIA2,TP53,IGF1,QPCT,FN1,DPP4,TIE1,APO M,IGFBP3,PRCP,IGF2,GDNF,TGFBI,IGFALS,NCAM1
Regulation of glucose metabolic process	1.61	0.0011	IGF1,IGFBP3,GCG,IGF2
Cellular protein metabolic process	0.57	0.0011	ST8SIA4,ST8SIA2,TP53,IGF1,QPCT,FN1,TIE1,IGFBP3,IGF 2,GDNF,TGFBI,IGFALS,NCAM1
Positive regulation of glucose metabolic process	1.93	0.0018	IGF1,GCG,IGF2
Regulation of semaphorin-plexin signaling pathway	2.84	0.0018	GDNF,NCAM1
Regulation of protein transport	1	0.0029	TP53,IGF1,FN1,GIP,DPP4,GCG
Regulation of secretion by cell	0.96	0.0032	IGF1,FN1,GIP,DPP4,GCG,GDNF
Regulation of localization	0.61	0.0037	TP53,IGF1,FN1,GIP,DPP4,TIE1,IGFBP3,PRCP,GCG,GDNF
Ganglioside biosynthetic process	2.36	0.0038	ST8SIA4,ST8SIA2
Regulation of cell communication	0.53	0.0038	TP53,IGF1,FN1,GIP,DPP4,IGFBP3,PRCP,GCG,IGF2,GDNF ,NCAM1

Keywords: Mechanical Thrombectomy, Stroke, Pathophysiology

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Friday Platform 2

Endovascular Treatment for Spetzler-Martin Grade III Pediatric Arteriovenous Malformations

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Introduction:

Grade III Spetzler-Martin (SM) brain arteriovenous malformations (AVMs) presents high variability in terms of size (S), angioarchitecture, flow characteristics, a frequent involvement of eloquent areas (E), and presence of central venous drainage (V). Therefore, this specific group fall into a gray zone in which the best treatment option is not established. Here, we aimed to assess the safety and efficacy of intent-to-cure embolization in pediatric grade III AVM management at two institutions.

Methods:

Pediatric patients (<18 years of age) with grade III AVMs treated with intent-to-cure embolization in two institutions between 2010 and 2019 were included. These two centers primarily perform endovascular treatment with intention to cure, which means that they attempt to occlude the maximal volume of nidus in a single session. Then, if the first session is not curative or the result is partial, a subsequent embolization is planned to completely occlude the AVM nidus. The clinical features, obliteration rates, and intraoperative complications were retrospectively collected from the clinical records. We categorized the AVMs based by the SM features: Type 1 = S1E1V1, Type 2 = S2E1V0, Type 3 = S2E0V1, and Type 4 = S3E0V0. The Institutional Review Boards approved this study.

Results:

Twenty-seven children (19 females; mean age: 12 years, standard deviation: 3.9 years) with grade III AVMs underwent 47 embolization sessions. The most common presentation was intracranial hemorrhage (66%), and the majority (48%) were deep lesions (basal ganglia, corpus callosum, ventricle). The size of AVMs was <3 cm in 16 patients, 3 – 6 cm in 9, and >6 cm in 2; 21 AVMs were in eloquent cortex and 20 had deep venous drainage. The AVMs were Type 1 in 16 cases, Type 2 in 5, Type 3 in 4, and Type 4 in 2. Complete obliteration was achieved in 12 patients (44%), including 37% of AVMs exclusions after a single session. Eight (30%) patients had multiple embolizations. The AVM was obliterated after a single session in 10 patients (63%) with Type 1 AVMs (small lesions). The most common embolic agent employed was Squid (17/44), followed by Onyx (14/44) and Histoacryl (6/44). Intraoperative complications were reported in 5 (4 microperforations, 1 microcatheter rupture) out of 47 sessions (11%), with only one complication in the large AVM group (Types 2 - 4). Deaths were not reported.

Conclusions:

Endovascular treatment with intent-to-cure of grade III SM AVMs in the pediatric population has demonstrated adequate complete obliteration rates with acceptable intraoperative complication rates. Therefore, long-term follow-up in this population is necessary in order to assess the real impact of embolization in terms of cure rates.

Keywords: Cerebral Arteriovenous Malformations, Avm Embolization, Endovascular Therapy, Endovascular, Pediatric Intervention

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Friday Platform 3

Direct to Angiography Suite versus Conventional Imaging in Suspected Large Vessel Occlusion Strokes: A Meta-Analysis

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Introduction:

Direct transfer to angiography suite (DTAS) for patients with suspected large vessel occlusion strokes potentially requiring mechanical thrombectomy has been shown to shorten treatment times and improve outcomes compared to conventional imaging (CI) selection. This meta-analysis compares both approaches to build more concrete evidence.

Methods:

The potentially relevant studies that were published in four electronic databases/search engines (PubMed, Web of Science, Cochrane Library, and Scopus) till August 2021 were reviewed. Eligible studies were included if they enrolled >10 patients in both groups, were published in English and reported baseline and procedural characteristics and 90-day outcomes. Relevant data were then extracted and analyzed.

Results:

Among 4514 searched studies, six qualified for the analysis. Time from door to puncture (MD= -26.76minutes, 95 % CI [-39.48, -14.03], P< 0.0001) as well as door to reperfusion (MD= -27.21 minutes, 95% CI [-47.42, -7.01], P=0.008) were significantly shorter and the rates of functional independence (mRS0-2: RR = 1.28, 95% CI [1.03, 1.60], P= 0.03) at 90-days were significantly higher in the DTAS versus the CI approach. There was no statistically significant difference between DTAS and CI groups in terms of successful reperfusion (modified Thrombolysis In Cerebral Infarction [mTICI] score 2B-3: RR=0.99, 95% CI [0.93, 1.06], P=0.86), near complete/ full reperfusion (mTICI 2C-3: RR=0.84, 95% CI [0.68, 1.04], P=0.11), or fair outcomes at 90-days (mRS 0-3: RR=1.05, 95% CI [0.67, 1.64], P=0.84). Moreover, there was no difference between groups regarding symptomatic intracranial hemorrhage (RR=0.81, 95% CI [0.55, 1.17], P=0.26) or 90 day-mortality (RR=0.85, 95% CI [0.59, 1.24], P=0.41).

Conclusions:

Our meta-analysis showed that DTAS significantly improves time metrics and functional outcome with comparable safety to the CI approach. Multicenter randomized clinical trials are ongoing to confirm these results.

Keywords: Acute Stroke, Mechanical Thrombectomy, Door To Groin Puncture

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Friday Platform 4

Influence of Catheter Tip Position and Aspiration Technique on ADAPT Revascularization Success with Various Catheters

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Introduction:

Previous studies demonstrated that both the location of the distal access catheter tip and angle of aspiration have a significant impact on revascularization outcomes^{1,2}. A direct aspiration First-Pass technique (ADAPT) with large-bore aspiration catheters has emerged as a fast, safe, and effective thrombectomy technique. Maximizing the catheter-to-vessel size has previously been shown to enhance distal flow control resulting in improved in-vitro revascularization rates for aspiration thrombectomy³. However, physicians differ in their preference for aspiration catheter tip placement, typically either positioning the catheter tip at the 'face' of the clot or advancing the catheter tip into the clot to engage it. We hypothesize that sizing the aspiration catheter outer diameter (OD) to the inner diameter (ID) of the vessel and embedding the catheter tip in the clot may result in 'pinning' fragments of clot between the catheter and vessel wall, thereby negatively affecting revascularization outcomes. Withdrawal of the aspiration catheter under continuous aspiration may mitigate this effect. We investigate the influence of catheter tip position and aspiration technique on ADAPT revascularization success with various sizes of aspiration catheters.

Methods:

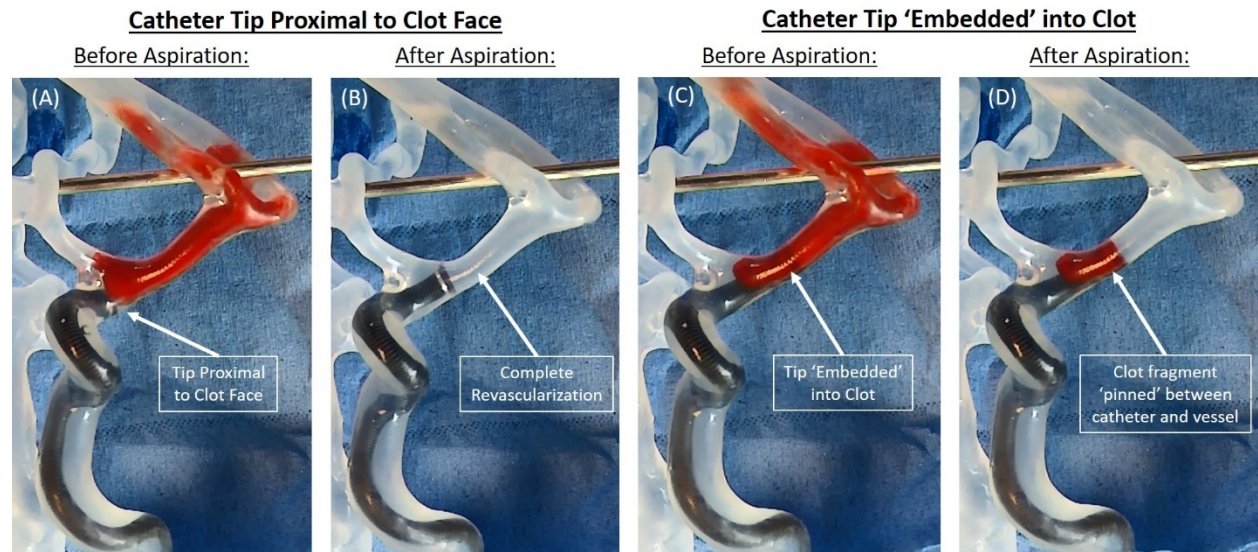
Two clot analogues phenotypes (RBC-Rich and Fibrin/Platelet-Rich) were created from human blood and used to form occlusions in an In-vitro thrombectomy model as previously described⁴. Two catheter tip positions and three techniques were investigated; 1). Catheter tip proximal to the face of the clot followed by conventional aspiration, 2). Catheter tip 'embedded' into the clot followed by conventional aspiration, and 3). Catheter tip 'embedded' into the clot followed by conventional aspiration and aspiration on catheter withdrawal even if clot ingestion occurred. Two aspiration catheters were investigated; Millipede 088" (Perfuze Ltd) and SOFIA Plus (Terumo). Multiple replicates of each test were performed. Endpoints were First-Pass Effect and procedural-related distal emboli from 200-1000µm.

Results:

Maximizing the catheter-to-vessel size increases success of the ADAPT approach when the tip is located proximal to the clot face (Fig 1 A&B); Millipede 088 achieves a higher First-Pass Effect rate than SOFIA Plus. Sizing the catheter-to-vessel and embedding the catheter tip into the clot (Figure 1C) results in 'pinning' of clot fragments between the catheter and vessel wall (Figure 1D) resulting in lower rates of First-Pass Effect. Withdrawing the catheter under continuous aspiration increases the success of the embedding method by capturing 'pinned' fragments.

Conclusions:

The position of the aspiration catheter tip and aspiration technique used both influence the success of ADAPT procedures. Sizing the catheter-to-vessel results in improved revascularization. However, embedding the tip into the clot when the vessel is similar in ID to the catheter OD may reduce First-Pass Effect rates. To optimize the rates of First-Pass Effect, aspiration catheters may be positioned at the proximal face of the clot or retracted under continuous aspiration if wedged into the clot.



Keywords: Mechanical Thrombectomy, Endovascular, Ischemic Stroke, Revascularization, Neurointerventional Education

Financial Disclosures: The authors had no disclosures.

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Poster

A New Technique To Prevent Ophthalmic Complications Prior To Middle Meningeal Artery Embolization

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²Staten Island University Hospital, Staten Island, New York, United States of America

Introduction:

Embolization of the Middle Meningeal Artery (MMA) is a minimally invasive procedure used as an alternative or adjunctive treatment of chronic subdural hematoma (cSDH). The benefits of MMA embolization have been attributed to targeting of the pathophysiology of cSDH which currently favors a process of increasing inflammatory response causing immature and leaky neovascularization. The major dural arteries and hazards associated with their embolization have been thoroughly described in past literature. The unintended embolization of orbital arteries leading to blindness is the most significant hazard associated with MMA embolization. The purpose of this study is to present 5 cases demonstrating the success of our technique in the treatment of cSDH while preventing the possibility of blindness by coiling the anastomotic vessel between MMA and Ophthalmic Artery (OA) branches prior to particle embolization.

Methods:

After doing an Internal Carotid Artery (ICA) run and ensuring the origination of the OA from the ICA and observing retinal blush, we routinely infused 10-20mcg of Nitroglycerine into the main trunk of MMA through a microcatheter to dilate and better visualize the MMA branches including anastomosis. If the meningeo-ophthalmic collaterals were visualized during the follow-up microcatheter run, we coil embolized the proximal segment of those collaterals through the same microcatheter. We then infused 100-300µm particles through the main branches of the MMA supplying the dura.

Results:

Of the 39 patients who underwent MMA embolization for cSDH, 5 received MMA/OA collateral variants coil embolization followed by successful particle embolization of all MMA branches supplying the dura without complication.

Conclusions:

In our cSDH patients, the collaterals from MMA to Ophthalmic or Lacrimal branches were safely coil embolized before complete particle embolization of the MMA dural branches. In a few patients these collaterals became obvious after inducing vasodilatation. None of these patients had major complications. This technique may be safer, more effective and cheaper than wedging, gluing or low pressure infusion. Our literature search did not find a similar technique used in this application.

Keywords: Coiling, Embolization, Endovascular, Hemorrhage, Interventional Neuroradiology

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

Acute Stroke, Subarachnoid Hemorrhage, VZV vasculopathy, And Carotid Dissection: An Interesting Case

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Introduction:

A 51-year-old lady with a past medical history of Essential Hypertension, Hypothyroidism, prior Herpes Zoster infection 8 weeks ago was admitted with complaints of abdominal pain, bilateral flank pain, and restlessness. Her initial workup was significant for hyponatremia and hypokalemia. On the 3rd day of admission, she developed acute hypoxemic respiratory failure which led to intubation. At that time, CTA Chest was not done but CT Chest revealed prominent mucous plugging with left side glass ground opacities, Ultrasound of lower extremities revealed right common femoral vein DVT which led to concerns that she may have suffered from Pulmonary Embolism and led to starting Heparin drip. On the 6th day of admission, she developed Acute Encephalopathy, MRI Brain revealed acute infarcts in bilateral cerebral cortices and cerebella, CT Angiogram Head showed acute subarachnoid hemorrhage in the high posterior right parietal lobe, stenosis of the right high cervical internal carotid artery, and irregular, the appearance of the arterial vasculature throughout and CT Angiogram Neck abrupt change in caliber of the right ICA, 1.5 cm distal to the bifurcation with markedly severe narrowing of the majority of the extracranial right ICA throughout its course. A cerebral Angiogram was done which showed diffuse tandem segments of tandem cervical and intracranial portions of the right internal carotid artery and she was given nitroglycerin was administered as a therapeutic intervention. Lumbar Puncture showed WBC 2, RBC 7, Protein 162, Glucose 64, VZV PCR was negative, CSF VZV IgG Antibody positive at 303 IV (>165 IV indicative of current or past infection). Serum VZV IgG Antibody was positive at >4000 IV. Infectious Diseases were consulted after Lumbar Puncture, they initially started Acyclovir but once the Serum VZV IgG Antibody came back much higher than Serum VZV IgG Antibody levels, their assessment was that VZV vasculitis is unlikely and Acyclovir was discontinued. Eventually, the case was discussed at Neuroradiology which led to us getting a repeat MRA Neck without contrast which showed a concentric T1 and T2 hyperintensity along with a small and irregular caliber right cervical ICA consistent with dissection. She eventually completed a 21-day course of Nimodipine due to underlying Subarachnoid Hemorrhage.

Methods:

NA

Results:

NA

Conclusions:

Our case demonstrates how it can become difficult to ascertain the etiology of stroke in certain patients. Our patient presented with multiple non-specific symptoms initially and it was later on due to her Acute

Encephalopathy that her Strokes and Subarachnoid Hemorrhage were discovered. It is still difficult to pinpoint whether the cause of strokes was dissection or VZV infection. Lumbar Puncture remains an essential tool to complete work up on uncommon etiologies of stroke.

Keywords: Ischemic Stroke, Subarachnoid Hemorrhage, Inflammation, Vasospasm, Vasospasm Intervention

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

Arterial steal in AVM: An etiology of ischemic stroke

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Introduction:

Arteriovenous malformations (AVM) are rare congenital malformations in the brain, often presenting with cerebral hemorrhage. Unruptured AVMs usually remain asymptomatic, or they can present with headache, seizure, or focal neurological deficits. “Arterial steal” is one of the mechanisms which can lead to focal neurological deficits. The idea of vascular steal through high flow shunting within brain AVMs is not a new concept. There is, however, debate about whether the vascular steal phenomenon indeed exists empirically. In a study focused on vascular reserve in patients with cerebral AVMs (utilizing acetazolamide augmentation and perfusion CT methods), decreased hemodynamic reserve was noted in 27% of parenchymal regions of interest close to the AVM and in 17% of parenchymal regions of interest far from the AVM. Other imaging modalities have shown abnormal blood regulation around AVM however there exists a level of discordance between various modalities which questions whether vascular steal exists in vivo. We present an ischemic stroke caused by “arterial steal” phenomenon.

Methods:

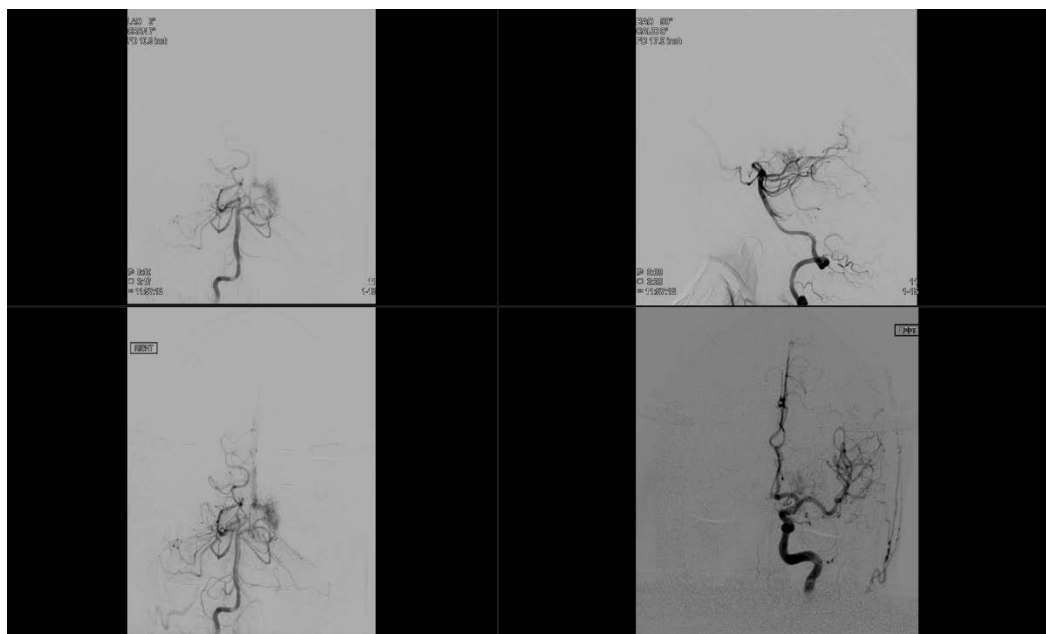
Case report

Results:

63-year-old male with past medical history of seizure, hypertension presented with confusion and dysarthria for 3 weeks. On exam he was found to have right upper quadrantanopia. CT head without contrast and MRI of brain revealed an evolving infarct in the left posterior cerebral artery (PCA) territory. CT angiogram showed possible occlusion in the left PCA P2 segment which correlated to the previously described stroke and in addition showed evidence of left thalamic AVM. Evaluation for cardioembolic or atheroembolic sources was unrevealing. A diagnostic cerebral angiogram showed a 1.3 mm AVM fed through anterior choroidal branches as well as posterior choroidal branches through left posterior communicating artery. There was delayed filling in the left PCA territory likely due to steal phenomenon which might be the etiology of the stroke.

Conclusions:

In our case, as demonstrated on angiogram, vascular steal phenomenon through high flow shunting of AVM is the likely explanation for the ischemic stroke.



Keywords: Acute Stroke, Cerebral Blood Flow, Cerebral Arteriovenous Malformations, Angiogram, Cerebral Physiology

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

Bilateral Vertebral Artery Occlusion and Involvement of the Posterior Circulation

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Introduction:

Rationale: Bilateral vertebral artery occlusion with collateral reconstitution is a rare finding. Compared to patients with acute occlusion, symptom progression may be much slower [1]. Atherosclerotic risk factors lead to occlusion, including hypertension and hyperlipidemia, but it is unclear what leads to collateral reconstitution [2]. These patients may have collateral circulation from anterior and posterior circulation sources that are well developed [1] [2]. Sufficient collateral flow correlates with lower rates of hemorrhagic transformation following recanalization [3] [4]. However, given the risk of spontaneous hemorrhage from microvascular collaterals, the hemorrhagic risk associated with thrombolytic therapy in patients with moyamoya collaterals, due to the fragility of these vessels [5], must be balanced with the benefit of therapy in the presence of severe neurologic deficits along with the mortality and morbidity that may stem from the occlusion.

Patient concerns: 67 year old Caucasian male with past medical history of coronary artery disease, abdominal aortic aneurysm, hypertension, history of tobacco use and type 2 diabetes mellitus presents with acute right-sided weakness.

Methods:

Diagnoses: On admission, CTA Head and Neck suggested chronic total occlusion of bilateral V4 segments from their origin to the midportion with tandem bilateral high-grade stenoses throughout the imaged distal V2 and V3 segments bilaterally. MRI could not be obtained because of old lumbar fusion spinal hardware. Cerebral angiography showed microvascular reconstitution, analogous to moyamoya, with slow mid basilar flow, which could be either due to occlusion or competitive flow from top of the basilar collaterals.

Interventions: Patient received intra-arterial integrilin and tPA thrombolysis with TIC1 1 reperfusion.

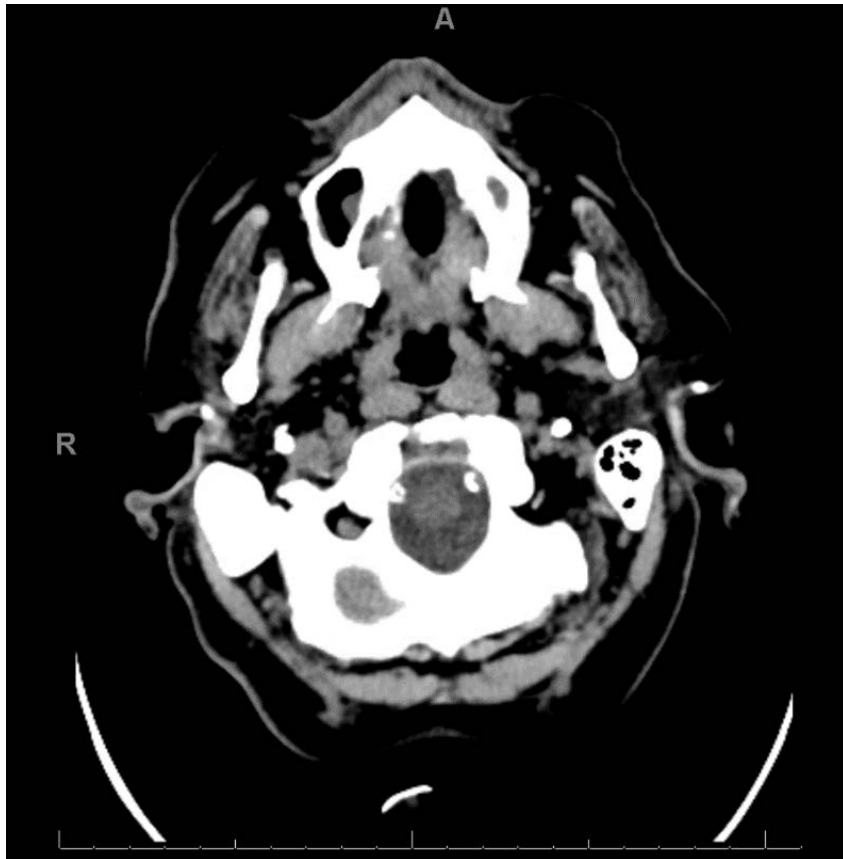
Results:

Outcomes: Patient presented with NIHSS 18 notable for right sided weakness (2/5 strength in his right upper extremity and 1/5 strength in RLE), bilateral hemianopia, severe dysarthria and right gaze preference. Patient had significant improvement in his exam the next day following thrombolysis. Notably, patient had 5/5 strength in his right upper and right lower extremities compared to his strength on presentation. Repeat head CT on the following day after thrombolysis showed left pontine infarct. Repeat NIHSS was 3 at 24 hours for partial hemianopia, minor nasolabial flattening and mild dysarthria.

Conclusions:

Conclusion: Bilateral intracranial vertebral artery stenosis and occlusion commonly occurs distal to PICA and near the vertebrobasilar junction [2]. Proximal (specifically areas supplied by PICA) and distal territories within the posterior circulation are often infarcted [2], which can yield a unique exam upon presentation that can help accurately guide diagnosis and treatment when appropriately recognized. The involvement of collateral circulation can play a crucial role in patients undergoing endovascular

revascularization therapy [6]. In the setting of bilateral vertebral occlusion with microvascular reconstitution, patients can still undergo catheter based thrombolysis, but not thrombectomy.



Keywords: Vertebral, Acute Ischemic Stroke Intervention, Thrombolitics, Intra-Arterial Therapy, Intra Caranial Stenosis

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

C-Guard Stent for the Treatment of Cervical Internal Carotid Artery Aneurysms: Report of 2 Cases

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Introduction:

C-Guard carotid stent is a self-expandable open cell stent covered with a double-layer mesh which was developed for the treatment of internal carotid artery disease. Lower procedural and complications rates, as well as lower post-operative infarctions are some advantages of this device. Nevertheless, the use of C-Guard in the treatment of cervical internal carotid artery (ICA) aneurysms is scarce. Therefore, we present two cases in which the C-Guard stent achieved complete angiographic occlusion at follow-up.

Methods:

We identified two cases in which the C-Guard carotid stent was used to treat symptomatic cervical ICA aneurysms. Angiographic follow-up was performed.

Results:

Case 1: 47-yo female presented left-sided motor deficit. CT showed ischemic areas in the right hemisphere and CTA demonstrated an unruptured aneurysm in the C1 segment of the right ICA. The patient started dual antiplatelet therapy (DAPT) with aspirin and clopidogrel. A 6mm x 40 mm C-Guard carotid stent was deployed without complications. One-year follow-up CTA showed complete obliteration of the aneurysm with reconstruction of the ICA.

Case 2: 38-yo male presented decreased left visual acuity. CTA and DSA showed an unruptured aneurysm in the C1 segment of the ICA. The patient started DAPT with aspirin and clopidogrel. A 7mm x 30 mm C-Guard carotid stent was deployed without complications. Three-month follow-up DSA showed complete obliteration of the aneurysm with adequate filling of distal vessels.

Conclusions:

C-Guard stent is a potential alternative to conventional carotid stents in the treatment of cervical ICA aneurysms with high obliteration rates at follow-up.

Keywords: Aneurysm, Stenting, New Technique

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

Charles Bonnet Syndrome Secondary To Massive Dural Arteriovenous Fistula Disguised As Extensive Venous Sinus Thrombosis

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Introduction:

Charles Bonnet Syndrome is characterized by visual hallucinations that can occur following severe visual insult, rarely due to dural arteriovenous fistulas (DAVF) or cerebral venous sinus thrombosis (CVST). Prompt differentiation between DAVF and CVST is important since treatments may differ and inadequate treatment may result in blindness. We highlight a patient who presented with Charles Bonnet Syndrome initially misdiagnosed with CVST by MR venography and later correctly diagnosed with a massive DAVF with superimposed CVST by digital subtraction angiography and underwent DAVF embolization with complete resolution.

Methods:

Case Report.

Results:

A 78 year-old man with hypertension and hyperlipidemia presented with three weeks of bilateral vision loss associated with formed hallucinations exacerbated by dark rooms. Neurological exam revealed decreased visual acuity of 20/400 and grade five papilledema bilaterally. Non-Contrast (TOF) MR venogram revealed lack of flow in the superior sagittal sinus (SSS), straight sinus (SS) and deep venous system, and partial flow of the left transverse and sigmoid sinus and left jugular vein. MR brain without gadolinium was unremarkable. Cerebral angiography revealed a high-grade DAVF predominantly supplied by the occipital branch of the left external carotid artery [Figure 1; A-C], with retrograde flow into the left sigmoid, transverse, superior sagittal, and straight sinuses, as well as retrograde flow into the right vein of Trolard [Figure 1; A-D]. The left distal sigmoid sinus and left jugular bulb were occluded. The left transverse and proximal left sigmoid venous sinuses were compartmentalized from non-occlusive thrombus, while the SSS and bilateral transverse sinuses were patent [Figure 1; A, B]. Embolization using coils and onyx was performed with complete occlusion of the left transverse and sigmoid sinuses, the points of main drainage of the fistula, as there was no single trans arterial pedicle suitable for embolization. Postembolization angiography demonstrated a Cognard Grade 1 fistula with some residual fistulous shunting of the occipital artery to the torcula. Follow up angiogram at six weeks showed interval occlusion of the residual shunt. He had minimal improvement in his vision at three months of follow up.

Conclusions:

This case highlights a patient with Charles Bonnet Syndrome due to a high flow DAVF. The MR venogram failed to capture the DAVF since the retrograde flow was interpreted as thrombosis on MRV. DAVF and CVST have a complex cause-effect relationship, since thrombosis may open up venous channels that can lead to a fistula and sluggish blood flow from a fistula may stimulate thrombus formation. Treatments between CVST and DAVF differ since high grade DAVF often require endovascular embolization and

anticoagulation may increase the risk of intracerebral hemorrhage in a subset of patients. Digital subtraction angiography and/or contrast enhanced MRV should be considered in cases of suspected extensive thrombosis to help differentiate between thrombosis and DAVF.

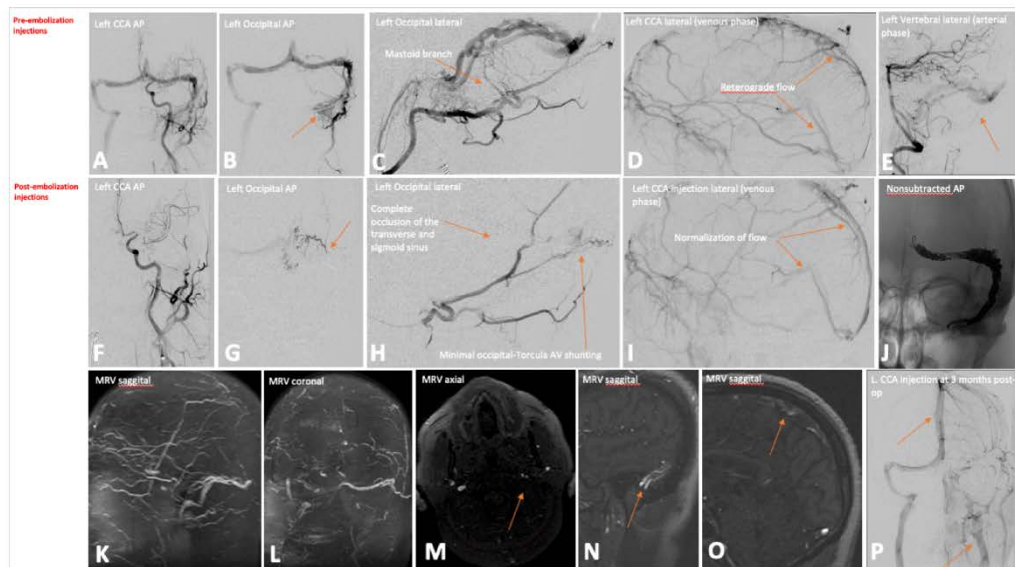


Figure 1: Pre-embolization left CCA [A] and left occipital artery injections [B, C] demonstrates AV shunting between the left occipital artery and left transverse and sigmoid sinus. The venous phase of a left CCA injection demonstrates reverse flow in the SSS and SS with preferential anterior drainage [D]. Left vertebral artery injection demonstrates minimal shunting between vertebral muscular branches and the left SS [E]. Post-embolization left CCA [F] and left occipital [G, H] injections reveal near complete occlusion of the left transverse and sigmoid sinus and normalization of flow into the SSS and SS [I]. Minimal shunting between the occipital artery and the torcula remained [G]. A nonsubtracted image highlights the extensive coils and onyx that were used to embolize the left transverse and sigmoid sinus [J]. MR venogram demonstrates no flow in the SSS [K, L] and left internal jugular vein [M] and thrombus in the left sigmoid [N] and SSS [O]. Left CCA injection at 3 months post-op demonstrates significantly improved flow in the SSS and left internal jugular vein with persistent occlusion of the left transverse and sigmoid sinus and resolution of shunting into the torcula [P].

Keywords: Cerebral Sinus And Venous Thrombosis, Cerebral Arteriovenous Malformations, Angiogram, MRI,

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

Covered stent placement for treatment of a dural arteriovenous fistula: case report and literature review

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Introduction:

Dural arteriovenous fistula (AVF) is a condition that can cause significant venous congestion, subarachnoid and/or intracranial hemorrhage. Endovascular treatment typically targets embolization of feeding arteries with the use of coils, adhesive or sclerotic agents. The purpose of this study is to illustrate a case of a dural AVF that underwent novel treatment via transvenous stenting with a Viabahn covered stent and review the current literature on this topic.

Methods:

Existing literature was searched using PubMed, Embase and Google Scholar using the terms covered stent and dural arteriovenous fistula.

Results:

69-year-old female presents with pulsatile tinnitus, right scalp and ear pain. Diagnostic cerebral angiography performed revealing a right temporal dural AV fistula with feeding arteries from right external carotid artery (ECA) branches, right vertebral artery and right meningohypophyseal trunk (MHT) draining into transverse sinus. Therapeutic angiogram performed using a heparin-coated (viabahn) covered stent and discharged home on aspirin monotherapy.

A total of 1363 articles were yielded from the above search. There were 3 case series that included patients with similar pathology and endovascular approach as our case. Treatment included transvenous placement of stent +/- angioplasty. None of the cases used a covered stent. The use of open stents can lead to low DAVF obliteration rate, 43% cure rate combined series. There are no current randomized clinical trials investigating treatment of dural AVF with covered stents.

Conclusions:

Treatment of dural AVF via transvenous approach with a heparin-coated covered stent can be an alternative option compared to open stents that may lead to higher DAVF obliteration rate. Covered stenting of dural venous sinus may be a cost-effective alternative to sinus sacrifice.

Keywords: Interventional Neuroradiology, Endovascular Therapy, Endovascular, Stenting

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

Dural Arteriovenous Fistulas with Traumatic Subdural Hematomas: A Case Series

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Introduction:

Dural arteriovenous fistula (dAVF) is a pathological shunt between the dural arterial supply and venous system including cortical veins and/or venous sinuses. Middle meningeal artery (MMA) embolization as an indication for chronic subdural hematomas (SDH) treatment has been evolving over the past few years. The relationship between traumatic SDH and dAVF is not well established.

Methods:

Twenty-one consecutive patients who received MMA embolization for chronic SDH performed in a single center from July 2020 to June 2021 were reviewed. We report a series of four cases of dAVF discovered immediately before or during MMA embolization for chronic SDH secondary to trauma.

Results:

15/21 (71%) patients were traumatic SDH. 4/15 (27%) of the patients were found to have dAVF on cerebral angiography immediately before or during MMA embolization. In two patients, the dAVF was demonstrated via super-selective microcatheter angiography of the external carotid and middle meningeal artery prior to embolization. The two patients, dAVF developed via the MMA distal to catheter placement during embolizing agent administration. These latter fistulae were uncovered due to the change of vascular resistance to surrounding meningeal branches. All four fistulae were successfully obliterated.

Conclusions:

Our case series demonstrate that traumatic SDH can be associated with dAVF. These fistulae may be associated with persistent SDH collections or refractory reaccumulations. While the true incidence and natural history of dAVF associated with traumatic SDH is unknown, we posit that cerebral angiography may be a necessary component in the complete evaluation of traumatic SDH.

Keywords: SDH, Embolization

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

Embolic Stroke of Undermined Significance with Unusual Degree of CSF Neutrophilic Pleocytosis

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Introduction:

A 50 year old African American female with a history of hyperlipidemia, hypertension, diabetes mellitus, and peripheral artery disease with right lower extremity bypass earlier in 2021 presented with altered mental status (AMS) and right-sided facial droop. She presented to an outside hospital where her temperature was 102.1° F and blood pressure was 185/84. The National Institute of Health Stroke Scale (NIHSS) was 16. Notable labs included white blood cell (WBC) count 10.3, sodium 133, lactate 2.7. Urine drug screen notable for THC. Urinalysis, CXR, COVID screen were negative. CT of the head did not show acute findings, CT angiogram did not show any stenosis or large vessel occlusions and CT perfusion revealed perfusion deficits in the left hemisphere. Given her elevated temperature and lactate, a lumbar puncture (LP) was performed. Cerebrospinal fluid (CSF) analysis revealed WBC count 58 (95% neutrophilic predominance), RBC count 128, glucose 324 (serum glucose 576), protein 77 and lactate dehydrogenase (LDH) 23. Concerns for meningitis lead to her being started on broad spectrum antibiotics (ampicillin, ceftriaxone, acyclovir, and vancomycin). She was then transferred to our comprehensive stroke center for further management.

Methods:

Initially she remained febrile and somnolent, but after 36 hours of antibiotics, her mentation improved. Antibiotics and antivirals were slowly tapered after the CSF meningitis panel, gram stain, cultures, and viral PCRs came back negative. MRI of brain showed acute left posterior cerebral artery (PCA) ischemic stroke with punctate infarcts of right lentiform nucleus and periventricular area. Transthoracic echocardiogram (TTE) showed the left ventricle with severe hypertrophy and ejection fraction (EF) 65-70%. There was concern for endocarditis with systemic infection, however transesophageal echocardiogram (TEE) was negative for infectious vegetations and bubble study was negative. Blood cultures showed no growth after four days. Syphilis screen, ANA, HIV were also negative. Lipids were elevated with total cholesterol 214 and LDL 138. Hemoglobin A1c was also elevated at 13.

Results:

After being stable for several days, the patient's NIHSS reduced to three, two points for right homonymous hemianopia and one point for minor facial paralysis. An implantable loop recorder was placed to monitor for any arrhythmias that may have led to her stroke and the patient was discharged home on aspirin and atorvastatin.

Conclusions:

With the initial presentation of fever and AMS in this patient, there was high suspicion of infective endocarditis. She also suffered an ischemic stroke which was determined to be embolic from an undetermined source. The patient did not meet modified Duke Criteria for "possible infective endocarditis" which is considered when the patient has one major and one minor criteria or three minor criteria. Two minor criteria were met including a temperature > 38°C on admission and vascular embolic

phenomena (stroke). Interestingly, blood and CSF cultures never grew an organism although the CSF WBC count was 58. While CSF lymphocytosis has been associated with TIA-like presentations and other viral or fungal etiologies associated with ischemic stroke, this is perhaps the first case of a neutrophilic-predominant CSF pleocytosis in setting of ischemic stroke without a clear source.

Keywords: Acute Stroke, Inflammation, Medical Management

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

Endovascular Management Of Infectious PICA Aneurysm In The Setting Of Recent Dental Work

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Introduction:

Infectious intracranial aneurysms (IIA) of the posterior inferior cerebellar artery (PICA) are exceedingly rare and have been infrequently reported. IIAs are typically distal and located in the anterior circulation, particularly the middle cerebral artery and its distal branches. Etiology is secondary to hematogenous spread of septic emboli from a proximal source such as infective endocarditis. Few cases have documented an association between IIA and dental disease or procedures. We describe a rare case of an infectious PICA aneurysm in the setting of recent dental work and successfully treated with endovascular intervention.

Methods:

An 88-year-old male with medical history of atrial fibrillation on anticoagulation presented with one month duration of recurrent falls and progressive generalized weakness. CT head demonstrated left cerebral hemorrhage with scattered subarachnoid hemorrhage. MRI brain noted a rounded enhancing intra-axial lesion located at the left paramedian cerebellum measuring 7 mm in maximal dimension. Further investigation with cerebral angiography demonstrated an infectious intracranial aneurysm of the left PICA. He underwent workup with an echocardiogram that noted a mobile echo density on the aortic valve consistent with a vegetation. Blood cultures were positive for *Streptococcus salivarius* and *viridans*. Investigation revealed that he had recent dental work performed and missed taking his prophylactic amoxicillin. Infectious disease was consulted and etiology was determined to be seeding of aortic valve from recent dental procedure that ultimately led to IIA formation.

Results:

Patient was treated with 6-week course of intravenous ceftriaxone and underwent glue embolization for his left PICA aneurysm. Post embolization angiogram did not reveal any evidence of contrast filling within the aneurysm. He tolerated the procedure well with no complications and was subsequently discharged to inpatient rehabilitation with a modified Rankin scale (mRS) score of 3.

Conclusions:

IIAs of PICA in the setting of recent dental procedures are exceptionally rare and challenging to diagnose. They may be clinically silent until rupture and are usually identified incidentally on imaging or during autopsy. Physicians should maintain vigilance for this unique entity as prompt recognition and timely intervention may prevent severe morbidity and mortality.

Keywords: Intracerebral Aneurysm, Endovascular Therapy, Aneurysm Embolization, Subarachnoid Hemorrhage,

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

Endovascular Thrombectomy For Straight Sinus Thrombosis

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Introduction:

Cerebral venous thrombosis (CVT) is an under-recognized disease that accounts for roughly 1% of all strokes¹. It presents a diagnostic challenge due to its varied and ambiguous presentation, which on average, delays diagnosis by 7 days. Pre-disposing factors include trauma, pregnancy, dehydration, and medications such as oral contraceptives. In one study, 50% of CVT occurred during pregnancy or puerperium². Seven out of 8 cases of CVT presented postpartum among 50,700 deliveries in Canada³. Clinical signs and symptoms range from a mild headache to decreased level of consciousness depending on the location of thrombosis. Up to 13% of individuals can have poor outcomes despite anticoagulation therapy.

Methods:

A 28-year-old, 7-week postpartum female awoke with a headache and difficulty speaking, followed by urinary and bowel incontinence. Her clinical status worsened and was admitted to an outside hospital where CT-head without contrast revealed right temporal lobe hypodensity. A hyperdense straight sinus sign was present but not recognized at that time. She was transferred to our hospital and MRI brain demonstrated extensive vasogenic edema in the basal ganglia, thalami, and deep white matter with cytotoxic edema in bilateral watershed areas from severe hydrocephalus. MR-Venography showed extensive cerebral venous thrombosis in the inferior sagittal sinus, vein of Galen, straight sinus, and left transverse and sigmoid sinuses. Upon transfer to our facility, NIHSS was 9 for decreased level of consciousness and aphasia with episodes of left-sided clonic movements. Despite adequate anticoagulation therapy, she continued to decline with extensor posturing and a comatose state.

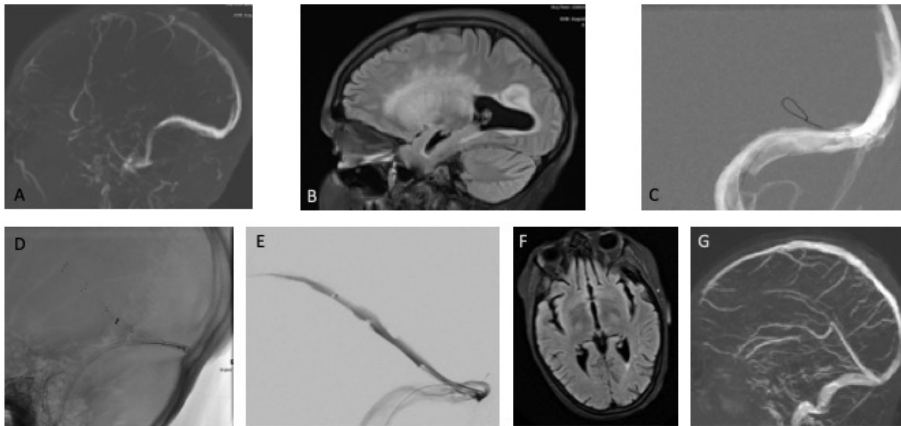
Results:

Since the findings on MRI-brain were predominantly vasogenic edema, thrombectomy was performed with a stent-retriever and aspiration, with complete recanalization of her straight sinus. Subsequent MRIs demonstrated improvement and resolution of the edema and hydrocephalus. Hypercoagulable work-up revealed an elevated protein C and antithrombin III and she was transitioned to enoxaparin and discharged to LTACH. At four-month follow-up she was able to speak and walk with physical therapy.

Conclusions:

We highlight the importance of early recognition of deep venous thrombosis as it commonly affects level of consciousness. A subtle finding, it should be in the differential diagnosis of alteration in level of consciousness without obvious neuroimaging findings. The AAN guidelines for management of CVT do not advocate for thrombectomy in all patients as large randomized controlled trials do not currently exist. However, they recognize that thrombectomy may be considered if deterioration occurs despite intensive anticoagulation treatment. The TO-ACT trial found no significant difference in mortality between intervention and medical therapy, aggressive intervention with thrombectomy prevented a

larger stroke burden in our patient. Therefore, thrombectomy should be considered in patients suffering from CVT, particularly in refractory and extensive cases.



A) Baseline MRV demonstrating no flow through straight sinus (SS); **B)** T2 FLAIR demonstrating extensive deep edema;
C) Microwire in occluded SS; **D)** Stent-retriever and aspiration catheter in SS; **E)** Near complete recanalization of SS;
F) Four-month MRI demonstrating complete resolution of edema with no long-term FLAIR changes;
G) Four-month MRV demonstrating continued recanalization of the SS

Keywords: Cerebral Sinus Thrombosis Therapy, Cerebral Sinus And Venous Thrombosis, Interventional Neuroradiology, Mechanical Thrombectomy,

Financial Disclosures: The authors had no disclosures.

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Poster

Evacuation of Bilateral Intracerebral Hemorrhages Using a Novel Disposable Surgiscopic System: A Case Report

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Introduction:

Patients presenting with intracerebral hemorrhage (ICH) face higher rates of morbidity and mortality than other stroke patients. Currently, these patients are managed by surgical intervention and decompression or medical management, depending on categorization of the hemorrhage. Simultaneous, multifocal hemorrhages are a rare presentation of ICH that portend a worse prognosis. Here we report the treatment of bilateral simultaneous ICHs in a young patient with diagnostic cerebral angiography, biopsy, and bilateral minimally invasive surgiscopic ICH evacuation in a single procedure.

Methods:

The patient was a young female who presented to an outside hospital after two days of progressively worsening headaches and vomiting. Her medical history was significant for systemic lupus erythematosus (SLE), hypertension, chronic migraines, and opioid use disorder. In the emergency department, her mental status deteriorated, and she was intubated. Computed tomography (CT) scan was performed and showed a right parietal 43.3 cc ICH and a left parietal 38.7 cc ICH. MR angiogram and venogram showed no evidence of vascular malformations but were suggestive of potential cerebral venous sinus thrombosis. Upon arrival, the patient remained intubated but was able to open her eyes, follow commands, and respond to stimulation. The patient was brought to the angiosuite for diagnostic cerebral angiography which revealed diffuse intermittent arterial narrowing suggestive of vasculitis and patent venous sinuses. The patient was then positioned in the prone position and bilateral parietal 1.5 cm craniectomies were performed. Surgiscopic evacuation was performed sequentially using stereotactic navigation to access and evacuate each clot. A right parietal brain biopsy was performed at the minimally invasive cortical access point.

Results:

Active bleeding was encountered in both hematoma sites and was treated with a combination of irrigation and monopolar cautery transmitted through the Aurora Evacuator. After complete evacuation of the hematomas on both sides, an intraoperative conebeam CT was performed, demonstrating good right-sided evacuation and resident left-sided hematoma. Additional evacuation was performed on the left side and repeat conebeam CT demonstrated good bilateral evacuation. CT head on post operative day 1 showed 97.7% right-sided evacuation and 81.5% left-sided evacuation. The patient was treated with steroids for presumed vasculitis given the angiographic findings, which was later supported by the results of the brain biopsy. The patient made a good recovery and was discharged from the hospital alert and oriented, with CN II-XII grossly intact, no focal deficits, and 5/5 strength in all extremities.

Conclusions:

Minimally invasive ICH evacuation can be performed in the angiosuite for ICH-associated with vasculitis and even multifocal ICH when appropriate. Performing the procedure in the angiosuite permits completion of the diagnostic cerebral angiogram, brain biopsy, and hematoma evacuation at the same time, accelerating time to treatment for a patient with severe, symptomatic vasculitis.

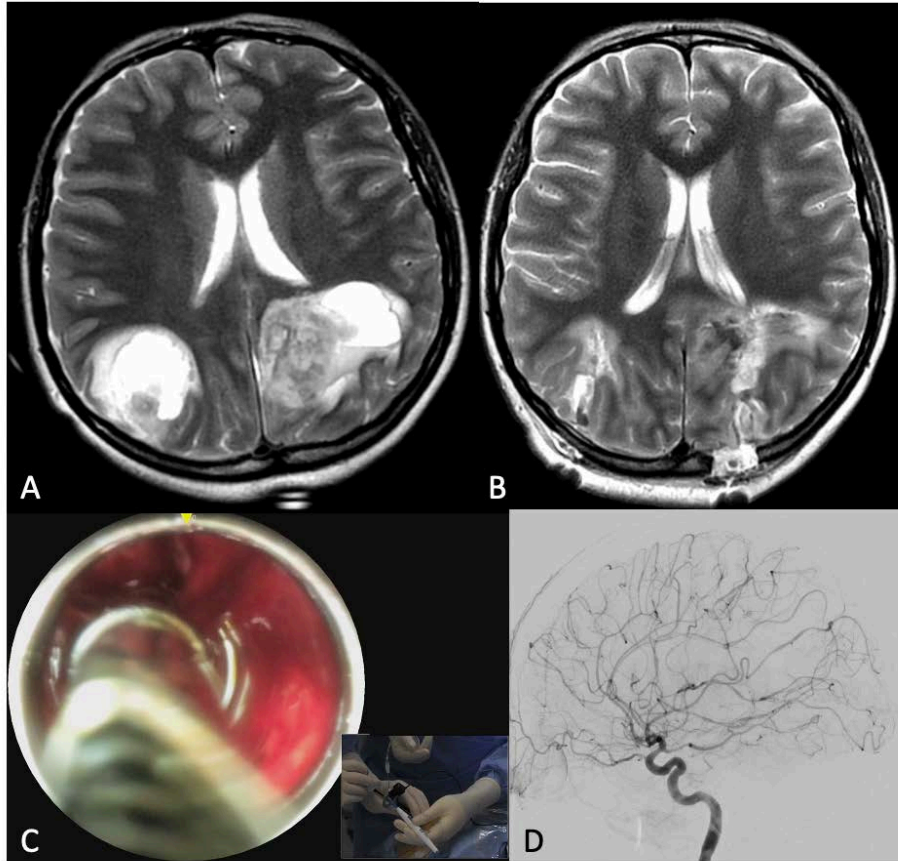


Fig 1: A) MRI of PreOp hemorrhage B) MRI of PostOp hemorrhage C) Surgiscope view of the hematoma with the Aurora Evacuator. The picture-in-picture shows monopolar cautery applied to the proximal shaft of the evacuator. D) Sagittal view of internal carotid artery (ICA) vasculitis

Keywords: Hemorrhage, New Technique, Stroke

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

Flow reversal after stent diversion causes in-stent thrombosis and anemia-driven ischemia

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Introduction:

Large symptomatic ICA aneurysms are rare, but present a life threatening risk of rupture that increases with size, female sex, and age >50 at the time of diagnosis, among other risk factors. Historically, large carotid aneurysms have been treated with intentional carotid sacrifice, requiring recruitment of contralateral, posterior, and ECA-supplied collaterals to provide flow to the anterior circulation previously supplied by the sacrificed ICA, lest the patient experience an iatrogenic stroke. While still a viable option in some cases, flow diverting stents provide an attractive alternative to vessel sacrifice. By providing a channel for blood to bypass the aneurysm, the stent can effectively exclude the aneurism from active circulation while preserving a path for blood to travel to the anterior cerebral circulation it currently provides.

Methods:

Here, we present a case of a 1.3 cm symptomatic left cavernous ICA aneurysm treated with such a flow diverting stent.

Results:

The patient presented to the emergency department with left sided ptosis. CTA head and neck revealed the 1.3 cm left sided cavernous ICA aneurysm. She was treated endovascularly under general anesthesia with continuous intra-operative monitoring. The procedure was complicated by iatrogenic flow reversal through the Circle of Willis at the time of stent deployment and resultant in situ thrombosis of the stent without alteration in electrical signals recorded at the scalp – thus creating a de facto carotid sacrifice without intra-operative complication. Follow up doppler study revealed a loss of flow through the left ICA and reversal of flow through the ophthalmic artery on the left side, thus confirming ECA collateral supply to the area. Post-op course was complicated by extensive bleeding from the scalp electrode sites used for intraoperative monitoring due to hyper-response to aspirin-ticagrelor dual-antiplatelet therapy. This gave rise to a symptomatic anemia that manifested as pressure-dependent left-sided circulatory failure on exam – specifically hemiparesis and aphasia. The symptoms ultimately resolved with pressure augmentation, blood transfusion, and supportive care in the Neuro ICU. The patient was successfully transitioned to a general neurology floor with subsequent resolution of the anemia and, correspondingly, the symptoms.

Conclusions:

The patient was discharged to rehab and at 4-month follow-up is again living independently with no residual deficits. This case has significance for pre-operative anti-platelet optimization for flow diverting stents, management of post-operative complications of flow-diverting stent placement including thrombosis and bleeding, and optimal critical care support for patients with pressure-dependent ischemia. Specifically, the course of the patient's symptoms and anemia raise the question of optimal

hemoglobin targets in the subset of patients with pressure-dependent ischemia, and how to best reach those targets.

Keywords: Aneurysm, Cerebral Blood Flow, Endovascular Therapy, Medical Management

Financial Disclosures: I founded and own financial holdings in biotechnology companies that develop biologics. No relation to neurology or neuro intervention.

Grant Support: None.

Poster

Giant Brain Aneurysm: a Case Report in a Pediatric Patient

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Introduction:

The incidence of intracranial aneurysms in the pediatric population ranges from 1 to 3 per million inhabitants. Within this population, aneurysms are even rarer in lactating patients. Unlike the adult population, the male gender is predominant, and the incidence is more significant in the posterior circulation, with a higher percentage in the middle cerebral artery. Microsurgical and endovascular treatment has been described as feasible treatment in these cases.

Methods:

Methodology: Description of a case report of a patient admitted to the Pediatric Intensive Care service of the Hospital Materno Infantil in Tegucigalpa, Honduras. We took informed consent from parents for the patient's treatment and subsequent academic dissemination of the clinical and neuroimaging data.

Results:

Case report: A two-year-old male patient presented to the pediatric emergency department with a 24-hour evolution of sudden headache of severe intensity, accompanied by nausea and multiple episodes of vomiting. At hospital arrival, the patient presented an episode of generalized epileptic seizures. At the initial clinical neurological evaluation with altered consciousness somnolent. Motor examination revealed a right facial and body hemiparesis and Hunt and Hess of 1. Noncontrast cerebral tomography (NCCT) showed Fisher IV subarachnoid haemorrhage, left frontal lobar intraparenchymal hematoma and acute hydrocephalus (Fig 1A).

Consequently, we placed an external ventricular shunt, for which the patient was admitted to the pediatric intensive care unit. The computed tomography angiography (CTA) showed a giant aneurysm in the anterior communicating artery (Fig. 1B). The patient underwent an endovascular procedure with the placement of coils with a successful result (Fig. 1C and Fig. 1D).

Conclusions:

Giant aneurysms are sporadic in children. They are commonly associated with the posterior circulation and, to a lesser extent, the middle cerebral artery is more commonly affected with the anterior circulation. Aneurysms in children tend to be more extensive compared to their adult counterparts. Clinically, they present with subarachnoid haemorrhage and seizures, as in our case. This case is a pediatric patient with a giant brain aneurysm at a less common age and rare localization. Endovascular management was successful, adding information to the therapeutic spectrum in these cases. It is essential to perform a detailed angiographic investigation. Surgery is the treatment of choice; however, clinical trials are needed to clarify endovascular versus microsurgical management.

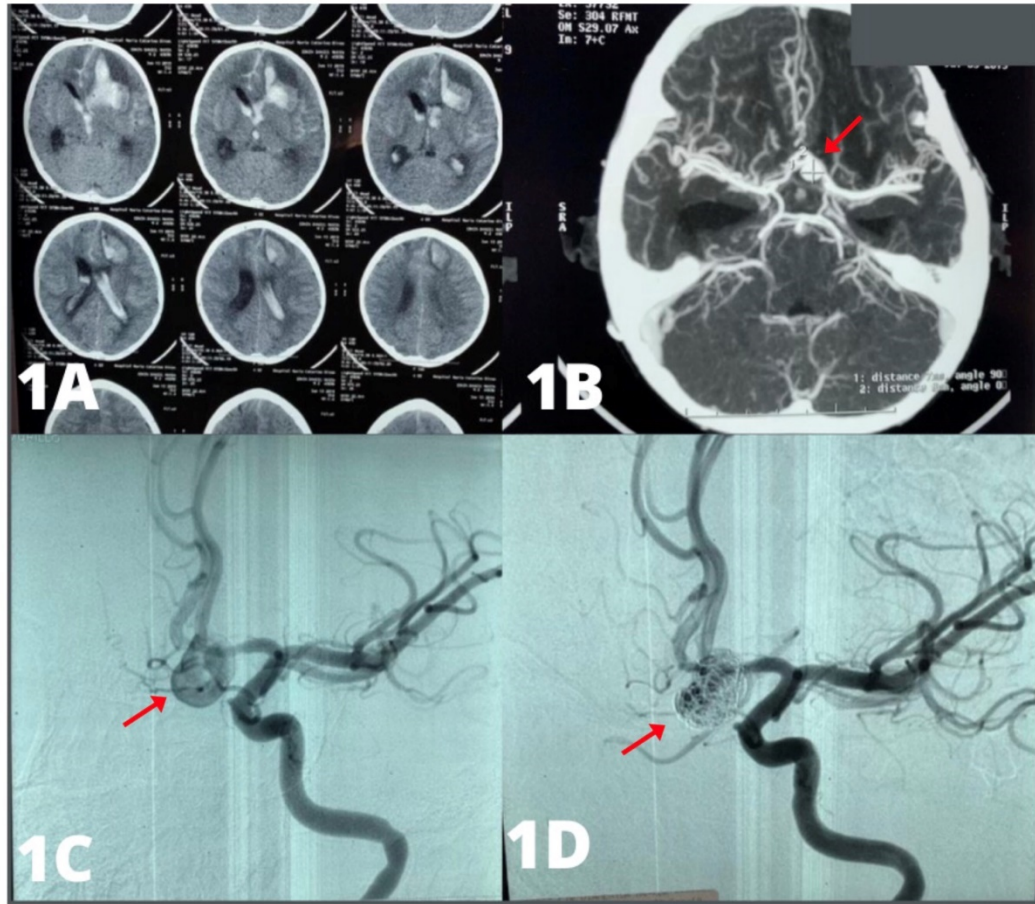


Fig 1. A. NCCT shows Fisher IV subarachnoid haemorrhage with a left frontal lobar intraparenchymal hematoma and acute hydrocephalus. B. CTA shows a giant aneurysm in the anterior communicating artery. C. Digital subtracted angiography shows a giant aneurysm in the anterior communicating artery and D. shows the aneurysm prior the embolization with coils.

Keywords: Aneurysm, Aneurysm Embolization, SAH,

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

Isolated Diplacusis due to Ipsilateral Temporal lobe infarction: A Case Report

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Introduction:

Double hearing or Diplacusis is a synchronous double perception of a sound and can have Binauralis or Monauralis pattern, with inner ear disorders being the main culprit ^[1]. Other forms of Auditory illusions have been reported as a co-manifestation of stroke syndromes, but none as an isolated presentation ^{[1][2]}. This is a case of a 77-year-old male with acute onset isolated Diplacusis in a patient due to a right temporal lobe ischemic infarct. To our knowledge, this is the first case report of an isolated diplacusis due to cortical infarct.

Methods:

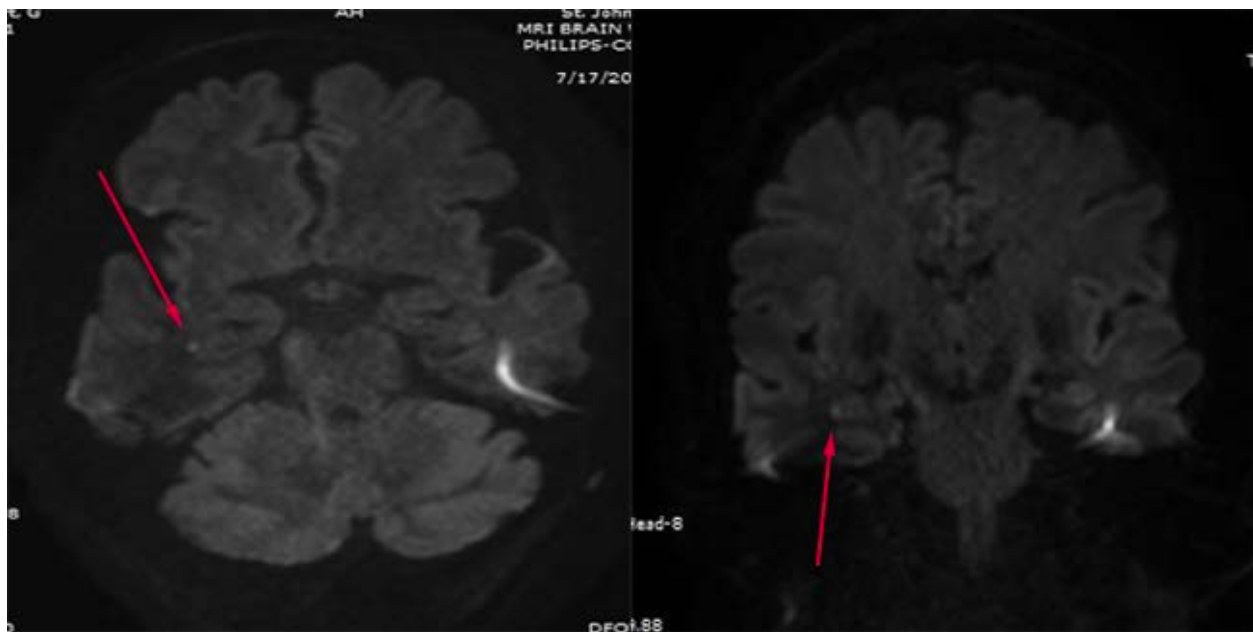
A case presentation with Pubmed search of review articles and case reports.

Results:

The patient had a past medical history of sensorineural deafness in his left ear. He described any sound heard as the same quality but occurring with an echo heard a fraction of a second later in his right ear. There was no decreased hearing quality or tinnitus reported in his right ear. His drug screen test was negative. His examination was only remarkable for a sensorineural hearing loss pattern on his left ear. His (NIHSS) was zero, and no other cranial nerve abnormalities were detected. His MRI was significant for a punctate restricted diffusion on the right temporal lobe, resembling an ischemic infarct (Figure).

Conclusions:

Isolated diplacusis can present as acute ischemic stroke in the temporal lobe. Further studies are needed to understand its pathophysiology.



Keywords: Acute Stroke, Stroke, Imaging

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

LVO in the setting of TTP

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Introduction:

Thrombotic Thrombocytopenic Purpura (TTP) is a disorder of coagulation caused by a deficiency of ADAMTS13 due to either hereditary mutations or acquired autoimmune inhibitors. Low levels of ADAMTS13 metalloprotease leads to Von Willebrand Factor (VWF)-platelet aggregation and microvascular thrombosis when patients with TTP are exposed to high shear stress in the microcirculation. [1] Hematologic disorder or coagulopathies are the major cause of 1-4% of all ischemic strokes. [2] TTP patients usually present with small vessel strokes or sometimes very distal branches of large arteries. The gold standard treatment for acute stroke in these patients is plasma exchange, however in patients presenting with LVO strokes, recanalization therapies should be considered. [3] Here we present a case of large vessel occlusion stroke in the setting of TTP.

Methods:

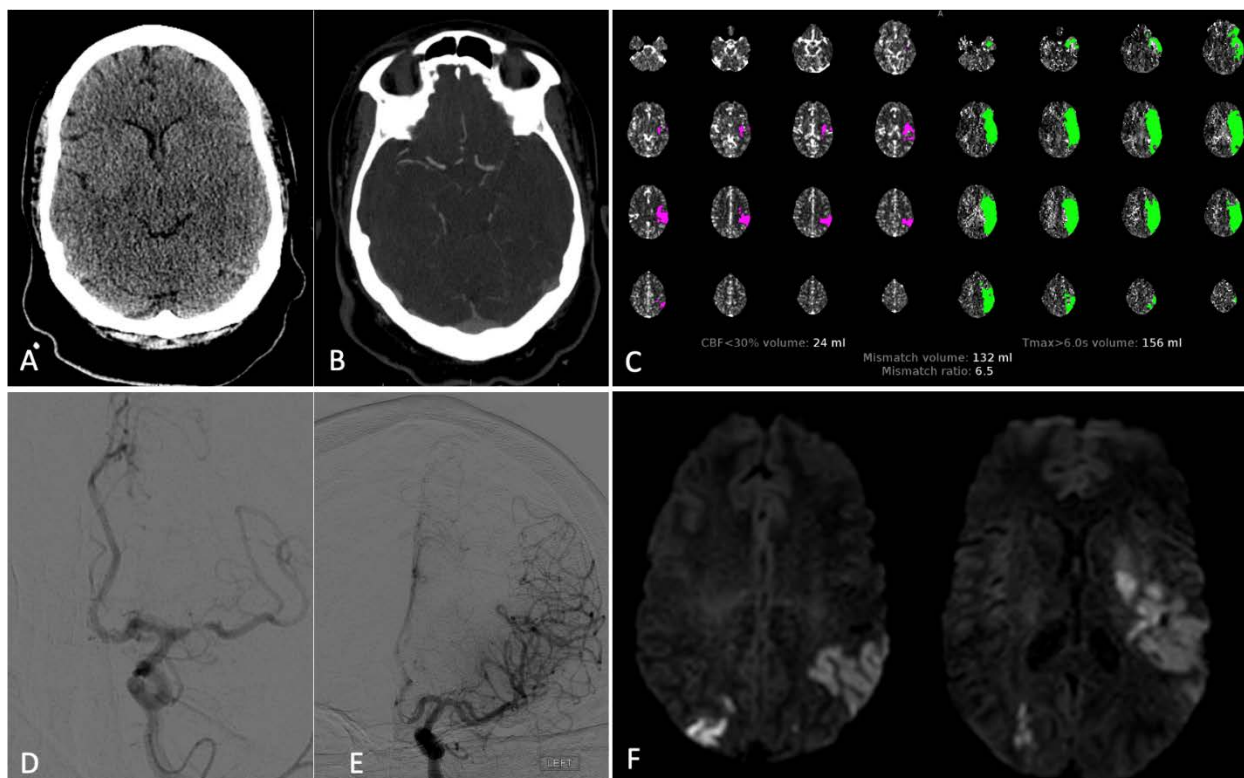
31-year-old African American female with TTP and Strokes admitted to with right sided hemiparesis, and expressive aphasia within 2h of symptom onset. National Institute of Health Stroke Scale (NIHSS) of 16. Laboratory work up significant for Platelets 114k, Hemoglobin 12, PTT 24 seconds, Serum glucose 107, ADAMTS-13 <1 IU/dL and negative COVID-19 PCR. CTH showing ASPECTS of 9 (Picture A), CTA head and neck revealing a left MCA occlusion and intracranial vessel irregularities in the left Anterior Cerebral Artery (ACA) and bilateral Posterior Cerebral Arteries (PCA) (Picture B). CTP with 24cc core and 132 cc mismatch (Picture C). Patient was taken to the Angiogram Suite for urgent thrombectomy with a final TICl score of 3 achieved after one pass (Picture D/E).

Results:

Post procedure NIHSS was 1 for mild expressive aphasia. Brain MRI revealed Left MCA and right parietal territories infarct (Picture F). Transesophageal Echocardiogram was unremarkable. She underwent urgent Plasma Exchange (PLEX) for TTP flair in light of undetectable ADAMTS-13, significant drop in platelet count and thrombotic event. After 5 PLEX sessions platelets remained stable with counts greater than 150,000. Immunotherapy with Prednisone, Caplacizumab, Atovaquone and Mycophenolate Mofetil was continued and she was discharged home on day 7 from admission.

Conclusions:

Our patient had severe and refractory disease presenting with LVO and underwent an unusual therapeutic approach considering the etiology of her disease. IV thrombolysis and arterial thrombectomy are well established therapies for acute strokes in the general population, but are rarely performed in patients affected by Thrombotic Microangiopathy (TMA) such as TTP. Safety and efficacy of these procedures have not been studied in this population and it is usually selected by extrapolating data from studies that used individuals without TMA. We aim to illustrate this uncommon case of LVO stroke in the setting of TTP and potentially stimulate the elaboration of studies that include these patients.



Keywords: Endovascular Therapy, Mechanical Thrombectomy, Medical Management, Coagulation, MCA

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

Multiple Watershed Strokes Following Catheter Ablation Procedure

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Introduction:

Cerebral watershed strokes involve the junction of two non-anastomosing arterial systems, which are hemodynamic zones at risk. Strokes occur in 3% to 9% of patients after cardiac procedures. The mechanism underlying post-cardiac surgery watershed stroke involves a combination of hypoperfusion and embolization, but the role of hypoperfusion has not been well elucidated. Watershed strokes in the general population are usually secondary to global hypoperfusion, such as during cardiac arrest, but may also be attributable to stenosis of the carotid artery or other major vessel, leading to local hypoperfusion. Atrial fibrillation confers a threefold to fivefold increase in the risk of stroke, causing 15-20% of all thromboembolic events in the United States. Catheter ablation of atrial fibrillation is the treatment of choice, and currently one of the most commonly performed electrophysiology procedures in the United States. Successful catheter ablation in patients with atrial fibrillation is associated with a decrease in systolic blood pressure. One study showed that in patients with hemodynamically significant stenosis, the average decrease in mean blood pressure during TIA attack was 26.4. mm Hg. In addition, carotid artery stenosis is frequently associated with stenosis of the vertebral arteries, carotid siphon, and cerebral arteries. In these patients, cerebral blood flow is directly dependent on perfusion pressure, due to the loss of normal autoregulatory capacity in the cerebral circulation.

Methods:

Single Case Study

Results:

84-year-old male patient with a past medical history of hypertension, gastrointestinal hemorrhage, coronary artery disease status post coronary artery bypass graft, prostate cancer, and atrial flutter on Apixaban status post recent catheter ablation performed five days prior to presentation at the hospital. Patient presented to the emergency room with complaints of spotty vision. The remainder of the neurologic exam was unremarkable. Patient's vision changes started after the cardiac ablation procedure and progressively worsened. At the time of assessment, NIH score was 1 due to left eye hemianopsia. CT scan of the head without contrast was done and was negative for hemorrhage. CTA of the neck showed 60% stenosis of the left carotid artery. MRI of the brain was done and showed infarct zones between the right anterior cerebral artery and right middle cerebral artery, the right middle cerebral artery and right posterior cerebral artery, the left anterior cerebral artery and left middle cerebral artery, and in the area supplied by the right posterior cerebral artery. Interestingly, based on the radiologic features, all of these strokes happened at approximately the same time.

Conclusions:

This case demonstrates that even in asymptomatic patients with hemodynamically insignificant carotid stenosis, hypotensive episodes can elicit hemodynamically significant changes that may result in ischemic stroke. Current guidelines don't include radiologic assessment of the carotid arteries before catheter ablation procedure in patients with known atherosclerotic disease. Based on our findings, in patients with known atherosclerotic disease, we recommend radiologic assessment of the carotid arteries prior to catheter ablation. Patient who undergo catheter ablation usually have an echocardiogram done prior to the procedure.

Keywords: Acute Stroke, Angiographic Ct, Acute Ischemic Stroke Intervention, Carotid, Imaging

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

Parenchymal and Subarachnoid Angiogenesis in Patients with Vein of Galen Aneurysmal Malformation

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Introduction:

Vein of Galen Aneurysmal Malformation (VGAM) is an arteriovenous malformation that accounts for 30% of all pediatric vascular malformations. VGAMs undergo significant remodeling of hemodynamic and structural anatomy due to angiogenesis. These changes not only affect the malformation on a molecular and morphological basis, but may also lead to alterations in planned surgical procedures. It is imperative to better understand the dynamic, angiogenic environment of the cerebrovasculature in order to more effectively treat this disease.

Methods:

We present 36 cases of secondary angiogenesis in VGAM. We also present three case reports of angiogenesis secondary to VGAM.

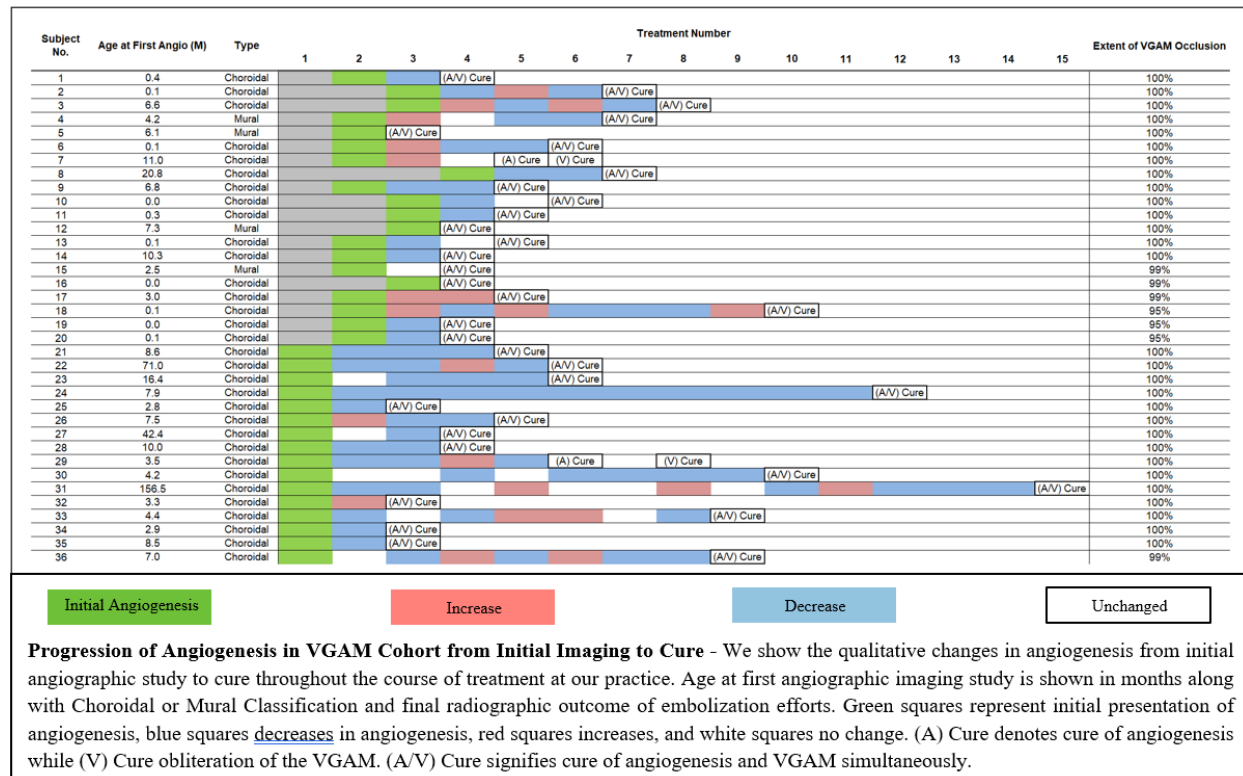
Results:

Pre-interventional angiogenesis was identified in 16 patients (44.4%) and post-interventional angiogenesis in 20 patients (55.6%) following a stage of embolization therapy. The cohort of patients with pre-interventional secondary angiogenesis was significantly older than patients with post-interventional angiogenesis at initial angiogram (12 months $\pm$ 40.1 months vs. 4.0 months $\pm$ 5.4 months; $p < 0.05$). Choroidal VGAMs presented with angiogenesis more frequently than Mural VGAMs (4/14 Mural vs 32/42 Choroidal; $p < 0.01$). Angiogenesis was localized to either the left, right, or bilateral thalamus in 2 cases, to the cisternal space surrounding the VOG in 16 cases, and both in 18 cases.

Conclusions:

Upon identification of secondary angiogenesis, our team's strategy is to embolize the venous component of the fistula. The ideal strategy in our practice is cannulation of the primary feeder of the malformation, as close to the fistula as possible, and injection of highly concentrated n-BCA glue (70%-90%) in a transarterial approach. After multiple rounds of embolization, feeders become less dilated and may be difficult to distinguish from angiogenesis. In this pattern, we use low-concentrate nBCA (40%-50%) from an identifiable, proximal feeder and occlude the venous component of the fistula. We identified two patterns of secondary angiogenesis: 1) pre-interventional angiogenesis identified at the initial diagnostic angiogram, 2) de-novo, post-interventional angiogenesis during the staged-embolization treatment-course. Occasionally, we noted random bursts of angiogenesis. A combination of the hypoxic environment, inflammation, and hemodynamic alterations to the VGAM caused by liquid embolic/coiling may lead to a burst of angiogenesis that subsides after repeated treatment. We hypothesize that the immature sinuses typically associated with VGAM patients, which experience a decrease in blood flow and subsequently narrow after embolization, may contribute to turbulent blood flow. Development of parenchymal and subarachnoid angiogenesis is common during the multi-session

treatment of VGAM. It represents the response to the angiogenic stimuli released from the draining vein. This angiogenesis can be observed to regress spontaneously or mature as we continue to treat the VGAM. It is unnecessary to embolize secondary angiogenesis outright and it is our recommendation to chiefly target primary feeders of the VGAM as close to the venous component as possible.



Keywords: Avm Embolization, Treatment, Embolization, NBCA, Cerebral Arteriovenous Malformations

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

Peri-embolization Use of Stent Retrievers as a Rescue Tool in Patients with Subarachnoid Hemorrhage

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Introduction:

Coil migration after endovascular embolization of intracranial aneurysms is one of the periprocedural complications in 2-6% of patients. Stent retriever use is well-established in treatment of ischemic stroke but has not been well established to address coil retrieval as rescue therapy. We describe three cases with successful removal of migrated coils using stent retrievers.

Methods:

A retrospective review at a single center university hospital was performed for all Neuro-endovascular case log from December 2018 to November 2020. Cases of coil migration were reviewed and coil retraction with Stent Retriever with successful coil mass extraction was considered an endpoint. Number of attempts, types of stent retrievers used and time taken for extraction were noted.

Results:

Case 1: 56-year-old female presented with ruptured tri-lobed 4x3 mm Anterior communicating artery aneurysm. Hunt and Hess (H&H) Grade 2. Modified Fisher scale (MFS) 4. Underwent primary coil embolization. Two 2mmx2cm Galaxy Orbit coils were deployed within aneurysm. During deployment of third coil the first two coils displaced out of the aneurysm migrating into left A2 segment. Stryker's Trevo 3x20 mm stent retriever was used for retrieval of coils however they dislodged at the left internal carotid artery (ICA) terminus and migrated distally into the left middle cerebral artery (MCA) M2 superior division. Subsequently, Medtronic's Solitaire 4x40 mm stent retriever was successfully deployed retrieving the migrated coils with full recanalization.

Case 2: 64-year-old female presented with ruptured 3x5.3 mm right posterior communicating artery (Pcom) aneurysm. H&H 5 and MFS 4. Underwent primary coil embolization with placement of Galaxy Orbit 2.5mmx3.5cm coil. On follow up run, coil mass had migrated into the origin of right fetal Pcom. Migrated coil was successfully retrieved using Stryker's 4x40 mm stent retriever with complete recanalization.

Case 3: 65-year-old female with presented ruptured 8.5 x 6.8 mm right supraclinoid ICA irregular aneurysm. H&H Grade 1. MFS 3. Underwent primary coil embolization with one Galaxy coil (5mm x 10cm) with plan for future flow diversion. Two weeks later, patient experienced acute neurological worsening with new left sided hemiparesis and right gaze deviation. Imaging revealed acute occlusion of right middle cerebral artery M1 segment occlusion with thrombosed migrated coil. Patient underwent retrieval of the coil and superimposed thrombus utilizing Stryker's Trevo (4*30 mm) stent retriever with resultant full recanalization.

Conclusions:

These cases demonstrate successful endovascular mechanical removal of migrated coils using stent retrievers. They add to the limited experience of stent retrievers utilization as effective tools for dealing with such complications.

Keywords: Aneurysm Embolization, Coiling, SAH

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

Persistent DWI signal for 18 months in ischemic stroke patient with carotid web

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Introduction:

Diagnostic tools for acute ischemic infarcts include the use of DWI sequence on MRI to identify acute infarcts is especially useful since lesions can become hyperintense on this sequence very rapidly (Albers 1998). Over the next 15 days, DWI hyperintensity slowly decreases back to isointense. In some patients, however, there is persistent DWI hyperintensity past 1 month. There are theories that these persistent areas exhibit delayed onset infarct, prolonged ischemia, or perhaps different repair processes (Rivers, et al 2006). To this day, all DWI signals have been known to resolve within a few months even for persistent hyperintensities (Rivers, et al 2006).

Carotid webs are a rare form of fibromuscular dysplasia that protrudes from the intimal tissues of carotid arteries. They are shelf-like projections that grow into the lumen and disrupt normal blood flow (Zhang, et al 2018). These outgrowths are theorized to lead to ischemic strokes due to flow stasis and subsequent embolization of clots that form (Zhang, et al 2018). There is no consensus on the best management of carotid webs, and secondary prevention of recurrent strokes range from medical management to carotid stenting.

Methods:

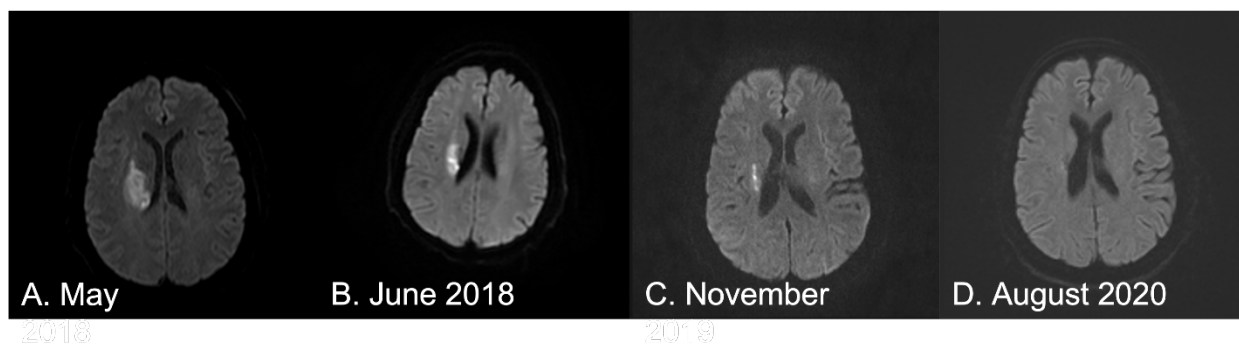
This is a case report, and information for the patient was gathered through review of medical records on the EMR.

Results:

We present a case of ischemic stroke in the right basal ganglia/corona radiata, who presented with left sided weakness. The patient was found to have prediabetes, HTN, and HLD. However, she had recurrence of her symptoms over the next 18 months (figure 1). Repeat MRIs showed persistent DWI hyperintensity that slowly decreased in size and signal intensity over this period but in the same area as the initial infarct. The rest of the work up was only significant for a carotid web in the right internal carotid artery identified on conventional angiography. Ultimately she was managed with medical therapy including aspirin, statin, and antihypertensives.

Conclusions:

It is unclear whether the carotid web is associated with persistent DWI for such an extended time frame. There is very little research that explores the pathophysiology of ischemic strokes from carotid webs. In addition, there is even less information about the physiology of an evolving infarct that shows persistent DWI signals for such an extended time frame. Further studies that look into carotid webs may help us understand the best long term management in such patients. Future studies that explore the physiology of ischemic strokes that show such persistent DWI signals may elucidate and perhaps expand upon current management options and possibly identify new areas for intervention.



Keywords: Stroke, Imaging

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

spinal cord infarction a young patient with a hypoplastic vertebral artery

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Introduction:

Rare presentation of disease processes is absolutely intriguing to the human mind. Spinal cord infarction is abundantly reported to be secondary to cardiological procedures, patients carrying multiple vascular risk factors and vertebral artery dissections. But for it to happen in a patient who is young, relatively healthy and without vascular risk factors is quite interesting. Herein, we present the case of a patient presented with bilateral upper extremity weakness, who has a hypoplastic right vertebral artery that has coincided with him being a professional gamer with exerting compression from video-gaming posturing of “forward leaning with neck hyperextension”, resulting in cervical spinal cord infarction.

Methods:

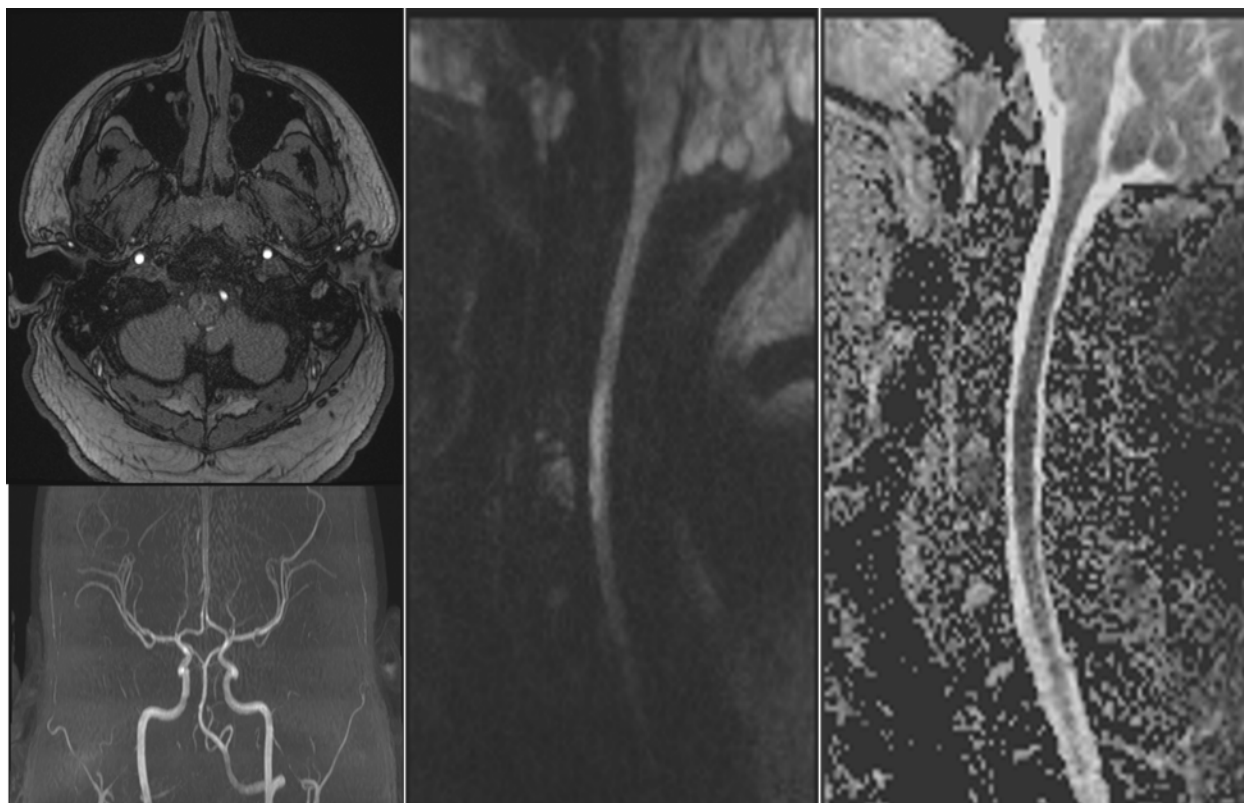
Case report

Results:

Vertebral artery dissection was excluded by CTA and MRA. our hypothesis was that the patient is a professional gamer and his posture of leaning forward and neck hyper-extension had a role in inducing his spinal cord infarction given the fact of him having a hypoplastic right vertebral artery.

Conclusions:

Vertebral artery disease is a well-recognized cause of ischemia in the posterior cerebral circulation. Recently, however, cervical cord infarction, albeit being extremely rare, has been increasingly reported as a complication of vertebral artery diseases such as dissection. Awareness must be raised that such condition can also happen in the young population due to compression of the vertebral arteries, especially when one is hypoplastic.



Keywords: Acute Stroke, Vertebral

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

Understanding The Gap In Public Stroke Awareness In India's Younger Generation

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Introduction:

Stroke is one of the major leading causes of death and disability in India. One reason is the lack of stroke awareness in India. With the adoption of an unhealthy lifestyle like a lack of physical exercise, smoking, and excessive alcohol consumption, newer stroke cases are more prevalent in young adults. I surveyed about 100 high school students from urban cities in India to assess their stroke knowledge and decide how to take measures to bring more awareness about its symptoms, risk factors, and new effective treatments.

Methods:

I randomly selected high school students(9th-12th graders) from Uttarakhand, Uttar Pradesh, Madhya Pradesh, Maharashtra, and Karnataka states to participate in the survey I created. I distributed multiple-choice anonymous questionnaires to hundreds of high school students. The participants completed survey questions to the best of their ability. The survey assessed candidates' demographic characteristics, knowledge of stroke symptoms, stroke risk factors, ability to identify stroke symptoms, and knowledge about stroke-related surgeries. It is important to note that these surveys were primarily sent to high school students in urban areas, where the knowledge and resources are relatively better than the rural areas.

Results:

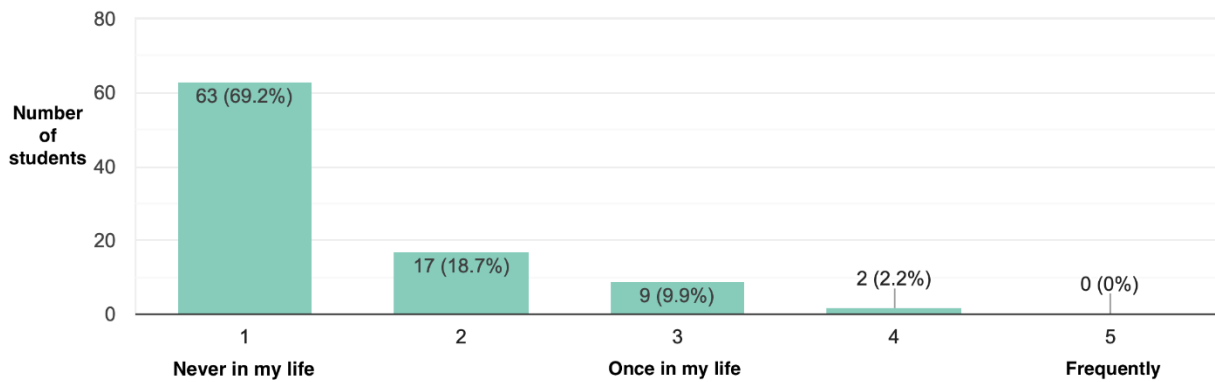
I received a total of 91 survey responses from high schoolers across different states in India (30% were from Madhya Pradesh, 40% were from Maharashtra and 30% were from Karnataka and Uttar Pradesh). Even though 53.8% of the respondents reported some level of prior knowledge about the stroke, the rest of the respondents simply did not know or had misconceptions about stroke. Nearly ¾ did not know any stroke risk factors, warning signs, or recognize that the brain gets affected during the stroke. Only 27.5% of the students have heard of the popular acronym BE FAST(Balance Eyes Face Arms Speech Time) which is used to detect stroke in a patient. It is shocking that only 12.1% of the respondents have received an education on stroke at least once in their lifetime.

Conclusions:

The high schoolers have a good recognition of some basic facts of stroke. However, they have a poor understanding of stroke risk factors, the severity of the disease, and the treatment availability. However, there is hope. More than 57% of the high schoolers in my survey mentioned that they were willing to learn about stroke and ways to prevent and detect it. So it is our duty to educate the younger generation about the dangers of stroke and how to prevent, as well as to detect it. We should strive to provide access to these children in the hope of helping spread awareness all around India one step at a time.

Have you ever recieved any education towards the topic of Stroke

91 responses



Keywords: Mechanical Thrombectomy, Care, Stroke, Ischemic And Hemorrhagic Stroke, New Technique

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

Unique Clinical Finding of Localized Bifacial Hyperhydrosis in a Patient with Basilar Artery Thrombosis

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Introduction:

Sweating abnormalities accompanied with other neurological deficits have been reported after cerebral infarcts involving the operculum, medulla and pons; however, these have always caused hyperhydrosis of the entire unilateral side of the body including the face, arms and legs.

Methods:

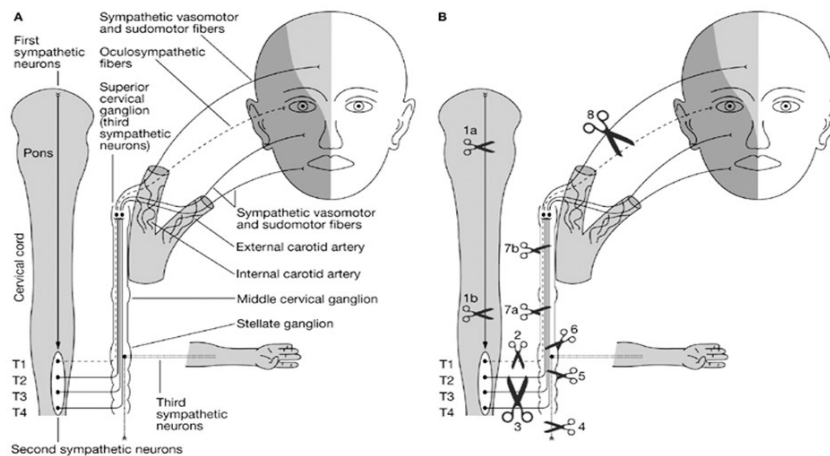
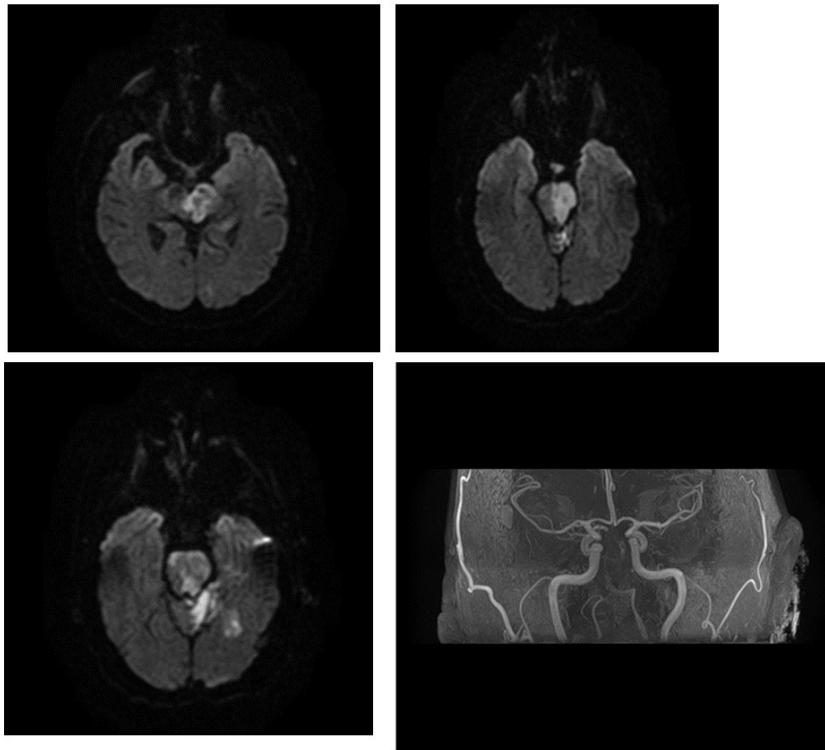
A 59 year old male who was found unresponsive to verbal and noxious stimuli after being admitted to our hospital for a vascular surgery procedure. He did not withdraw to pain in any of the extremities including to sternal rub. Pupils were bilaterally equal and reactive to light and the patient did not have any facial asymmetry. He did have intact brainstem reflexes initially in the first day. He was admitted to the Medical ICU and a brain MRI was obtained after initial head CT head was found to be unremarkable. MRI demonstrated a large bilateral pontine acute infarct, more prominent on the left side. There was also acute infarction in the left thalamus as well as some involvement of left midbrain. An MRA of Brain showed complete occlusion of the mid-distal basilar artery.

Results:

The patient subsequently was found to have excessive sweating of both sides of his face, forehead and head from day 1 of the stroke onwards. This occurred independent of the patient's body temperature (37C) and room temperature (28C). The patient remained afebrile for the next few days; however, profuse sweating continued for the next two weeks when he passed away. The patient continued to remain intubated and unresponsive off sedation during this time.

Conclusions:

Pure Bifacial hyperhydrosis might indicate bilateral pontine lesions. This appears to be due to disruption of a putative inhibitory pathway that controls sweating of the contralateral face and body. This pathway originates in the operculum and ends in the sympathetic sudomotor neurons in the contralateral thoracic spinal cord via the hypothalamus and brainstem. It is likely that in our patient, only the bulbar fibers of this pathway were disrupted making the face the only part with excessive sweating.



Keywords: Basilar, Cerebrovascular Disease, Stroke, Thermoregulation, Vertebral

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

Vorapaxar as an alternative for ticagrelor resistance in neuroendovascular intervention

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Introduction:

Perioperative dual-antiplatelet therapy (DAPT) for flow diversion (FD) limits thromboembolic complications. Practice of DAPT varies across the neuroendovascular field but typically includes aspirin and an ADP receptor antagonist such as clopidogrel, prasugrel, or ticagrelor. Unfortunately, resistance to DAPT medications remains a concern for neuroendovascular intervention, and there is a current lack of standard alternatives for such resistance. The main goal of this abstract is to discuss ticagrelor resistance and to inform possible therapeutic options.

Methods:

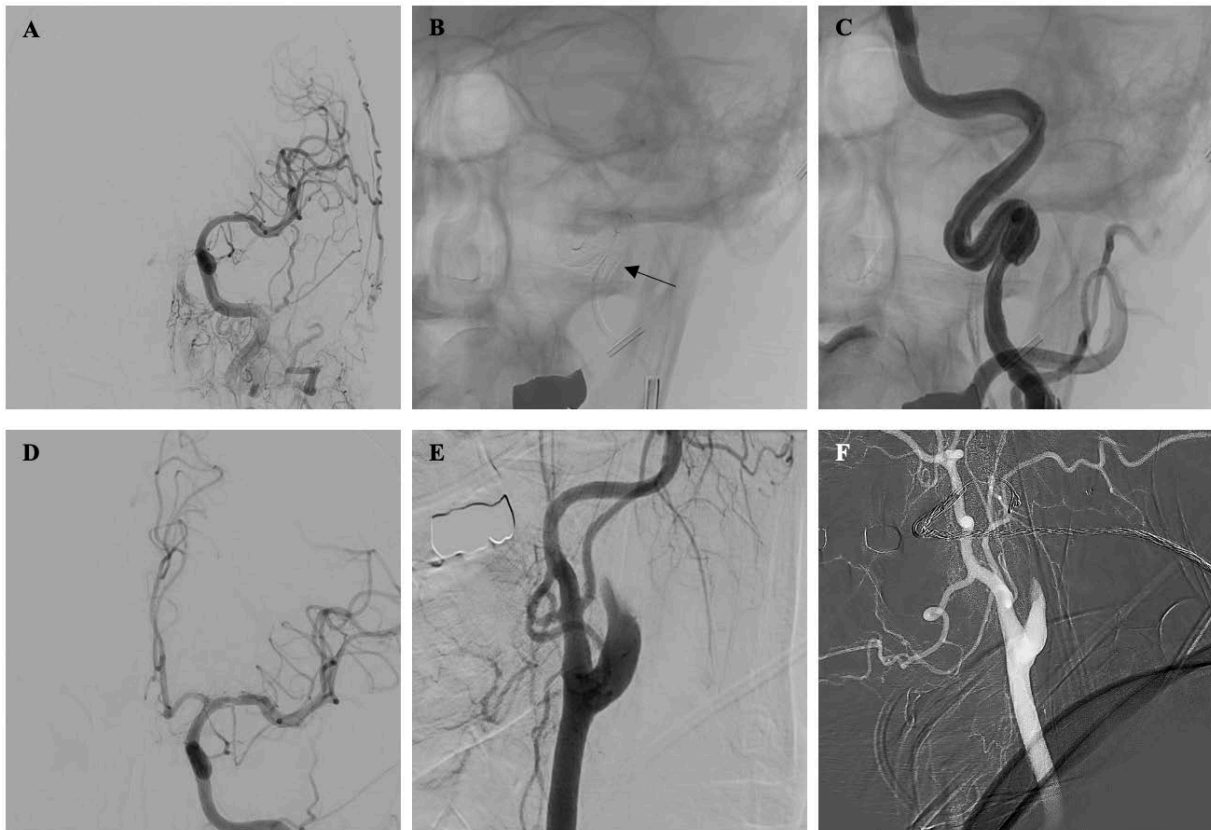
We report a case of vorapaxar treated FD for an intracranial aneurysm in a patient with ticagrelor resistance. FD was deployed for a left internal carotid artery (ICA) blister aneurysm and bilateral ICA dissecting pseudoaneurysms (Figure 1). We also provide a narrative review on previous reports of ticagrelor resistance and associated treatment responses. We used the keywords: "ticagrelor," "resistance," "hypo-response," "stent thrombosis," and "aneurysm." These were implemented in various combinations with Boolean operators in three databases: PubMed, Ovid MEDLINE, and Ovid EMBASE.

Results:

During a complicated clinical course, the patient had three thromboembolic complications while on DAPT with ticagrelor or prasugrel leading to transition of antiplatelet therapy to vorapaxar. Thromboelastography with platelet mapping (TEG-PM) routinely demonstrated inadequate platelet inhibition, which was confirmed with platelet function analyzer-100. Initial TEG-PM results were 0.0% ADP receptor inhibition and MA-ADP of 62.2 mm. Repeat angiograms also indicated thromboembolic formation after each of the three events (Figure 1). After introduction of vorapaxar, the patient had adequate platelet inhibition with TEG-PM results of 49.1% ADP receptor inhibition and MA-ADP of 48.3 mm. At 84 days follow-up, the patient was fully recovered with complete occlusion of the aneurysms. In a narrative review of the literature, there were ten previously reported cases of ticagrelor resistance or hypo-response: three cases in the neuroendovascular literature and seven cases in the cardiovascular literature. Among all of the cases, there was a variability in protocol for treating patients with suggested ticagrelor resistance. All three neuroendovascular cases either employed another ADP receptor antagonist in hopes that the resistance would not generalize or eliminated DAPT altogether and settled for aspirin alone. In some of the cardiovascular cases, ticagrelor was even continued after patients exhibited laboratory evidence of resistance or hypo-response.

Conclusions:

Given the paucity of cases describing ticagrelor resistance or hypo-response in the neuroendovascular and cardiovascular literature, management of DAPT should remain a multifactorial decision depending on the clinical situation. Moreover, we need to consider therapeutic alternatives for cases of resistance such as thrombin receptor antagonists, specifically PAR1 receptor antagonists like vorapaxar. High quality randomized controlled trials are needed to elucidate the safety and efficacy of vorapaxar in neuroendovascular procedures.



Keywords: Flow Diverter, Pipeline, Intracerebral Aneurysm, Antiplatelet, Platelet Testing

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

INARI FlowTrieve system: First Endovascular Clinical Experience to Treat Diffuse Cerebral Venous Sinus Thrombosis

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Introduction:

Cerebral Venous Sinus Thrombosis (CVST) is a rare stroke with a wide range of symptomatology at presentation ranging from headache, focal weakness, and coma. Anticoagulation remains the mainstay of treatment. However, in a subset of patients endovascular treatment can be potentially beneficial. Here we describe the first clinical experience using the INARI FlowTrieve system to treat a patient presented with focal weakness and found to have diffuse cerebral venous sinus thrombosis.

Methods:

Case report of CSVT treated with INARI FlowTrieve system.

Results:

A 78-year-old female with past medical history of Autoimmune hepatitis and hypothyroidism, was brought to the hospital with left arm weakness. CT head revealed left temporoparietal intraparenchymal hemorrhage and right frontal subarachnoid hemorrhage. CTA of the head and neck revealed extensive CVST involving superior sagittal sinus, bilateral transverse and sigmoid sinuses. She was started on heparin drip. Patient was taken for venous thrombectomy due to persistent left-sided weakness and multicompartiment bleeding while being on anticoagulation for 48 hours. She underwent successful endovascular venous thrombectomy using the INARI FlowTrieve system with large clot burden extracted. She was switched to novel oral anticoagulation prior to discharge. During the 3 months follow-up—MRI brain with and without contrast revealed near complete resolution of the clot burden in the superior sagittal sinus and left transverse/sigmoid complex and her modified Rankin score was at 0.

Conclusions:

Here we discussed a case of diffuse CVST who was treated initially with heparin drip then underwent endovascular venous thrombectomy using INARI FlowTrieve system with large clot burden aspirated with a reasonable safety profile. The INARI medical FlowTrieve system is the only mechanical thrombectomy system indicated for the treatment of pulmonary embolism. It is specifically designed for venous clots. It is composed of a trackable large bore aspiration catheter. The INARI FlowTrieve Catheter; has 3 expanding nitinol mesh disks; designed to engage and disrupt venous clots and subsequently deliver it to the large bore aspiration catheter. Its larger size makes it an attractive candidate for venous sinus clot retrieval. This study illustrates the first clinical use of INARI thrombectomy device in CVST with a reasonable safety profile. Anticoagulation is the mainstay first line treatment for CVST. However, a small subset of patients would potentially benefit from endovascular treatment but it still uncertain how to select these patients and what is the best timeline to offer early

endovascular treatment. Various neuro endovascular techniques has been attempted to treat cerebral venous sinus thrombosis. However; it is unclear which approach and device provides the optimal restoration of venous blood flow. Current neuro endovascular techniques and devices are not particularly designed for CVST pathology treatment and there is need for further innovation and new devices.

Keywords: Cerebral Sinus And Venous Thrombosis, Mechanical Thrombectomy

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

Mechanical Thrombectomy for Cerebral Venous Sinus Thrombosis in the setting of APL

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Introduction:

28 year-old woman with newly diagnosed acute promyelocytic leukemia (APL) undergoing chemotherapy with tretinoin and arsenic trioxide developed new onset headache and binocular diplopia. Neurologic exam was significant for bilateral papilledema and bilateral abducens nerve palsies. MR venogram showed incomplete opacification of the right and left transverse sinuses consistent with thrombosis. Therapeutic dose enoxaparin was started and she was taken to the neuroangiography suite.

Methods:

The left internal jugular vein was catheterized, and the microcatheter was advanced to the opacified left sigmoid sinus. A stent retriever was then deployed and suction thrombectomy was performed, with improvement of the filling defect. Next, the right internal jugular vein was catheterized and the right sigmoid sinus was accessed. Suction thrombectomy was performed, but due to residual thrombus, a stent retriever was deployed in the right transverse sinus and suction thrombectomy was reattempted, with improved recanalization.

Results:

Patient returned to the unit and continued therapeutic enoxaparin. Three days post-procedure, she developed worsening headache and syncope. She was again taken to neuroangiography suite and the RIJ vein was again catheterized. Venogram after advancing the catheter to the right sigmoid sinus showed multiple filling defects in the proximal right transverse sinus. The catheter was advanced to the sigmoid sinus and a stent retriever was introduced; multiple attempts were made to remove the thrombus. Follow-up venogram showed significant improvement in recanalization. The LIJ vein was then catheterized and venogram was performed, showing worsening filling defect in the left sigmoid sinus. A stent retriever was deployed in the left transverse sinus and suction thrombectomy was performed, however there was still significant residual thrombus. Suction thrombectomy, another stent retriever attempt and finally balloon angioplasty were then performed with some improvement of patency.. Follow-up CTV 5 days post-procedure showed stable venous sinus filling defects. Patient reported gradual improvement of headaches and was transitioned to apixaban. On follow-up evaluation 3 months post-procedure, patient reported resolution of headaches and diplopia.

Conclusions:

CVST is generally treated with systemic anticoagulation based on data from two randomized trials, however, ISCVT showed that 13% still decline on anticoagulation. Data regarding the safety and efficacy of MT for CVST is lacking, as well as data regarding patient selection. Our initial decision to treat with MT was due to involvement of posterior fossa and signs of increased intracranial pressure, which are potential prognostic factors for clinical decline with anticoagulation alone from ISCVT. Our patient was initially treated with therapeutic enoxaparin, however developed neurologic deterioration, so she was taken back to the neuroangiography suite. This case report illustrates an example of successful

utilization of endovascular therapy for CVST in a patient with acute neurologic deterioration, with good neurologic outcome following recanalization

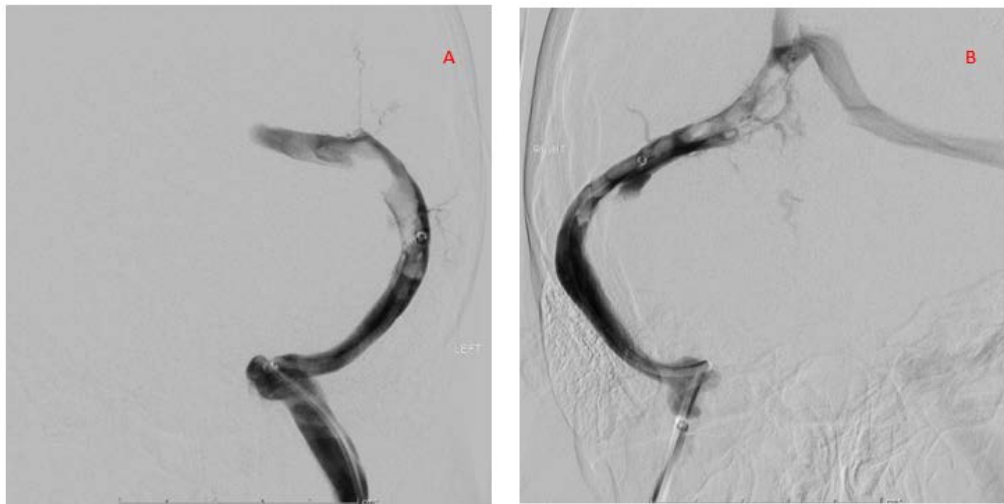


Figure. Bilateral cerebral venous sinus thrombosis. A) Left Transverse, Sigmoid and B) Right Transverse sinus, filling defects delineating extensive sinus thrombosis.



Figure. Post intervention venography demonstrating improved sinus patency. C) Left transverse, sigmoid, and D) Right transverse sinus improved venous drainage.

Keywords: Cerebral Sinus And Venous Thrombosis, Cerebral Sinus Thrombosis Therapy, Endovascular Therapy, Mechanical Thrombectomy,

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

Stent Retrievers Utilization in Endovascular Treatment of Cerebral Venous Sinus Thrombosis

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Introduction:

Patients with Cerebral Venous Sinus Thrombosis (CVT) are candidates for Endovascular Mechanical Thrombectomy (EMT) in cases of coma on presentation or clinical deterioration despite anticoagulation. We present two cases of CVT successfully treated with mechanical thrombectomy using Medtronic's Solitaire Stent retriever.

Methods:

A retrospective review at a single center university hospital was performed for all cerebral venous sinus thrombosis case log from December 2018 to November 2020. Cases resistant to conventional medical therapy that underwent intrasinus stent retriever endovascular thrombectomy were noted.

Results:

Case 1: 26 year-old male with a history of hypertension presented with 2 weeks of headaches, left sided numbness and blurriness of vision. Imaging revealed superior sagittal (SSS) and bilateral transverse sinus thrombosis. Patient was treated with heparin infusion and discharged home on oral apixaban. The following day he presented with new onset expressive aphasia. Imaging was unchanged. Due to worsening symptoms despite anticoagulation, Patient underwent mechanical thrombectomy using a stent retriever. Solitaire 6x40 mm stent was advanced and deployed through the microcatheter and retracted in the upper segment of posterior one third of SSS followed by alteplase infusion at 1 mg/hr (25 ml/hr) via Berenstein catheter for the next 36 hours. Intravenous heparin infusion was also started with aPTT goal 60-80. Cerebral angiogram was repeated two days later revealing successful recanalization of previously thrombosed SSS and bilateral transverse sinuses with significantly improved cerebral venous drainage. Patient was transitioned again to oral apixaban. Repeat CTA in 3 months showed significantly improved patency and recanalization.

Case 2: A 42 year-old male with history of ulcerative colitis presented with sudden onset right-sided hemiparesis and hemisensory loss along with one month of headaches. Presenting NIHSS 14. Imaging revealed SSS thrombosis with thrombosis of the left transverse sinus complicated by left frontal intraparenchymal hemorrhage and subarachnoid hemorrhage. Patient underwent mechanical thrombectomy of SSS using Solitaire 6 x 40mm stent retriever with distal aspiration resulting in improved flow. Clinical course was complicated by seizures and acute respiratory distress syndrome requiring intubation followed by tracheostomy and G-tube placement which were eventually removed during recovery. Patient was treated with high intensity heparin during his hospitalization and eventually transitioned to apixaban. Work up revealed protein S deficiency. Serial CT angiograms at 6 and 11 months revealed resolution of CVT. NIHSS improved to 1 with mRS of 2.

Conclusions:

These cases imply that intra-cerebrovenous sinus mechanical thrombectomy with stent retrievers may be considered in patients with continuing worsening despite optimal medical management.

Keywords: Cerebral Sinus Thrombosis Therapy, Endovascular Therapy, Mechanical Thrombectomy

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

Anticoagulation Versus Antiplatelet Alone in Acutely Symptomatic Carotid Artery Stenosis

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Introduction:

Acutely symptomatic carotid artery stenoses carry a significant risk of early ischemic recurrence. Timely initiation of effective antithrombotic therapy and revascularization interventions are necessary to reduce the risk of recurrent events. While antiplatelet agents are widely used, there is some limited evidence supporting short term anticoagulation as well. Moreover, most patients require early revascularization with carotid endarterectomy (CEA) which is almost exclusively performed with anticoagulant protection. Thus, we sought to determine the potential safety and efficacy of short term pre-operative anticoagulation in the secondary prevention of stroke/TIA from acutely symptomatic carotid stenosis.

Methods:

A prospective single institution registry of carotid revascularization was queried retrospectively. We included all CEA patients who presented to the hospital with acute ischemic strokes or TIAs attributed to the ipsilateral stenotic lesion of the internal carotid artery. Treatment arms were assigned based on exclusive use of antiplatelet agents (AP) or use of anticoagulant (AC) with or without additional antiplatelet agents.

Results:

443 patients were identified; 342 treated with anticoagulation (97.7 % IV Heparin) and 101 with antiplatelets alone (95.1% aspirin, 23.8% clopidogrel and 24.8% aspirin and clopidogrel). Baseline characteristics for the antiplatelet and anticoagulation groups were similar except for mean age (73±9.5 vs 71±10.5), premorbid mRS (1.4±1.3 vs 1.0±1.2) and stroke as presenting symptom (53.5 vs 65.8%). Notably the stroke severity (admission NIHSS), degree of stenosis, presence of intraluminal thrombus or median time to surgery was balanced between treatment arms. Patients treated with anticoagulation had significantly lower incidence of recurrent TIA/Stroke (10.9 vs 3.8%, p=0.006). Symptomatic ICH was only observed in 1 patient in the AC arm and none of the AP group and postoperative bleeding was similar (2 vs 2.3%, p=0.83). AC appeared to be protective with OR 0.30 (p=0.007) for incidence of the primary outcome when controlling for degree of stenosis, presence of intraluminal thrombus, stroke severity, premorbid mRS, age, gender and time to surgery.

Conclusions:

Our findings suggest short term pre-operative anticoagulation in patients with acutely symptomatic carotid stenosis awaiting revascularization is a potentially safe and effective alternative to antiplatelet agents alone. Confirmatory prospective studies are warranted.

Keywords: Carotid, CEA

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

Stroke Risk of Carotid Artery Stenting Using Balloon-Guide Catheter Versus Distal Embolic Protection Devices

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Introduction:

Prevention of distal embolization during carotid artery stenting (CAS) is a key element of procedural technique and is standardly performed using distal protection devices (DPDs). Data in support of DPDs, however, are limited. Here, we present our experience of proximal occlusion using a balloon guide catheter (BGC) during CAS as the primary method of distal embolic protection.

Methods:

We conducted a retrospective review of patients undergoing CAS at our healthcare system between January of 2018 to March of 2021. Procedures were categorized by embolic protection strategy: DPD or BGC (with or without DPD). Emergent cases were defined as patients receiving CAS within <24 hours of presenting with an ischemic stroke or TIA ipsilateral to the carotid disease side. Severe stenosis was defined as 70-99% per NASCET criteria. The primary outcome was rate of procedural ischemic stroke between the DPD and BGC groups, and was defined as acute focal neurological deficit lasting for ≥ 24 hours following CAS related to an embolic event during the procedure.

Results:

A total of 126 CAS procedures were performed during the study period. 91 cases were performed under proximal BGC protection (of which 24 also included DPD usage) and 35 CAS cases via DPD as a primary mean for embolic protection. The median age for the cohort was 68 [IQR 62-76], 37% females, 31% (n=39) cases were treated emergently, and elective cases were 69% (n=87). Baseline characteristics were similar in both groups except for hyperlipidemia (BGC vs DPD, 71.4% vs 42.9%; p=0.003) and history of smoking (BGC vs DPD, 56% vs 34.4%; p=0.029). Severe carotid stenosis was present in 80.2% BGC group and 77.1% in DPD (p=0.573). Post-stenting balloon angioplasty was more frequent in the BGC group as compared with DPD (54% vs. 26%, BGC vs. DPD, p=0.005). Procedural embolic stroke rates were low in both groups, and not significantly different (1.1% vs. 2.9%, BGC vs. DPD, p=0.48).

Conclusions:

CAS with BGC as the primary means of distal embolic protection showed comparable, low rates of procedural embolic ischemic events compared to those with DPD. These findings suggest BGC embolic strategies may be a viable alternative to DPD usage.

Keywords: Carotid Stenting And Angioplasty, Balloon Guide Catheter, Angioplasty, Stroke, Acute Stroke

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

Demographic and Pharmacological Characteristics of Dementia Patients with Parkinson's Disease Stratified by Gender

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Introduction:

Gender differences in dementia patients and Parkinson's Disease have been investigated extensively; however, factors that contribute to gender differences in Parkinson's Disease with Dementia patients (PDD) is not fully understood. In this study, we tested the hypothesis that specific, demographic, and pharmacological factors may be associated with men and women patients with PDD, and contribute to gender differences.

Methods:

Data collected for 5 years from 7594 PDD patients was analyzed using univariate analysis to determine different factors associated with men or women with PDD. Multicollinearity interactions between independent variables in the model were examined using variance inflation factors

Results:

Overall, 55.22% of the PDD patients were men while 44.77% were women. In the adjusted analysis, Aripiprazole (OR=0.581, 95% CI, 0.302-1.118, P=0.104), ETOH (OR=0.371, 95% CI, 0.260-0.531, P<0.001) African American (0.249, 95% CI, 0.088-0.703, P=0.009) with PD were more likely to be men. The use of Aripiprazole (OR=0.195, 95% CI, 0.06-0.631, P= 0.006), Escitalopram (OR=0.651, 95% CI, 0.468-0.906, P=0.011), and Tobacco (OR=0.620, 95% CI, 0.444-0.866, P=0.005) were associated with women.

Conclusions:

This study showed that women presented fewer cases of PDD than men. The current study reveals gender differences in PDD patients associated with specific demographic and pharmacological factors

Keywords: Clinical Investigations, Treatment

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

Impact of RNF213 p.R4810K variant on endovascular therapy outcome for acute large vessel occlusion stroke

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Introduction:

The ring finger protein 213 gene (*RNF213*) has been identified as a susceptibility gene for moyamoya disease, and the p.R4810K polymorphism as a founder variant commonly found in East Asian patients.¹ A recent large case-control study including over 46,958 Japanese subjects reported that the *RNF213* p.R4810K variant was a strong risk factor for Japanese cerebral infarction: the variant was found in 5.2% of patients with non-cardioembolic stroke and in 2.1% of healthy controls.² Mechanical thrombectomy (MT) is a standard treatment for acute ischemic stroke due to occlusion of the internal carotid artery and M1 segment of the middle cerebral artery, but in East Asians, about 15–25% of LVOs for which MT was performed were reportedly caused by intracranial atherosclerotic disease (ICAD).³ *RNF213* p.R4810K variant may be involved to some extent in ICAD-related LVO of Asian patients undergoing MT. In this study, we aimed to investigate the impact of *RNF213* p.R4810K variant on EVT for anterior circulation LVO stroke.

Methods:

Of the consecutive ischemic stroke patients from 2011 to 2021 seen in our institute, patients who underwent EVT for acute occlusion of the intracranial ICA or M1 segment of MCA and signed a consent form for *RNF213* genotyping were included. Outcomes were instant re-occlusion, final modified Thrombolysis in Cerebral Infarction (mTICI) ≥ 2 reperfusion, early re-occlusion, and modified Rankin Scale (mRS) score 0–2 at 90 days. Instant re-occlusion was defined as occurrence of re-occlusion during the procedure, whereas early re-occlusion as re-occlusion detected on magnetic resonance angiography within 2 weeks after confirmation of successful reperfusion at the end of the procedure.⁴

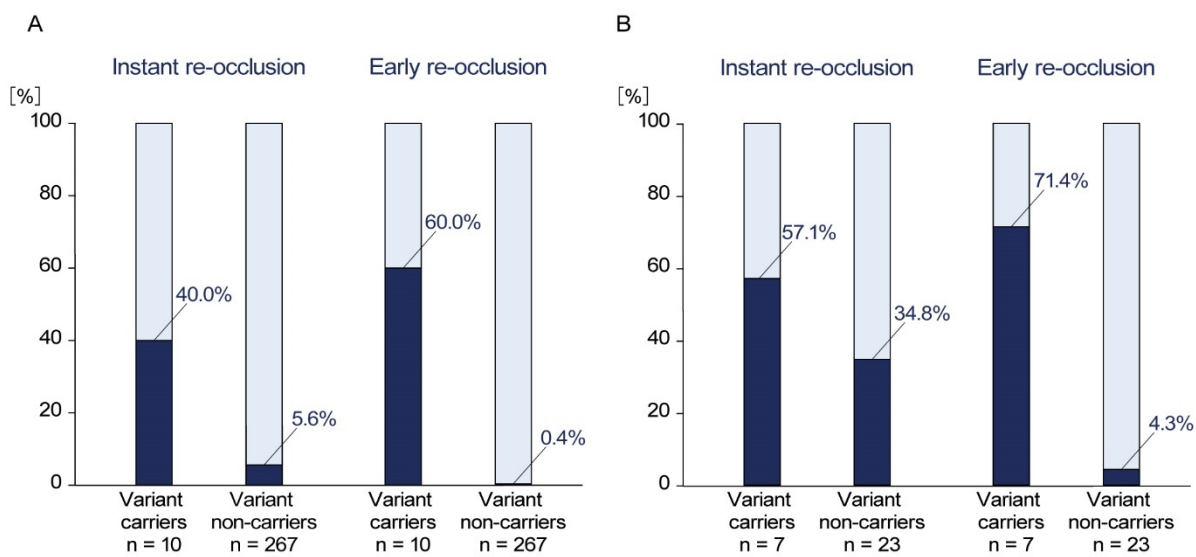
Results:

Of the 277 patients (128 women [46.2%]; median age, 76 years) analyzed, 10 (3.6%) patients had the *RNF213* p.R4810K variant. The variant carriers were younger (67 years vs. 76 years, $P < 0.01$), more frequently received angioplasty (40.0% vs. 12.0%, $P < 0.01$), and more frequently had intracranial atherosclerotic disease-related LVO as a cause of acute LVO (70.0% vs. 8.6%, $P < 0.01$) than non-carriers. The variant carriers showed higher rates of instant re-occlusion (40.0% vs. 5.6%, $P < 0.01$), but there were no statistically significant inter-group differences for the final mTICI ≥ 2 reperfusion rate between carriers and non-carriers (100.0% vs. 81.6%, $P = 0.22$). Early re-occlusion was more frequent in the variant carriers than non-carriers (60.0% vs. 0.4%, $P < 0.01$) with no intergroup difference in the rate of repeated

EVT (67.7% vs. 100.0%, $P=0.71$). There were no statistically significant inter-group differences for achievement of mRS score 0–2 (60.0% vs. 51.7%, $P=0.75$)

Conclusions:

Both instant and early re-occlusion were more frequent in the *RNF213* p.R4810K variant carriers who had received EVT for acute anterior circulation LVO than in the non-carriers. Potential impact of *RNF213* polymorphism status on EVT outcomes was clarified.



Keywords: Ischemic Stroke, Endovascular Therapy, Angioplasty, Atherosclerosis, Treatment

Financial Disclosures: The authors had no disclosures.

Grant Support: This study was supported by the Japan Agency for Medical Research and Development [grant number 19ek0210120h0001], the Japanese Society for Neurovascular Therapy [grant number 2020-B-6] and the SENSHIN Medical Research Foundation.

Poster

Study design and selection criteria of a large core thrombectomy trial — ANGEL-ASPECT

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Introduction:

The ANGEL-ASPECT trial (NCT 04551664) is an ongoing, multicenter, randomized controlled trial (RCT) currently being conducted in China. The goal of ANGEL-ASPECT's is to include the maximum patients with a true large core for whom EVT is not recommended under current guidelines with level 1 evidence. By enrolling patients with ASPECTS <6, expanding the window to 24h from stroke onset (beyond the windows in DAWN and DEFUSE3), and defining large core volume as >70 cc, ANGEL-ASPECT maximizes the inclusion of patients with true large cores. What's more, intracranial atherosclerotic disease (ICAD) is common in the Asian population while most of the previous trials have been performed in the Western world where ICAD is less prevalent.

Methods:

We reviewed the merits of ANGEL-ASPECT's design and suggest that it be included in the discussion of patient selection criteria in large core trials.

Results:

The primary goal of our trial is to determine whether EVT will benefit or harm AIS patients with LVO and a "large core" infarct. The inclusion criteria for ANGEL-ASPECT are:

1. If ASPECTS is 3-5 and presentation is within 24 hours of onset, patients are enrolled without obtaining CTP.
2. If ASPECTS is >5 and presentation is beyond 6 hours of onset, only patients with relative cerebral blood flow (rCBF) of < 30% by CTP or apparent diffusion coefficient (ADC) of < 620 on MRI and estimated core volume of 70-100 cc are enrolled.
3. If ASPECTS is <3, only patients with rCBF < 30% or ADC on MRI < 620 and estimated core volume of 70-100 cc are enrolled. Patients are enrolled under a pre-specified protocol. Each randomized patient is qualified by two core lab members who are available at all hours to calculate ASPECTS and infarct core volume using specialized, RAPID software.

Conclusions:

We believe that defining core volume using CTP can compensate for the inconsistencies of ASPECTS if we exclude patients with onset within six hours and core volume of 50-70 cc since these patients have already been shown to benefit from EVT in multiple RCTs. We believe that this decision captures more patients with true large core volumes for the trial. The ANGEL-ASPECT inclusion criteria also eliminate the second group of "good ASPECTS + unfavorable CTP". The sample size of our trial is calculated based on studies excluding these populations. The power of the trial was maintained for the relatively consistent large core volume patient population.

Table 1 comparison of all six "large core" trials

Trial	TENSION	LASTE	TESLA	RESCUE-Japan LIMIT	SELECT 2	ANGEL-ASPECT
Official Title	Efficacy and Safety of Thrombectomy in Stroke With Extended Lesion and Extended Time Window	Large Stroke Therapy Evaluation - ASPECT 0-5	Thrombectomy for Emergent Salvage of Large Anterior Circulation Ischemic Stroke	Randomized Controlled Trial of Endovascular Therapy for Acute Large Vessel Occlusion With Large Ischemic Core	A Randomized Controlled Trial to Optimize Patient's Selection for Endovascular Treatment in Acute Ischemic Stroke	Study of EVT in Acute Anterior Circulation LVO Patients with a large infarCT core
NCT Number	NCT03094715	IN EXTREMIS	NCT03805308	NCT03702413	NCT03876457	NCT04551664
Country	Austria, Canada, Czechia, Denmark, France, Germany, Norway, Slovakia, Spain	USA - EUROPE	United States	Japan	United States (Canada, Europe)	China
Imaging inclusion Criteria	NCCT or DWI ASPECTS 3-5	NCCT or DWI ASPECTS 0-5	NCCT ASPECTS 2-5	CT-ASPECTS 3-5 or DWI-ASPECTS 3-5 ;	1.ASPECTS ≥ 6 & core ≥ 50 cc 2.ASPECTS 3-5 & core ≥ 50 cc 3.ASPECTS 3-5 & core < 50 cc	1.ASPECTS 3-5 2.ASPECTS > 5 (> 6 h): core 70-100cc 3.ASPECT < 3 :core 70-100cc
NIHSS	< 26	NIHSS > 5	NIHSS > 6	NIHSS ≥ 6	NIHSS ≥ 6	NIHSS ≥ 30
Age	> 18 y	18-80y	18-85y	> 18 y	18-85y	18-80y
Time	< 12 h LSW	< 6.5 h LKW	Random < 24 h	Random < 6 h LKW , 6-24 FLAIR(-)	Treat < 24 h (0-12 vs 6-24)	Random < 24 h
Primary Outcome	mRS shift analysis	mRS 90d & 180d	Utility-weighted 90d mRS	mRS 0-3 90d	shift on 90d mRS	mRS 90d
Actual Study Start Date	2018.7.20	-	2019.7.16	2018.11	2019.10.11	2020.9.28
Estimated Primary Completion Date	2020.8.31	-	2022.7.16	2020.11	2021.5.1	2022.11

Core: [rCBF $< 30\%$] on CTP or [ADC < 620] ; Information source: <https://clinicaltrials.gov> and website

Keywords: Mechanical Thrombectomy

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

A Review of Effect of Ticagrelor on Platelet Inhibition in Clopidogrel Non-responders Undergoing Neuroendovascular Procedure

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Introduction:

Neuroendovascular procedures are becoming more routine in the treatment of intracranial conditions such as aneurysms, arterial stenosis, and ischemic stroke. These patients are frequently treated with antiplatelet agents prior to the procedure to prevent thrombotic complications. The combination of aspirin and a P2Y₁₂ inhibitor such as clopidogrel is often initiated days before elective procedures or as loading doses for emergent procedures. However, some patients may still experience post procedural thrombotic or hemorrhagic complications which may be related to platelet inhibition.

Methods:

A retrospective review of patients who underwent a neuroendovascular procedure from 1/2017 to 12/2019 in a single tertiary care academic hospital. Procedures included flow-diverting stent placement for aneurysms, intracranial, and cervical carotid artery stenting. Patients undergoing elective procedure were started on Aspirin and Clopidogrel 75 mg daily. Patients undergoing emergent procedures were given loading doses of Aspirin (650 mg) and Clopidogrel (600 mg). P2Y₁₂ assay was checked prior to receiving Platelet inhibitor and from 3-6 hours after Clopidogrel loading dose. Optimal platelet inhibition was classified as reduction in P2Y₁₂ assay by at least 60%. Patients with suboptimal platelet inhibition <60% were given Ticagrelor loading dose (180 mg) and P2y₁₂ assay was rechecked. Patients who did not have complete chart information, patients with AFib requiring DOAC and patients previously on ADP inhibitors, were excluded from analysis.

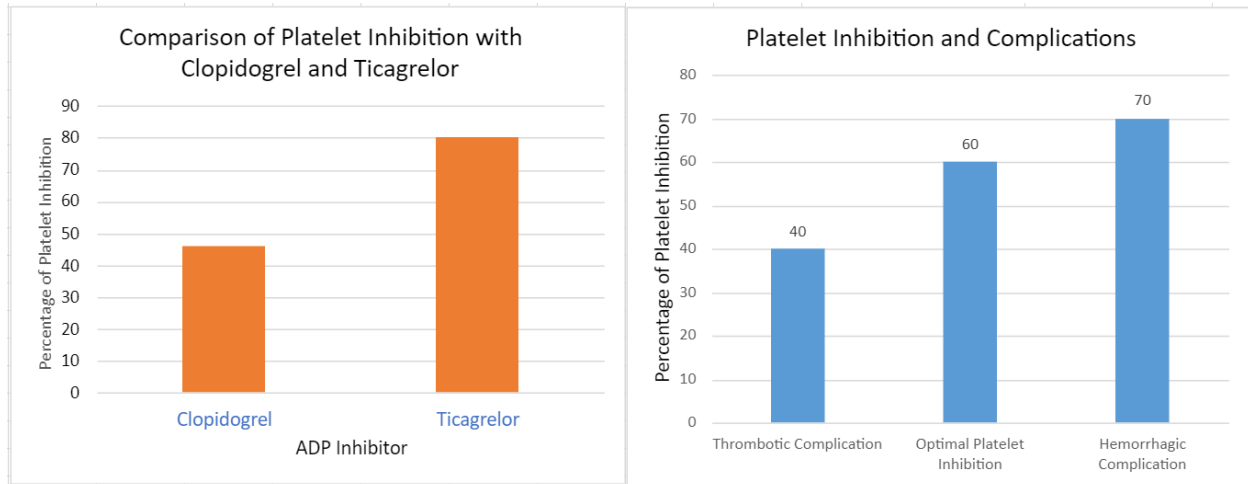
Results:

Total neuroendovascular procedures requiring stents were 687 over the period of 3 years. mean age of patients was 61 years. This neuroendovascular procedure consisted of aneurysm stenting (239), aneurysm stent-assisted coiling 112, intracranial stent for failed mechanical thrombectomy 62, carotid artery stent 108. Suboptimal platelet inhibition was noted in 54% (282) of 523 patients after receiving Clopidogrel. After receiving Ticagrelor, optimal inhibition was noted in 80% (226) of 282 patients with median increase of 26%. 62 patients with suboptimal response to Ticagrelor, 47 were started on Prasugrel. Thrombotic complications were noted in 7 patients, 6 of them were noted to have <50% platelet inhibition. Hemorrhagic complications were noted in 17 patients, amongst them >70% platelet inhibition was noted in 14 patients with mean P2Y₁₂ value of 59.

Conclusions:

Patients receiving P2Y₁₂ ADP antiplatelet therapy may have suboptimal platelet inhibition which results in increased thrombotic risk. Patients who have significant platelet inhibition (>70%) after loading dose are at increased risk for hemorrhagic complications. Better platelet inhibition was achieved with Ticagrelor in Clopidogrel hypo-response patients. In patients with Clopidogrel hyper-response, dosing

was changed to half the dose or alternate day to reduce hemorrhagic complications. As the use of endovascular therapies requiring dual anti-platelet agents becomes more established, there is an increasing need to develop titration protocols that minimize the risk of thrombotic and hemorrhagic events based on platelet inhibition.



Keywords: Antiplatelet, Aneurysm, Stenting

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

Collaborative Stroke Pathway for In-patient Implantation of Long-term Cardiac Rhythm Monitors for Atrial Fibrillation Detection

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Introduction:

Atrial fibrillation (AF) is a recognized risk factor of ischemic stroke and AF-related stroke is twice more likely to prove fatal. Long-term cardiac rhythm monitoring has greater diagnostic yield compared to conventional monitoring in detecting AF. Utility of implantable loop recorder (ILR) in detecting AF was established not only in patients with cryptogenic stroke but more recently in strokes due large artery atherosclerosis and small vessel disease Stroke AF trial. We present a collaborative care pathway and share multi-year data on ILR implantation.

Methods:

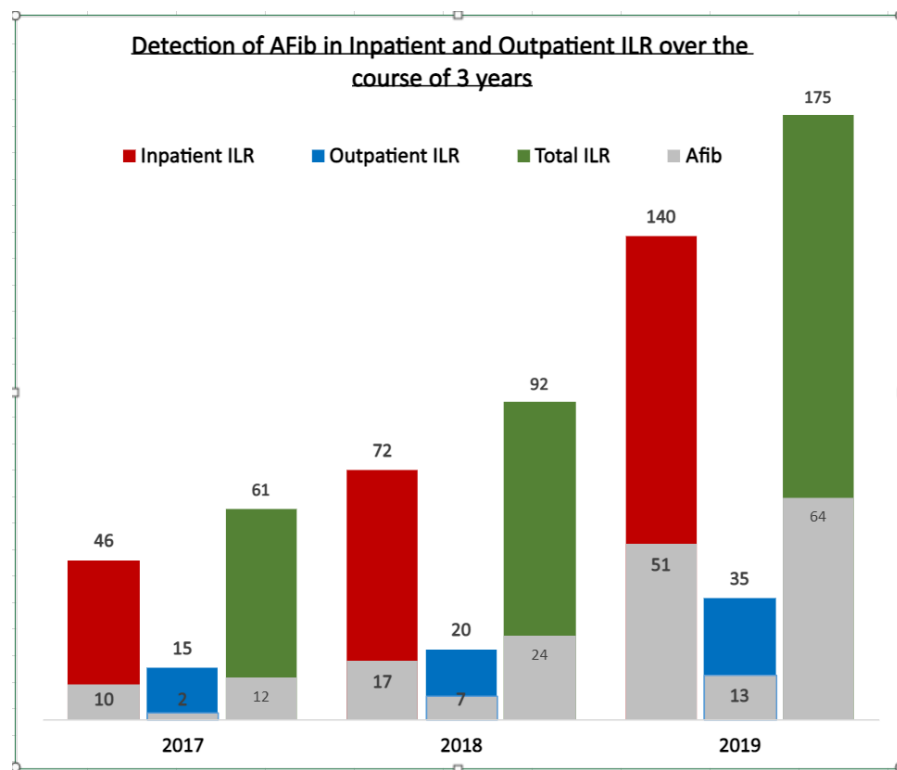
A review of prospectively collected registry of ILR implantations performed at a Comprehensive stroke center was conducted. Data from 2017-2019 of in-patient and out-patient implantation was analyzed. Eligible patients identified by vascular neurology (VN) underwent in-patient implantation primarily by interventional neurology (IN) and as out-patient by electrophysiology Cardiology. In-patient implant and programming were done on the day of discharge. Continuous monitoring was followed by EP Cardiology. AF detection was urgently communicated by EP Cardiology and anticoagulation initiated by VN. Patients lost to follow up or lacking information in medical records were excluded from analysis.

Results:

Total of 428 ILR implantations were performed over a period of 3 years (1/2017 - 12/2019) with majority implants as in-patient prior to discharge 290 (67.8%) and out-patient 78 (32.2%). Inpatient ILR placement was noted to be 75% in 2017, 78% in 2018 and 80% in 2019. 57.2% of in-patient ILRs were placed by IN and 42.8% by EP. Average time to in-patient ILR was 4.1 days with 77% within 5, 18.5% within 10, and <5% within 11 or more days post-stroke. Average time to out-patient ILR placement was 57 days with only 16% within 15, 29% within 30 day and 53% in more than 30 days from stroke. Over the course of 2 years of monitoring, AFib was detected in 33% with false detection in 1.5% (19.6% in 2017, 26% in 2018 and 36.5% in 2019).

Conclusions:

A multispecialty collaborative care pathway to increase implantation rate in eligible patients is recommended. In-patient implantation allows establishing continuity of care, patient retention, prevents lost to follow-up, avoids delay in monitoring, and importantly decreases the risk of stroke recurrence by early initiation of anticoagulation.



Keywords: Acute Stroke, Medical Management, Clinical Trial

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

Distal Radial Access Learning Curve Spanning Eighty Attempts: A Single-center, Single-operator Experience

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Introduction:

The transradial approach (TRA) has recently been adopted by neurointerventionalists and is now widely used. Among some of the benefits of TRA are reduced access site complications, increased patient comfort, earlier ambulation, and decreased time for postprocedural monitoring. The Distal transradial access method (dTRA) involves accessing the radial artery via the anatomic snuffbox and is practiced due to the belief that it may mitigate some of the complications seen with conventional TRA including but not limited to hand positioning, patient comfort (especially in those with shoulder injuries), and radial artery occlusion.

Methods:

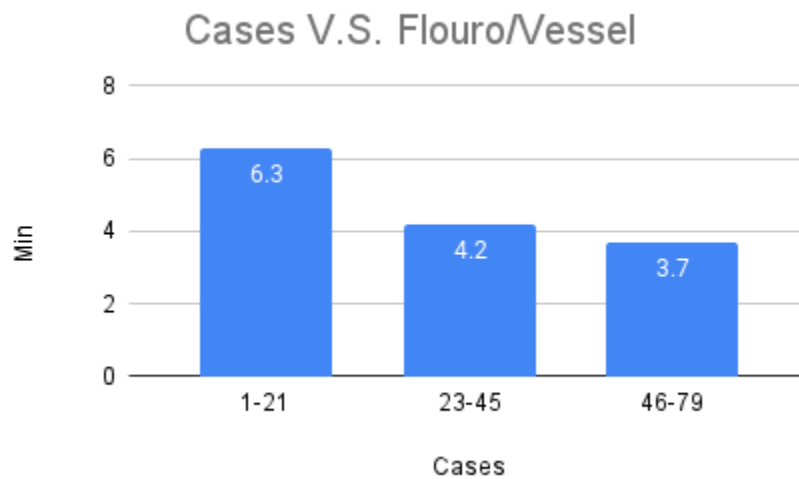
A retrospective chart review was done of all patients on whom dTRA was performed between October 2018 until March 2020. Procedures were performed by 1 neuroendovascular fellow under the supervision of 2 neuroendovascular attendings. Although the number of cases was counted serially, cases were excluded from analysis if there was occlusion of the radial artery, aberrant origin of the subclavian artery was present, or if there was an intervention other than just diagnostic angiography (including but not limited to stenting, coiling, mechanical thrombectomy, intra-arterial verapamil for cerebral vasospasm). Procedures were performed under local anesthetic and conscious sedation. Patient demographics, procedural complications, procedural time, total fluoroscopy time, and total radiation were collected.

Results:

Fifty-seven cases were included in the analysis. The age of the patients ranged from 16 to 78. Thirty-one cases out of the included cases were outpatient same-day procedures. The total length of stay in these cases was a total of 444 minutes or 7.4 hours and they were discharged 213 minutes or 3.55 hours following the procedure on average. The highest rate of improvement in total fluoroscopy per vessel, total radiation per vessel, and case time per vessel occurs in the first 50 cases. When the 57 cases were broken down into 3 groups of 19 and analyzed with ANOVA there was a significant difference between groups (Fluoro per Vessel $p=0.0003$, Total radiation per vessel $p=0.0001$, Duration of case per vessel $p=0.05$). No major complications or significant bleeding were noted post-procedurally. Vasospasm was the most common complication occurring in 5 and occurred within the first 25 cases. Conversion to conventional radial occurred in 4 of 57 cases. Two cases were converted due to vasospasm and 2 due to the inability to successfully puncture.

Conclusions:

Distal radial access in the anatomical snuffbox has been shown to have some benefits over conventional radial access. For those willing to adopt this practice, we have shown that a single operator can expect the greatest improvement within the first 50 cases.



Keywords: Endovascular Therapy, Angiogram, Diagnostic Neuroradiology

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

Initial Experience with the Scepter Mini; Embolization of Vascular Malformations in the Pediatric Population

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Introduction:

Achieving distal access and flow control provides a significant advantage for the treatment of intracerebral arteriovenous shunting lesions. The Scepter Mini Catheter (SMC) is a low-profile, dual-lumen balloon catheter, designed to provide navigability in small-caliber, tortuous intracranial vessels. We sought to describe the initial experience of the SMC in the treatment of pediatric arteriovenous malformations and fistulas.

Methods:

A single-institution, retrospective chart review identified all consecutive uses of the SMC for endovascular embolization of vascular malformations in the pediatric population.

Results:

Three different arterial pedicles were embolized with the SMC in two different patients. One patient was diagnosed with a vein of Galen malformation that had undergone multiple treatments and the other with a torcular dural arteriovenous fistula. All cases encompassed quite challenging tortuosity of small-caliber feeders which precluded the use of another balloon microcatheter. The SMC navigated into feeding arteries of diameters 0.65, 1.9 and 1.25 mm, and its balloon was inflated to achieve excellent blood flow control. Total obliteration (100%) of the shunting lesion was achieved in both cases. No reflux, pedicle rupture or other untoward effects were observed. Both patients had an uneventful recovery.

Conclusions:

The SMC afforded fast and safe distal access, flow control and treatment of arteriovenous malformations in this initial pediatric cohort. The catheter's low profile and easy navigability should support its use in tortuous and small arterial feeders, especially in the pediatric population.

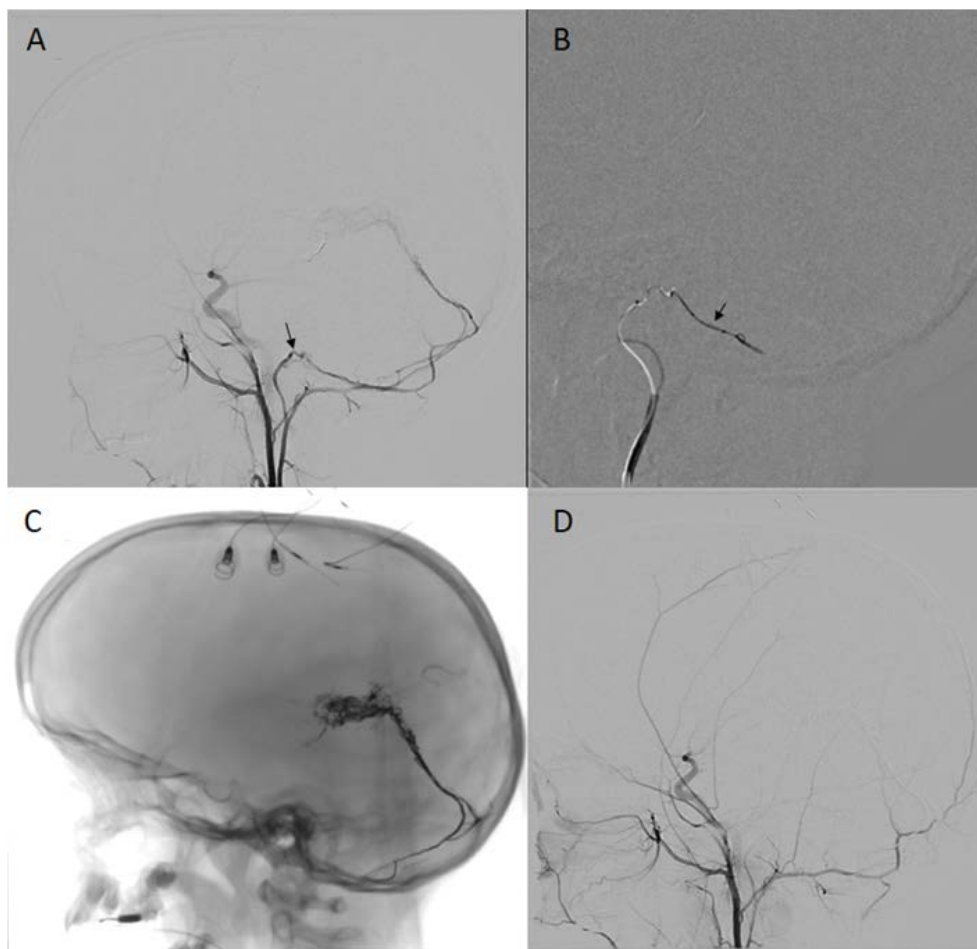


Figure 1: A) Digital subtraction angiography, right external carotid injection, lateral view shows posterior meningeal feeders to residual Vein of Galen Malformation originating from a right pharyngo-occipital trunk. Arrow indicates proximal tortuosity prohibiting passage of standard dual-lumen balloon catheter. B) A deflated Scepter Mini (arrow) successfully catheterized the posterior meningeal artery over a 0.007" wire. C) Final glue cast shows significant penetration into the malformation. D) Final angiogram confirms absence of any residual external carotid feeders.

Keywords: Avm Embolization, Balloon Assisted

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

Intravascular Delivery and Crosslinking of Photosensitive Hydrogels for Embolizing Animal Models of AVMs and Tumors

Jerry C Ku, MD¹, Yuta Dobashi, MSc², Christopher R Pasarikovski, MD¹, Joel Ramjist, MSc³, John Madden, PhD⁴, Konrad Walus, PhD⁴, Victor X Yang, MD PhD¹

¹*Division of Neurosurgery, University of Toronto, Toronto, Canada;* ²*Institute of Medical Sciences, University of Toronto, Toronto, Canada;* ³*Department of Biomedical Engineering, Ryerson University, Toronto, Canada;* ⁴*Department of Engineering, University of British Columbia, Vancouver, Canada*

Introduction:

Embolization represents a minimally invasive treatment modality for arteriovenous malformations (AVMs), tumors, and other indications, but can be limited by currently available embolic agents, in terms of safety and efficacy. Discovery of new and improved agents could lead to better treatment outcomes. The goal of this project was to test a novel embolization methodology for the treatment of AVMs and tumors.

Methods:

We formulated low-viscosity, shear-thinning hydrogel formulations which were mixed with a photo-initiator agent and non-ionic contrast medium. We then developed a method of intravascular hydrogel delivery with photo crosslinking at the tip of the catheter, using an integrated optical fibre. This allowed for rapid transition from a low viscosity liquid to a crosslinked solid-state hydrogel to block blood flow to the vascular target. In addition, the UV intensity can be dynamically modulated, in real-time, to modify the degree of crosslinking and thus the viscosity of the embolic agent. We utilized the swine rete mirabile as an animal model for AVMs, and the swine renal arterial tree (inferior segmental artery) as a model for hypervascular tumors. 5 animals were utilized without prior preparation. Embolization was graded based on degree of complete obliteration of the rete nidus or the renal arterial tree. Any non-target embolization or other complications were recorded. Follow-up angiography was performed at the 4-week interval.

Results:

With a combination of shear-thinning properties and dynamic modulation of photo crosslinking, we show that we are able to deliver an embolic agent with a viscosity range of up to 10^4 Pa*s through a single low viscosity precursor that is injectable through microcatheters (Figure 1). Using this methodology, hydrogel embolization was technically successful in all animals. Following embolization, 4/5 rete mirabile and 5/5 inferior renal arterial trees were completely obliterated. Representative angiographic images are shown in Figures 2 and 3. There were no instances of clinical or angiographic complications.

Conclusions:

We demonstrated a novel method of intravascular delivery of low viscosity photosensitive hydrogels, with photo crosslinking at the tip of the catheter, to successfully embolize animal models for AVMs and tumors. This promising technology will be investigated further with longer-term comparative animal trials.

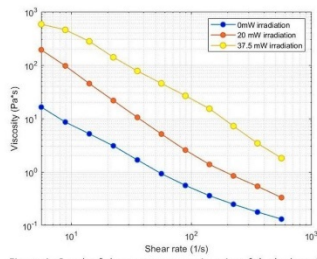


Figure 1: Graph of shear rate versus viscosity of the hydrogel formulation with no crosslinking (0mW irradiation; blue line), partial crosslinking (20mW irradiation; orange line), and full crosslinking (37.5mW irradiation; yellow line)

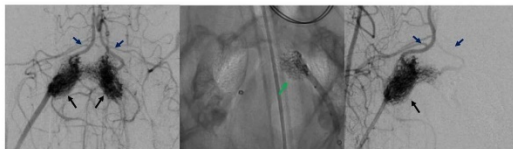


Figure 2: Swine rete mirabile embolization. Left image showing pre-embolization angiogram of bilateral rete mirabile (black arrows) and internal carotid arteries (blue arrows). Middle image showing hydrogel embolization of the left rete nidus (green arrows). Right image showing post-embolization angiogram with right rete nidus and internal carotid artery patency.

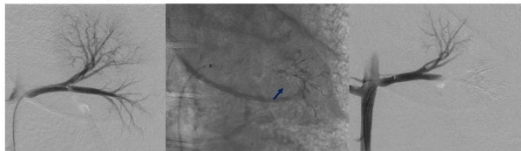


Figure 3: Swine renal arterial tree embolization. Left image showing pre-embolization angiogram of the renal arterial tree. Middle image showing hydrogel embolization of the inferior segmental artery and downstream vessels (blue arrow). Right image showing post-embolization angiogram with obliteration of the target vasculature.

Keywords: Avm Embolization, Tumor Embolization, Basic/Translational Vascular Science, New Innovation

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

Neurological Patterns in Covid -19 – A Hospital Based Study

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Introduction:

COVID-19 infection can show various manifestations, including neurologic manifestations, such as meningoencephalitis, cerebral vascular thrombosis, transverse myelitis, ischemic and hemorrhagic stroke, Guillain-Barre syndrome, posterior reversible encephalopathy syndrome, reversible cerebral vasoconstriction syndrome, and many more. The study aims to briefly touch upon and identify the neurologic manifestations in the COVID-19 infection in Pakistan during its third wave of SARS –Cov -2 (Kent or alpha) variant strain.

Methods:

We conducted a prospective study of all patients diagnosed with SARS-CoV-2 infection either by RT-PCR or by COVID Index at our institution, from the beginning of the third wave from March 2021 to June 2021. A total of 2,808 patients with Covid were identified at our institution, 26 of whom were diagnosed with neurological diseases.

Results:

A total of 26 cases of COVID -19 manifested with neurological diseases. The patients were of all ages ranging from 18 years to 84 years. There were 17 males in the study. hemorrhage. Five patients had Subarachnoid hemorrhaging. Four patients presented with post-COVID -19 mucormycotic. Sixteen cases reported confirmed COVID-19, confirmation by positive swab test using the real-time RT-PCR method, neurological disorder, or syndrome on presentation or found during the hospital stay. The rest were diagnosed based on COVID Index; all markers were raised with COVID -19 symptoms. In seventeen cases, the patients recovered fully, while the others all expired.

Conclusions:

It is not commonly known, but COVID-19 also affects the brain, resulting in a global and focal neurologic manifestation. Currently, it is difficult to distinguish whether the neurological complications of COVID-19 are a consequence of direct or indirect effects of viral infections—therefore, emphasis on finding the concomitant cause of neurological infection in COVID -19. Further, healthcare providers treating a patient with a COVID-19 infection should also be aware of neurologic manifestation associated with a COVID-19 infection to improve patient outcomes.

Keywords: Acute Stroke, Cerebrovascular Disease

Financial Disclosures: The authors had no disclosures.

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Poster

Outcomes of Chronic and subacute subdural hemorrhages treated with Middle Meningeal Artery Embolization

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Introduction:

Chronic subdural hematoma (cSDH) is a common neurosurgical condition with a high recurrence rate. Middle meningeal artery (MMA) embolization has been shown to reduce the incidence of re-bleeding and prevent recurrence of cSDH by devascularizing the subdural membranes and shifting the balance from continued leakage and accumulation of blood and proteinaceous material to reabsorption. We report our single center experience of MMA embolization for treatment of chronic and subacute subdural hematoma.

Methods:

We performed a retrospective chart review of all patients ≥ 18 years who underwent MMA embolization between 01/01/2020-03/01/2021 for cSDH. We looked at the outcomes, rate of recurrence and possible complications after MMA embolization. A descriptive analysis for continuous and categorical variables was performed using SAS 9.4 version.

Results:

A total of 41 MMA embolizations were performed on 32 patients with a median age of 75 (Q1-Q3 70-83). Median hematoma thickness was 12 mm. Among them, 52% patients underwent particle embolization while 48% underwent liquid embolization. One patient had recurrence on follow up imaging and required drainage with burr hole. Three patients underwent hematoma evacuation after MMA embolization without evidence of recurrence on imaging. Three cases were aborted due to high risk or difficult access. There were no procedure related complications in the whole study population. 65% patient achieved mRS 0-2 on 90 day follow up visit. There was no significant difference between particles and liquid embolizations.

Conclusions:

Middle meningeal artery embolization could be used as a safe and effective intervention for prevention of recurrence and improving outcomes of subacute or chronic subdural hematoma.

Keywords: Embolization, SDH, Onyx

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

Safety and Efficacy of Dual Lumen Balloon Catheters for neurointervention: Systematic review and pooled analysis.

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Introduction:

Dual-lumen balloon catheters (DLBCs) are used routinely in the endovascular treatment of cerebral vascular malformations and reportedly, they have been noted to present significant advantages compared to single-lumen catheters (SLCs). We conducted a systematic review and a pooled analysis in order to assess DLBCs' overall safety and efficacy and complication rates.

Methods:

In this PROSPERO registered, PRISMA compliant systematic review, we sought to identify all MEDLINE and EMBASE published single-arm (DLBCs) and double-arm (DLBCs versus SLCs) cohorts where DLBCs were used for the treatment of cerebral arteriovenous malformations (AVMs) and dural arteriovenous fistulas (dAVFs). A pooled analysis was conducted for the included single-arm studies. Immediate angiographic outcome, complications related to the catheter, reflux episodes and entrapment were the primary outcomes, summarized in the pooled analysis. Secondary outcomes included mortality and reported navigability. A meta-analysis of the double-arm studies summarized the primary outcomes of total procedural time and immediate angiographic outcome. Registration-URL: <https://www.crd.york.ac.uk/prospero/> Unique Identifier: CRD42021269096

Results:

Of the 298 records that were screened by title and abstract, 24 underwent full-text review. Ultimately, 19 studies were included and combined into a pooled analysis. Of the 227 lesions that were treated, complete (100%) nidal occlusion was achieved in 171 (75%; 95% CI: [69.1-80.7%]), near-complete (90-99%) in 18 (8%; [4.9-12.4%]), partial/incomplete (25-89%) in 36 (16%; [11.5-21.4%]) and none (<25%) in 2 (1%; [0.2-3.5%]). In total, 13 complications related to the catheter were reported (5.73%; [3.2-9.8%]), 14 reflux events (6%; [1.9-10.4%]), 2 entrapment events (1%; [0.2-3.5%]) and 0 deaths (mortality rate 0%; [0-2.1%]). Based on two independent reviewers, the navigability of the catheter was judged to be reported as "very good" in 4 studies, "subjectively good" in 9, "slightly more difficult than SLCs" in 5 and "significantly more difficult than SLCs" in 1 study.

Of the 19 included studies, only two were double-armed and combined into a meta-analysis. The mean total procedural time (SD) was 64.9 minutes (37.5) for DLBCs compared to 125.7 (81.8) for SLCs ($P<0.0001$), while complete nidal occlusion was noted in 39/45 (86.7%; [72.5-94.5%]) with the DLBCs compared to 17/29 (58.6%; [39.1-75.9%]) with the SLCs ($P=0.00596$), when only dAVFs were combined. The mean total procedural time was 65.5 minutes (39.1) for DLBCs compared to 106.2 (78.3) for SLCs ($P=0.001$), while complete nidal occlusion was noted in 46/59 (78%; [65.3-87.3%]) with the DLBCs compared to 52/69 (75.3%; [63.3-84.6%]) with the SLCs ($P=0.726$), when both AVMs and dAVFs were combined.

DLBCs are safe and effective for the embolization of cerebral AVMs and dAFVs. More importantly, they can achieve faster and potentially superior results compared to SLCs, when used in the appropriate context. A lack of well-designed controlled comparative studies has been identified in the literature.

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Poster

Social and Cultural Barriers to Global Stroke Care

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Introduction:

Comprehensive stroke centers require resource-intensive patient care and supportive divisions. Resource underutilization can include: traditional beliefs about etiology of stroke, transportation barriers, or an inability to recognize early symptoms of stroke. We explore the available literature to determine region-specific social and cultural barriers to obtaining stroke care.

Methods:

A literature review was performed to identify studies that described stroke care in low-income and middle-income countries (LMICs). We used the search term “stroke” along with the following terms: “burden”, “incidence”, “prevalence”, “awareness”, “transportation”, “stroke services”, “rehabilitation” “tissue plasminogen activator”, “acute stroke”, “emergency care”, “infrastructure”, “stroke services”, “quality improvement”, and “stroke units”, between January 1st, 2015 and August 1st, 2021. Forty-five articles were identified.

Results:

We identified two broad limitations to expanding stroke care across the globe: infrastructure and education/ culture. We subdivided stroke care regionally into Middle East and North Africa (MENA), Europe, Asia, Latin America, and Sub-Saharan Africa. In MENA, religious health fatalism scores on questionnaires are negatively correlated with adherence to rehabilitative protocols and stroke outcome. Increased faith engagement conversely is strongly correlated with improved psychiatric outcome following stroke, indicating a role in properly educating Middle Eastern citizens regarding stroke etiology and urgency of treatment. In Europe stroke mortality and incidence is greater in rural areas in the region, likely indicating transit-related difficulties in obtaining stroke care or deficits in education regarding lifestyle-based measures to reduce vascular disease. Low per capita numbers of stroke-specific care units in southern and eastern countries indicate a significant care access need in rural and low-resource regions. For Asia, a lack of major infrastructure obstacles to wider accessibility of EVT, especially among developing countries. Only 6.5% in a nationwide survey in China were aware that there was a therapeutic window for thrombolytic therapy in 2016, increased to 32.8% after a 2 year nationwide campaign. The adept use of social media to target high-risk populations can improve awareness of therapeutic windows. Ethnic and socioeconomic disparities are especially pronounced in this region. The RESILIENT trial demonstrated the effectiveness of EVT in Brazilian public hospitals, which helped convince the government to change policy and promote the use of EVT. Similar trials could be used to convince other governments to shift policy and promote the use of EVT as standard of care in public hospital systems. Some African communities consider stroke to be an illness of debilitating/ paralytic, ghost, or shivering etiology. Many communities rely on non medical means of care. A survey at

Ignance Deen Neurology ward in 2014 revealed that only 2% of stroke patients arrived in an ambulance while 46% came by public transport and 27% arrived by personal car.

Conclusions:

Social and cultural barriers to obtaining stroke care are based on lack of availability and patient trust. Trust in care and compliance with preventive/rehabilitative measures may be helped by connecting NGOs such as Stroke Angels and Mission Thrombectomy 2020 with community-based/ religious leaders to correct assumptions about origin and treatment. Targeted, culturally-relevant messaging may help to increase awareness about symptoms, risk factors, and etiology.

Keywords: Acute Ischemic Stroke Intervention, Acute Stroke, Endovascular Therapy, Neurointerventional Education

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Grant Support: None.

Poster

Transradial Results in Faster Recanalization in Left Anterior Circulation Stroke and Bovine Arch.

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Introduction:

We compared technical and clinical outcomes of transradial (TRA) versus transfemoral (TFA) access for mechanical thrombectomy (MT) of acute ischemic stroke (AIS) due to large vessel occlusion (LVO) in the left anterior cerebral circulation of bovine origin.

Methods:

A single-center retrospective review of a prospectively maintained neuro-interventional database from a large volume service in a tertiary academic center. Procedural metrics, technical, and clinical outcomes data were collected and analyzed for patients who underwent MT presenting with AIS and LVO in the left anterior circulation of bovine origin. Primary outcomes included the average number of passes, single first effective pass, rate of successful recanalization (thrombolysis in cerebral infarction (TICI) score $\geq 2b$), 3-month disability modified Rankin Scale (mRS) score ≤ 2 , time from skin puncture to microcatheter placement and recanalization.

Results:

Between January 2018 and January 2021, 26 patients (TRA=13, TFA=13) underwent MT. The TRA cohort had a significantly shorter time in minutes for skin puncture to microcatheter placement (TRA: 17.0 ± 5.8 vs TFA: 35.4 ± 20.5 , $P=0.0001$), shorter skin puncture to recanalization (TRA: 34.0 ± 15.6 vs TFA: 58.1 ± 34.6 , $P=0.01$), and shorter total fluoroscopy time (TRA: 13.8 ± 9.4 vs TFA: 29.5 ± 18.0 , $P=0.03$). The 3-month mRS score of 0-1 was higher in the TRA group (38.5% vs 7.69%, $P=0.06$).

Conclusions:

In patients with LVO in the left anterior cerebral circulation of bovine origin, right TRA access permits more direct navigation and provides a stable platform resulting in shorter procedure times and faster recanalization with the potential to improve functional outcomes.

TABLE 1 Summary of procedural and clinical outcomes

Variable	TRA (n=13) Mean±SD or n (%)	TFA (n=13) Mean±SD or n (%)	P value
Lab arrival to skin puncture (min)	12.4±4.6	11.8±4.3	0.84
Skin puncture to microcatheter placement (min)	17.0±5.8	35.4±20.5	0.0001
Skin puncture to recanalization time (min)	34.0±15.6	58.1±34.6	0.01
Fluoroscopy time (min)	13.8±9.4	29.5±18.0	0.03
Amount of contrast used (mL)	63.1±19.3	76.5±38.1	0.02
Number of passes (avg.)	1.38±0.51	1.42±0.67‡	0.35
Single first effective pass	7 (53.8%)	7 (53.8%)	1
Successful recanalization (≥TICI 2b)	9 (69.2%)	7 (53.8%)	0.43
Complete revascularization (TICI 3)	4 (30.7%)	4(30.7%)	1
Coaxial system	5 (38.4%)	4 (30.5%)	0.68
Triaxial system	8 (61.5%)	9 (69.2%)	
Anesthesia			
Conscious sedation	5 (38.5%)	8 (61.5%)	0.1
General anesthesia	1 (7.69%)	3 (23.0%)	
Local anesthesia	7 (53.9%)	2 (15.3%)	
sICH	0	2 (15.4%)	
Delta NIHSS Score (mean ±SD)	8.23±6.07	9.16±5.76	0.87
Percent change NIHSS score (mean ± SD)	76.3±57.6	61.2±38.7	0.198
mRS categories at 3-months			
0-1	5 (38.5%)	1 (7.69%)	0.06
2-6	8 (61.5%)	12 (92.3%)	
Delta mRS (mean ± SD)	3.1±1.80	2.38±1.66	0.78

*The mRS score for two patients in the TRA group were calculated based on the last documented exam before 3-months. TICI (Thrombolysis In Cerebral Infarction); mL (milliliter); min (minute); sICH (symptomatic intracranial hemorrhage). ‡ A patient in the TFA group had MCA, ACA, and PICA occlusions, for the MCA and ACA occlusions, each required two passes and are included here as a sum of 4 passes to recanalization. (PICA was not accessed).

Keywords: Mechanical Thrombectomy, Door To Groin Puncture, Acute Ischemic Stroke Intervention, Recanalization, Door To Needle

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

Transvenous Embolization Technique: A Modern Strategy for Anterior Ethmoidal Dural Arteriovenous Fistulas

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Introduction:

Ethmoidal dural arteriovenous fistulae (AVF) are rare intracranial lesions and account for 2-3% of all dAVF. They are often supplied by the ethmoidal or falcine branches of the ophthalmic artery and typically drain into a cortical vein then into the superior sagittal sinus (SSS). Current available treatment options include surgical resection and endovascular embolization via transarterial and transvenous routes. Prior studies have solely compared surgical and transarterial endovascular treatment approaches. Reports of the transvenous approach remain scarce in the literature.

Methods:

We performed a retrospective review for anterior ethmoidal (AE)-dAVFs treated with transvenous embolization by our practice between August 2018 and August 2021. Four patients with 5 dAVFs were identified. We describe the presentation, treatment, and outcome of these cases.

Results:

We describe four patients with AE-dAVF. Case 1 is a 33-year-old man with a previously treated basal ganglia arteriovenous malformation achieving cure. He was lost for follow up for three years and returned with symptoms of peri-orbital headache and blurry vision. Diagnostic angiography revealed a dAVF arising from the cribriform plate with arterial supply derived from bilateral AE arteries and venous drainage via a common cortical frontal interhemispheric vein to the anterior third of the SSS. Transvenous embolization was achieved and liquid embolic was injected into the vein with retrograde penetration to the fistulous point. Follow-up angiography revealed obliteration of the dAVF. Case 2 is a 23-year-old man with chronic headache who was found to have a right sided ethmoidal dAVF arising from the right ophthalmic artery for which he underwent successful embolization through a transarterial approach. Follow-up angiography demonstrated occlusion of the treated fistula and new left sided ethmoidal AVF arising from the left ophthalmic artery with a single draining cerebral vein which drains into the anterior third of the SSS. Transvenous embolization was achieved via coiling. Follow up angiography also showed complete occlusion of the dAVF. Case 3 was a 67-year-old woman who presented with a Cognard type III right ethmoidal dAVF with arterial feeders through supra-orbital branches of the right ophthalmic artery, draining into a frontal cortical vein leading to the SSS. The patient underwent transvenous embolization using coils. Case 4 was a 64-year-old woman who presented with scalp tenderness. Diagnostic angiography revealed a left AE-dAVF. Transvenous embolization with complete occlusion was achieved using a combination of liquid embolic and coil embolization. No adverse events were encountered during or after embolization, but long-term outcome has yet to be collected for cases 3 and 4. There were no neurologic procedural complications.

Conclusions:

This small case series shows that transvenous embolization is a feasible, effective, and safe alternative to surgery. Larger prospective studies are needed to further validate this treatment approach in patients with ethmoidal dAVF.

Keywords: Endovascular, Endovascular Therapy, Embolization, Avm Embolization, Cerebral Arteriovenous Malformations

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

Blunt traumatic vertebral artery injury: incidence, treatment, and outcomes

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Introduction:

Blunt cerebrovascular injury (BCVI) refers to any injury to the carotid or vertebral arteries sustained via blunt trauma. Computed tomographic angiography (CTA) has become a standard and widely available screening tool for BCVI, often allowing injuries to be detected on admission. Prior research has shown that BCVI is associated with subsequent stroke. Treatment protocols vary by institution, and the optimal treatment method for these injuries is not standardized.

Methods:

This research was approved by the IRB. All patients presenting to a level 1 trauma center from 2011 to 2018 were screened for inclusion using the Primordial Database imaging report search tool (San Mateo, CA). All included patients underwent CTA within 24 hours of presentation. Patients were excluded if they had penetrating injury, age <16 years, or concomitant carotid injury. Data was retrospectively collected. Injuries were graded according to the criteria of Biffi et al. Treatment and follow up imaging of BCVI was determined by the vascular neurosurgeon on call.

Results:

A total of 2819 patients underwent screening CTA, with 156 patients (5.5%) identified with isolated vertebral artery injuries. Sixteen patients (10%) had bilateral vertebral artery injuries, for a total of 172 injured vertebral arteries. There was a male predominance (n=97, 62%). Ninety-two patients (59%) had a cervical spine fracture at the level of injury. Three posterior circulation strokes were detected, all within 24 hours of admission, prior to starting any treatment. Treatment regimens included aspirin (n=135 vessels), clopidigrel (n=1), anticoagulation (n=2), or no treatment (n=18). Follow up imaging was available for 84 patients (98 arteries). Three patients had worsening Biffi grade on follow-up CTA, and the remainder were stable or improved. The three worsened injuries were all grade 2 on initial presentation.

Conclusions:

In our patient population, isolated blunt vertebral artery injuries were treated with multiple regimens. The majority of patients in our group were treated with aspirin; no strokes were detected after the initiation of therapy, regardless of the treatment modality or the fate of the injured. Our study is not randomized and the treatment groups are not evenly distributed. Further investigation is required to address the optimal method and duration of treatment for blunt vertebral artery injury. However, our data suggest that aspirin alone may be sufficient therapy for isolated vertebral artery injuries.

Keywords: Vertebral, Antiplatelet, Ischemic Stroke

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

Cerebral Arterial Variations In Patients With Ischemic Stroke Undergoing Mechanical Thrombectomy.

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Introduction:

This study aimed to determine what anatomical variants of the Circle of Willis (CoW) and the middle cerebral artery (MCA) are observed in patients with acute M1 occlusion and whether their prevalence differs from that described as “normal” in anatomy textbooks.

Methods:

We have performed a retrospective assessment of radiological examinations of patients with stroke due to middle cerebral artery M1 segment occlusion. All patients underwent mechanical thrombectomy from January 2015 until March 2021. The anatomy of the CoW was assessed on initial CT-angiography and DSA. Branches of the MCA were observed on control DSA after recanalization.

Results:

A total of 100 patients were included in the analysis (58 females and 42 males, mean age: 71.6 +/- 13.9). Fully complete CoW was observed in 19% of patients. A total of 10% of patients had an incomplete anterior portion of CoW. In the incomplete anterior portion subgroup, the most common variation was the absence of anterior communicating artery (6% of total hemispheres), followed by the absence of one A1 (3% of total hemispheres). An incomplete posterior portion of CoW was identified in 79% of the patients. The absence of posterior communicating artery (PCoA) was observed in 59 patients. Sixteen patients had adult-type PCoA, 3 patients had transitional-type PCoA and 21 patients had fetal-type posterior cerebral artery (PCA). In the subgroup of patients with fetal-type posterior circle, 5 patients had no P1 segment of PCA. Anterior temporal branch of MCA was observed in 45% of the patients. Middle cerebral artery bifurcation was found in 80% of hemispheres, and trifurcation in 20%. In the bifurcation subgroup, 26% of MCAs had a dominating upper branch and 18% had a dominating lower branch. A duplicate MCA was observed in one hemisphere.

Conclusions:

In comparison to normal anatomy described in anatomy textbooks, the population of patients suffering from ischemic stroke due to M1 occlusion had a lower proportion of complete and closed CoW. A foetal type PCoA was observed to be prevalent (21%) in patients suffering from acute M1 occlusion. Detailed anatomical knowledge of anatomical variants of CoW in patients undergoing mechanical thrombectomy is essential for clinicians performing intravascular interventions and may aid procedure planning.

Keywords: Cerebral Blood Flow, Imaging, Angiographic Ct, Interventional Neuroradiology,

Financial Disclosures: The authors had no disclosures.

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Poster

Management of traumatic carotid-cavernous fistulas in the acute setting of penetrating brain injury

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Introduction:

Traumatic carotid-cavernous fistulas (tCCFs) represent abnormal vascular shunt between the carotid artery, in its cavernous segment, and the cavernous sinus, after direct or indirect trauma. Literature on tCCF associated with gunshot wounds (GSW) is scarce and is unique due to potential risk of exsanguination or bleeding into the brain proper. Furthermore, the management of tCCF in the GSW population is particularly relevant as gunshot patients represent a unique challenge be it due to the presence of concomitant cranio-cervical vascular injury, other organ involvement, or contraindications for anticoagulation and /or antithrombotic use.

Methods:

Case presentation

Case A

Patient is a 23 y/o female with GSW to the right side of the head with multiple skull base fractures and right temporal lobe penetrating injury with retained bullet fragment, traumatic subarachnoid hemorrhage in the basal cisterns, diffuse cerebral edema, and a 5mm right to left midline shift. Patient also has a high-flow right tCCF with significant arterialization of cortical veins. Patient underwent venous coiling of the cavernous sinus with flow diverter stents in the arterial wall of the cavernous segment of the carotid artery. The patient remained in the hospital fifty-one days and suffered multiple neurological complications, including cerebral vasospasm, development of a pseudoaneurysm in the right anterior choroidal artery that was embolized, and hydrocephalus, requiring ventriculo-peritoneal shunting (VPS). Patient had a GOSE 2 at the discharge to a long-term acute care facility.

Results:

Case B

Patient is a 30 y/o male with GSW to the left side of the head with left hemispheric subdural hematoma, left temporal lobe injury, and diffuse traumatic subarachnoid hemorrhage. The injury also resulted in a temporal bone fracture, lateral to the carotid canal, and extensive left facial fractures. Patient also has a high-flow left tCCF that was also treated successfully with cavernous sinus coiling with flow diverter stenting of the carotid artery at the site of the fistula after initiating antithrombotic agents. Post the tCCF repair the patient developed a CSF leak that necessitated an extensive surgical repair that would not have been possible while on antithrombotic agents. At this point, the patient underwent balloon test occlusion (BTO) and sacrifice of the carotid artery at the site of the fistula. Patient was discharged to acute rehab facility with a GOSE of 5.

Conclusions:

Traumatic CCF may occur in patient with gunshot wounds to the head, representing an extreme of penetrating mechanisms associated with this type of injury. Current penetrating brain injury guidelines are outdated and provide no consensus on management of this condition. Embolization of the fistula, flow diversion via stenting of the fistula site and finally vessel sacrifice are viable options depending on the size of the fistula, flow grade, collateral flow, phase on injury, and concomitant injury that may dictate permissibility of antithrombotic therapy.

Keywords: Aneurysm Embolization

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

AI-Software Detection of Large Vessel Occlusion Stroke on CTA: Real-World Diagnostic Test Accuracy Study

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Introduction:

The treatment for large vessel occlusion (LVO) stroke has significantly improved in recent years with the advent of endovascular therapy (EVT). The triage of LVOs requires rapid completion, interpretation, and communication of neuroimaging. Historically, these steps were performed manually, potentially leading to treatment delays. A computer-aided triage software, Viz LVO, streamlines this process by providing a(n) image viewer, communication system, and artificial intelligence-based algorithm that automatically detects LVOs and alerts appropriate teams. However, the actual performance is yet to be determined. We sought to determine the real-world accuracy of Viz LVO in a large, tiered hub and spoke healthcare network.

Methods:

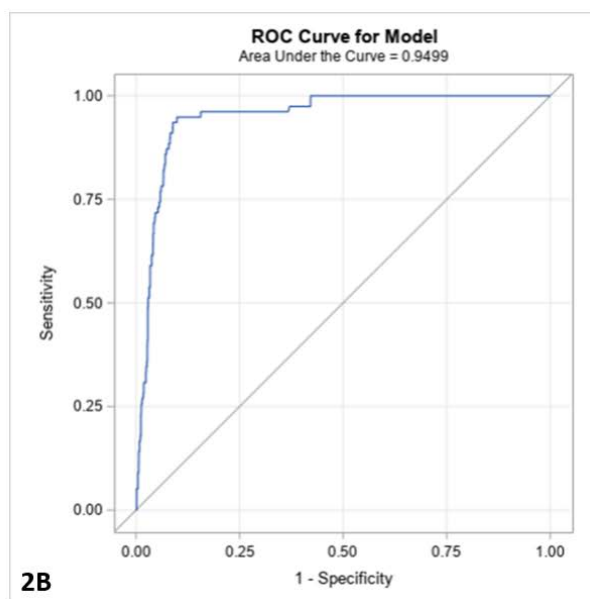
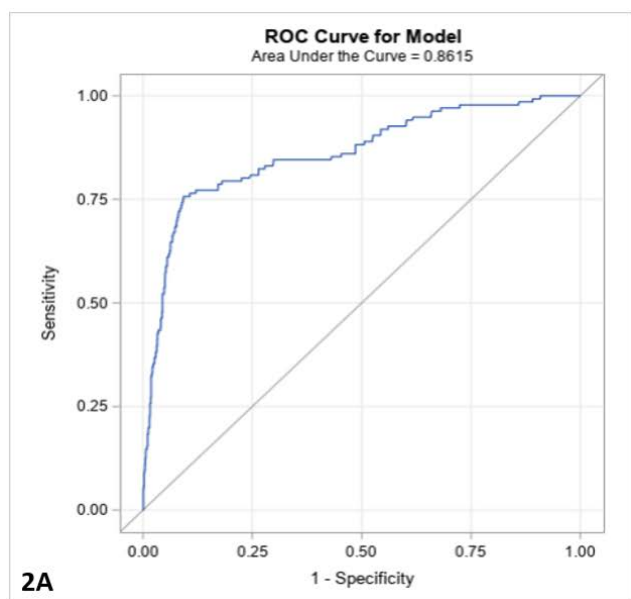
All consecutive head and neck computed tomography angiography (CTA) scans that were performed in the context of stroke codes and read by Viz LVO during the period of May 2019 to October 2020 were included. CTA impressions provided by radiologists served as the clinical reference standard test and Viz output served as the index test.

Results:

Of the 5,381 stroke codes, 1,822 had a CTA read by Viz LVO and were analyzed. Impression was negative for occlusion in 1,632 CTAs. Of the 190 occlusions, only 142 were ICA-T, M1, or M2 and constituted the LVO population of our study. Accuracy metrics were analyzed for two different subgroups. For the ICA-T, M1, and M2 subgroup, the algorithm yielded 74.6% sensitivity, 91.1% specificity, 97.6% negative predictive value, 89.8% accuracy and 0.86 area under the curve. Excluding M2 for the analysis, the accuracy metrics were 93.8%, 91.1%, 99.7%, 91.2% and 0.95, respectively. Sensitivity for ICA-T, M1, and M2 occlusions was 100%, 93%, and 49%, respectively. Importantly, the algorithm has better sensitivity for proximal M2 occlusions (58%) compared to mid/distal M2 occlusions (28%), $P < 0.03$.

Conclusions:

High sensitivity and negative predictive value allows Viz LVO to be a powerful adjunct tool in stroke diagnostics. The fast and accurate diagnosis can potentially save time and help identify difficult cases in the clinical setting.



Keywords: Vascular Imaging, Diagnostic Neuroradiology

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

Application of the Berenstein-DeLeacy Grading Scale to Assess Treatment Outcome in Orbital Lymphatic Malformations

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Introduction:

Lymphatic malformations (LMs) are low-flow vascular malformations that arise as a result of erroneous vascular development during embryogenesis. Prior to the advent of the Berenstein-De Leacy (BDL) scale, no reproducible grading system had been designed to compare sclerotherapy outcomes on the basis of radiologic findings. The soft-tissue detail, absence of ionizing radiation, safety profile, and ubiquity of MR imaging made it an ideal technique on which the imaging-based criteria was developed. The BDL scale ranges from 1-7 denoting complete obliteration to significant progression respectively. A “B” modifier is assigned for identification of granulation tissue in the treatment bed. We examine and validate the BDL scale on a cohort of 16 orbital LMs from our practice.

Methods:

Orbital LMs treated with sclerotherapy at our practice between 2000 and 2021 were assessed by an attending physician prior to initial and after final treatment to assign scale scores. The assigned scores represent changes in the orbit as defined by pre- and post-septal spaces, above and below eyelids, and intra/extracanal spaces going to the coronal apex without the cavernous sinus.

Results:

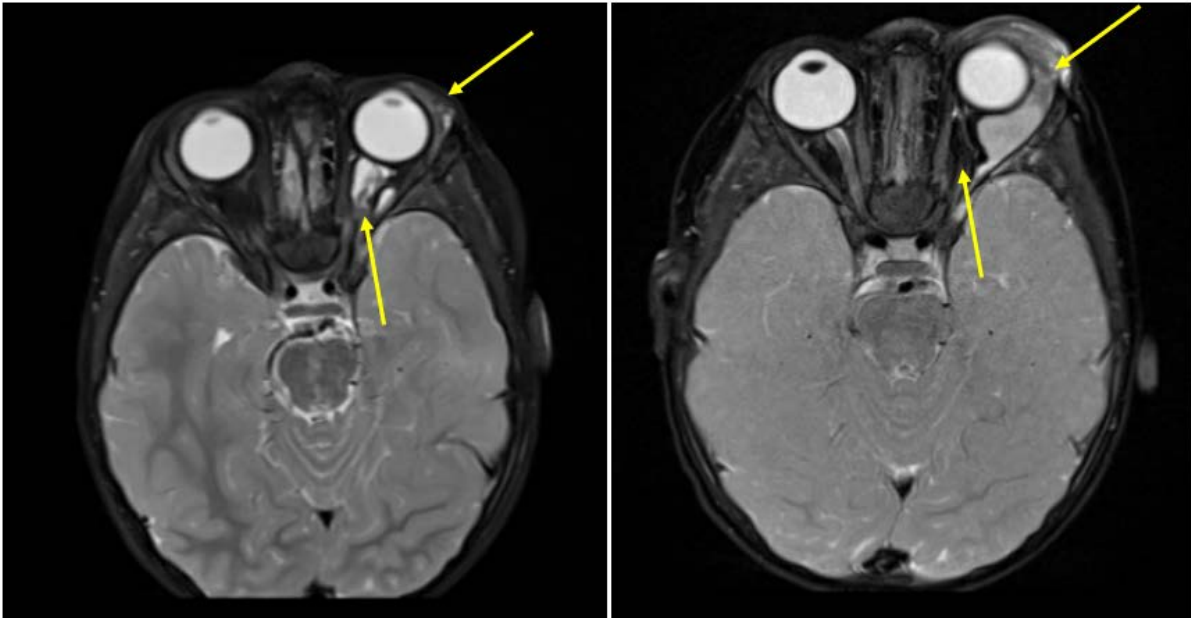
The median age at initial imaging was 24 months (range: 1-445 months) and 108 months (range 12-528) at final imaging. The median imaging interval was 61 month. Males and females were represented in our cohort equally. Six cases presented with right orbital LMs (37.5%) and 10 presented on the left (62.5%). Six cases presented with macrocystic malformations (37.5%), five cases with microcystic (31.25%), and five cases with mixed (31.25%). 11 patients were treated with bleomycin and 5 patients were treated with bleomycin and doxycycline. BDL scale scores ranged from 2-7 with one case assigned the “B” modifier. Two cases were labelled as BDL7, or gross interval progression of the LM. Four cases were labelled as BDL6, or regression of the LM in one region with progression into a previously uninvolved/untreated area. Three cases were labelled as BDL5 with minimal or no gross interval change. One case was labelled as BDL4 and assigned the “B” modifier for partial regression with >50% estimated volume of residual malformation and granulation tissue in the treatment bed. Three cases were labelled as BDL3, or partial regression with <50% estimated volume of residual malformation. One case was labelled as BDL2 with near-complete regression with trace residual of the lesion. No cases were labelled as BDL1, or complete regression of the lesion.

Conclusions:

The BDL scale was applied to a series of 16 orbital LMs to demonstrate its versatility in describing the treatment progression of this historically difficult-to-classify malformation. We hope visualization of BDL

scores for orbital LMs will assist other interventionalists with incorporating this scale as a metric for treatment progression and outcomes.

BDL 6



Keywords: Vascular Imaging, Scale, MRI, Head And Neck Malformation Therapy

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

Artificial Intelligence Algorithms for Hemorrhage Detection in CTs and MRI Scans: A Systematic Review

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Introduction:

Stroke is a leading cause of morbidity and mortality worldwide, with hemorrhagic strokes accounting for 10-20% of all strokes. Patients presenting with intracerebral hemorrhage (ICH) often face higher rates of mortality and poorer prognosis than those with other stroke types. As ICH treatment relies on in-hospital neuroimaging findings, one potential barrier in the effective management of ICH includes increased time to ICH detection and treatment, particularly due to delays in imaging interpretation in busy hospitals and emergency departments. Artificial Intelligence (AI) driven software has recently been developed and become commercially available for the detection of Intracranial Hemorrhage (ICH) and Chronic Cerebral Microbleeds (CMBs). Such adjunct tools may enhance patient care by decreasing time to treatment and diagnosis by helping to adjudicate diagnoses in difficult cases. This systematic review aims to describe the current literature surrounding all currently existing AI algorithms for ICH detection with either non-contrast computed tomography (CT) scans or CMBs detection with magnetic resonance imaging (MRI).

Methods:

Following PRISMA guidelines, MEDLINE and EMBASE were searched for studies published through March 1st, 2021, and all studies investigating AI algorithms for hemorrhage detection in non-contrast CT scans or CMBs detection on MRI scans were eligible for inclusion. Any studies focusing on AI for hemorrhage segmentation only, including studies that enrolled patients with hemorrhages only as their study group, were excluded. Extracted data included development methods, training, validation and testing datasets, and accuracy metrics for each algorithm, when available. Meta-analysis was not conducted due to heterogeneity in reported accuracy metrics and highly variant algorithmic development. The completed protocol is available for review in the PROSPERO registry.

Results:

After the removal of duplicates, a total of 609 studies were identified and screened. After an initial screening and full text review, 40 studies were included in this review. Of these, 18 tested a 2-Dimensional (2D) convolutional neural network (CNN) AI algorithm, 3 used a purley 3-Dimension (3D) CNN, and 2 utilized a hybrid 2D-3D CNN. Of note, one software was able to identify ICH in the setting of ischemic stroke using MRI scans. Included papers noted the following challenges when developing these AI algorithms: extensive time required to create suitable datasets, the volumetric nature of the imaging exams, fine tuning the system, and focusing on the reduction of false positives. Diagnostic accuracy data was available for 21 of these studies, which reported a mean accuracy of 94.37% and a mean AUC of 0.958.

Conclusions:

As reported in this study, many AI-driven software tools have been developed over the last 5 years. These tools have high diagnostic accuracy on average and have the potential to contribute to the diagnosis of ICH or CMBs with expert-level accuracy. With time to treatment often dependent on time to diagnosis, this AI software may increase both the speed and accuracy of adjudicating diagnoses. Although there have been several obstacles faced by the developers of these algorithms, AI-driven software is an important frontier for the future of clinical medicine.

Keywords: Hemorrhage, Imaging, New Innovation

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

Assessing meningeal lymphatic MRI biomarkers in acute large vessel occlusion stroke treated with thrombectomy

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Introduction:

Until recently, there was very little known about the brain's waste removal system. Unlike the peripheral organ systems, the CNS lacked a clearly defined lymphatic vasculature and waste clearance mechanism. However, in 2015, the meningeal lymphatic system (MLS) was first visualized in the dura of humans (1). Since then, a number of studies have investigated the MLS's potential impact on various neurological diseases, including Alzheimer's, Parkinson's, Multiple Sclerosis, hydrocephalus, and epilepsy (2-6). Other studies have also demonstrated the MLS's profound influence on stroke (7-10). However, there is little research that characterizes MLS imaging biomarkers in relation to stroke. Our study evaluates currently proposed MLS MRI biomarkers in large vessel occlusion stroke treated with thrombectomy.

Methods:

Participants: We recruited twenty patients who had an acute ischemic stroke treated with mechanical thrombectomy (MT) in a large intracranial artery (middle cerebral artery, internal carotid artery, basilar and/or vertebral). The mean age of our population was 69.9 ± 15.5 years. 12 (60%) of our patients had been treated with a combined approach stentriever + aspiration catheter, 4 (20%) with stentriever only, and 4 (20%) with contact aspiration only. **Study Design:** Basic demographic data, clinical comorbidities, information related to the stroke, technical details about the MT and outcome were collected from electronic medical records. We implemented High Resolution MR Vessel Wall Imaging (HR-VWI) with a black blood T1-weighted sequence to characterize changes in the enhancing vessels around the superior sagittal sinus that have been described as potential markers for meningeal lymphatic vessels (1). Within 24 hours after the MT procedure, patients underwent a 45-minute 3T- brain MRI with contrast using a 20-channel head coil (MAGNETOM Skyra, Siemens) with a sagittal isotropic black blood sequence included with the standard protocol. Our field of view included the superior sagittal sinus. Coronal reconstructed pre-and post-contrast black blood T1 sequences were qualitatively evaluated by a board certified Neuroradiologist with 8 years of academic experience evaluating the cerebrovasculature for the presence of purported meningeal lymphatic prominence or asymmetry.

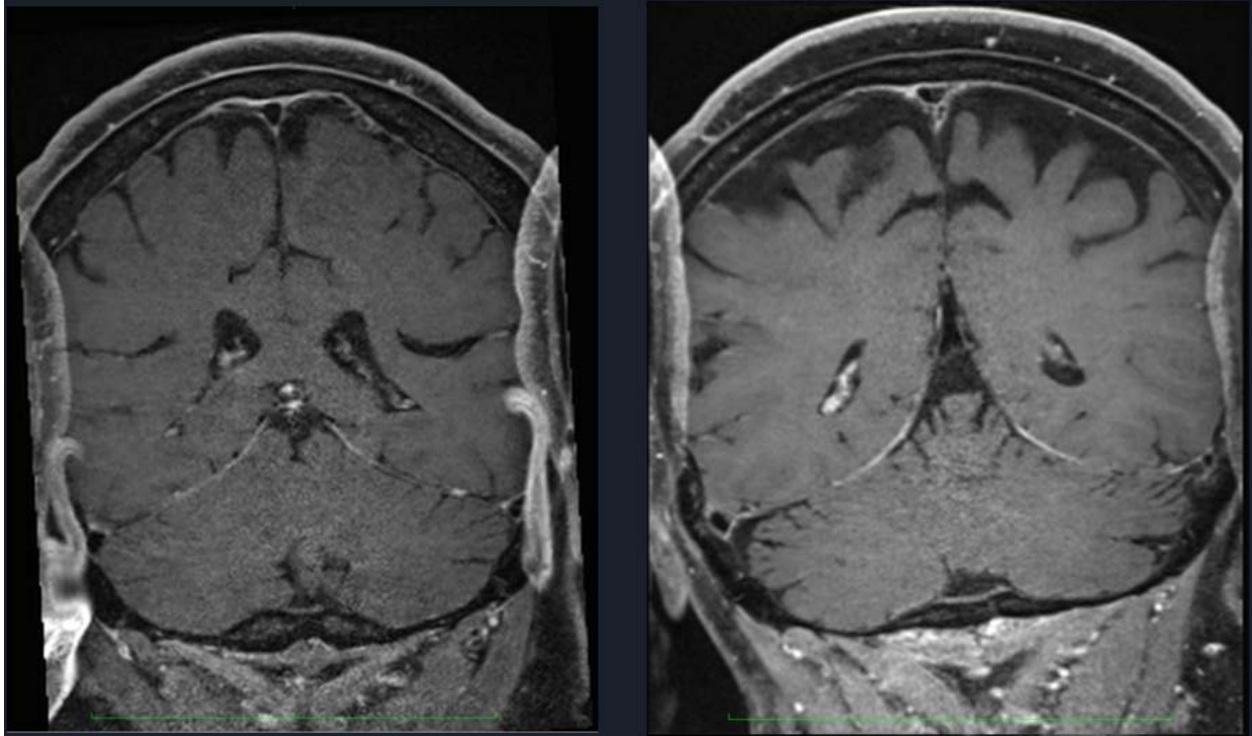
Results:

There was no significant prominence or asymmetric difference seen in the purported meningeal lymphatics based on 3D high-resolution T1 black blood MRI sequences in acute stroke large vessel occlusion post-MT subjects.

Conclusions:

While in our study no observable differences were seen in the purported meningeal lymphatics based on current MR techniques, it marks an important initial step in development of a useful biomarker for

the CNS lymphatic system. Future studies are needed to evaluate alternative meningeal lymphatic quantitative biomarkers. Our study also highlights the need for improved standardization of biomarkers for the meningeal lymphatics. By continuing to evaluate imaging biomarkers, we can further understand the MLS's potentially profound role in complex neurological diseases.



Keywords: Stroke, Imaging, MRI, Acute Stroke, Neuromonitoring

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

Association Of 24-hour Blood Pressure Parameters Post-thrombectomy With Functional Outcomes According To Collateral Status

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Introduction:

Introduction: Higher blood pressure (BP) most post mechanical thrombectomy (MT) can restore perfusion to the ischemic brain tissue depending on collateral status. We aim to determine the association of 24-hour post-MT BP parameters with the functional outcome depending on the pre-MT collateral status.

Methods:

We performed a retrospective chart review of patients who underwent MT at a comprehensive stroke center from 7/2014 to 12/2020. The patients were divided into two groups (good versus bad) depending on collateral status. A board-certified neuroradiologist, who was blinded to the clinical outcomes, used collateral grading scales of Mass ≥ 3 and modified-Tan $> 50\%$ to designate good collaterals on the pre-MT CT Angiogram. A binary logistic regression analysis was performed, controlling for age, sex, NIHSS, ASPECTS ≥ 6 , TIC score $\geq 2b$, time to thrombectomy, LDL, Hemoglobin-A1C, intravenous-alteplase, with the 24-hour post-MT BP parameters as the predictors. The outcomes were good functional outcome (3-month mRS ≤ 2) and mortality.

Results:

220 patients met the inclusion criteria. 24-hour BP parameters of standard deviation (SD) SBP (OR, 1.16; 95% CI, 1.01-1.33; P 0.047) and maximum DBP (OR, 1.05; 95% CI, 1.01-1.09; P 0.036) had an association with a good functional outcome, while SD SBP (OR, 1.15; 95% CI, 1.01-1.31; P 0.045), coefficient variation (CV) SBP (OR, 1.19; 95% CI, 1.01-1.41; P 0.043), SBP range (OR, 1.04; 95% CI, 1.01-1.07; P 0.046), maximum DBP (OR, 0.95; 95% CI, 0.91-0.99; P 0.016), pulse pressure (OR, 1.09; 95% CI, 1.02-1.16; P 0.022) and SBP ≥ 140 (OR, 5.85; 95% CI, 1.11-30.85; P 0.038) had an association with mortality in patients with good collaterals according to Mass grading. 24-hour BP parameters of SD SBP (OR, 1.13; 95% CI, 1.04-1.24; P 0.007), CV SBP (OR, 1.18; 95% CI, 1.05-1.32; P 0.006), SBP range (OR, 1.04; 95% CI, 1.01-1.06; P 0.008) and maximum DBP (OR, 0.97; 95% CI, 0.94-1; P 0.02) had an association with mortality in patients with good collaterals according to modified-Tan grading. There was no such association in patients with bad collaterals.

Conclusions:

Various 24-hour BP parameters post-MT are associated with a functional outcome or mortality in patients with good collaterals, unlike in patients with bad collaterals.

Keywords: Collateral, Blood Pressure Management In Acute Stroke, Imaging

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

Association Of Pre-Mechanical Thrombectomy Collateral Scores With Functional-Outcome In Short Versus Extended Window For Thrombectomy

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Introduction:

We aim to determine the utility of pre-mechanical-thrombectomy (MT) collateral scores in the short (<6 hours from onset) versus extended (6-24 hours from onset) window for MT with respect to a good functional-outcome.

Methods:

We performed a retrospective chart review of patients who underwent MT for anterior circulation LVO at a comprehensive stroke center from 7/2014 to 12/2020. A board-certified neuroradiologist, who was blinded to the clinical-outcomes, used collateral grading scales of Miteff (ordinal), Mass (ordinal), and modified-Tan (dichotomous) to designate collateral scores on the pre-MT CT Angiogram. The patients were divided into short (<6 hours from onset) versus extended (6-24 hours from onset) groups depending on their timing of presentation to the emergency department. A binary logistic regression analysis was performed, controlling for age, sex, NIHSS, ASPECTS $\geq$ 6, TICI score $\geq$ 2b, recanalization time, mean arterial pressure, blood glucose, location of occlusion, atrial fibrillation, LDL, hemoglobin-A1C, and administration of intravenous-alteplase, with the pre-MT collateral grading scores as predictors. The primary outcome was a good functional-outcome (3-month mRS $\leq$ 2)

Results:

162 patients met our inclusion criteria for patients who presented in the short window. The pre-MT scales of Mass (OR, 0.35; 95%CI, 0.16-0.78; P 0.01) and modified-Tan (OR, 0.35; 95%CI, 0.16-0.78; P 0.01) were associated with a good functional-outcome, unlike the Miteff scale (OR, 0.46; 95% CI, 0.18-1.18; P 0.103). 58 patients met our inclusion criteria for patients who presented in the extended window. The pre-MT scales of Mass (OR, 0.75; 95% CI, 0.23-2.48; P 0.63), Miteff scale (OR, 0.78; 95%CI, 0.17-3.64; P 0.746) and modified-Tan (OR, 1.14; 95%CI, 0.1-12.98; P 0.918) were not associated with a good functional-outcome.

Conclusions:

Our study demonstrates that good collateral grades on Mass and modified-Tan scales are associated with a good functional outcome for patients who present to the ED in the short window for MT. We did not find an association of any pre-MT collateral scores with a good functional-outcome for patients presenting in the extended window for MT.

Keywords: Collateral, Endovascular Therapy

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

Automated Detection of Intracerebral Hemorrhage Using Artificial Intelligence: Pilot Deployment of Viz ICH

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Introduction:

Stroke is a major cause of morbidity and mortality. Hemorrhagic strokes are often more severe and associated with higher mortality when compared to ischemic stroke and account for approximately 13% of all strokes. Initial care for patients with intracerebral hemorrhage (ICH) is in part guided by neuroimaging findings. Non-contrast computed tomography (NCCT) is often the first imaging obtained in the work up of the acute stroke patient given its diagnostic accuracy for hemorrhage, ubiquity, low cost, and short scan time. Immediate evaluation of imaging by stroke experts, such as neurologists, neurosurgeons, and radiologists, is essential. Artificial intelligence tools can help to expedite image assessment and careteam coordination thereby accelerating time to treatment. In this study, we report on the use of Viz ICH, an AI-enhanced ICH detection platform, to identify ICH on initial CT and coordinate emergent care in an urban health system with an ICH Center.

Methods:

All consecutive stroke codes presenting with ICH from May 2019 to August 2019 were eligible for analysis. Non-contrast CT (NCCT) was conducted for each patient and submitted to the Viz ICH in a prospective fashion. An automated volumetric analysis of these NCCTs was conducted by Viz ICH and assessment was conducted for potential ICH. If suspected ICH was detected, Viz ICH sent an automated prompt to the stroke care team for review. CT impressions provided by radiologists served as the clinical reference standard test and Viz ICH output served as the index test. Diagnostic accuracy tests were then performed.

Results:

A total of 682 patients were analyzed for ICH, out of which 28 patients were positive for intracerebral hemorrhage (ICH) (4%) and 654 were negative for hemorrhage (96%) based on radiology impressions. Viz ICH was able to correctly identify hemorrhages in 25/28 patients and non-hemorrhages in 650/654 patients. Overall, the software had high diagnostic accuracy with 89.3% sensitivity, 99.4% specificity, and an overall accuracy of 99.0%. The software also had a positive predictive value of 86.2%, a negative predictive value of 99.5%, a positive likelihood ratio of 145.98, and a negative likelihood ratio of 0.108.

Conclusions:

Viz ICH is an AI-enhanced platform that may help in the diagnosis and detection of ICH, with a sensitivity of 89.3 and a specificity of 99.4% in this preliminary study. Though future validation studies with a larger cohort of patients positive for each type of hemorrhage must be conducted for true diagnostic accuracy data, Viz ICH has the potential to be an adjunct tool to streamline ICH triage, reduce treatment delays, and improve outcomes of patients presenting with ICH.

Keywords: Imaging, Intracerebral Hemorrhage

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

Carotid-cavernous fistula: does transcranial duplex worth revisiting?

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Introduction:

Carotid-cavernous fistula (CCF) represents a well-known multifaceted diagnostic challenge starting from clinical presentation till angiography. This case presentation and literature review shed the light on the value of a bedside transcranial duplex (TCD) as a timely and a plausible screening tool.

Methods:

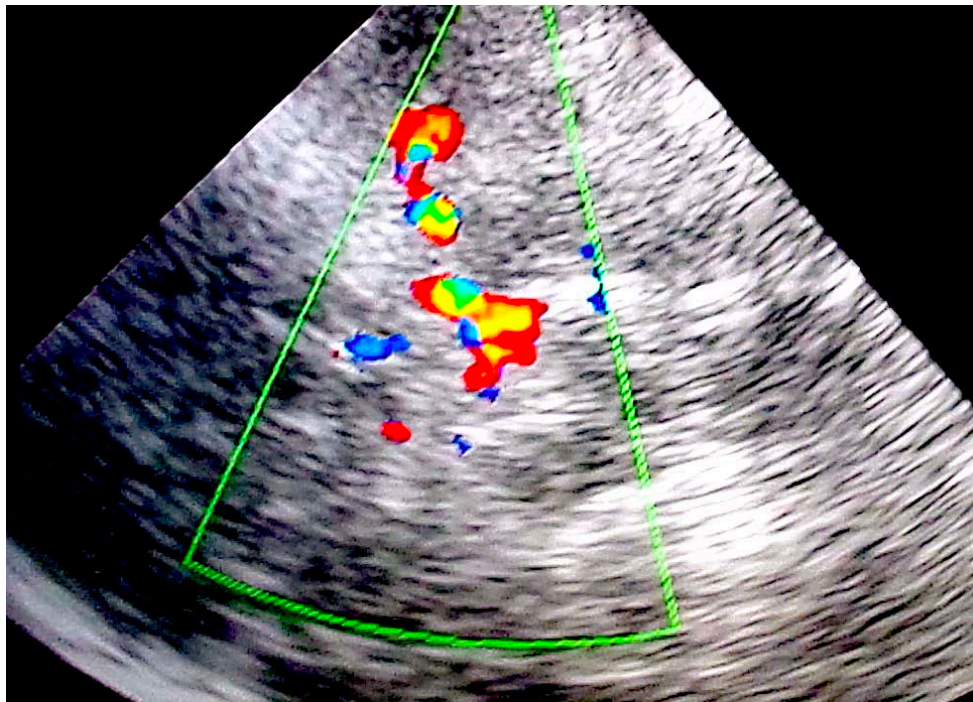
A case presentation and a brief literature review of CCF diagnosed via transcranial temporal window and made time to angiography shorter than the MRI brain. A review of literature was conducted for the timely diagnostic role of transtemporal TCD compared to transorbital US and an MRI brain.

Results:

Our case report showed the valuable role of the bedside TCD in diagnosing CCF. There is a limited number of studies which tackled the timely diagnostic role of transtemporal TCD compared to transorbital US and an MRI brain from door to angiography.

Conclusions:

A large-sampled randomized controlled trial is needed for evaluating the actual utility of a bed side time and cost-effective Transtemporal TCD vs other state-of-art non-angiographic diagnostic modalities such as MRI, CT and transorbital US.



Keywords: Vascular Imaging

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

Clinical and Neuroperfusion Predictors of Functional Outcome and Final Infarct Volume in Posterior Circulation Stroke

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Introduction:

Computed tomography perfusion (CTP) is considered standard of care in patient selection for mechanical thrombectomy (MT) in anterior circulation large vessel occlusion (LVO) ischemic strokes presenting after 6 hours from symptom onset. Its role in triaging patients is uncertain in posterior circulation stroke. The aim of this study is to assess the value of the admission CTP sequences in predicting clinical and radiological outcomes in posterior circulation LVO.

Methods:

We performed a retrospective cohort study of a prospectively maintained stroke database of patients who were diagnosed with a posterior circulation LVO and underwent MT. We included patients with a CTP on arrival and follow-up imaging (brain MRI or CT) after MT. Baseline clinical as well as CTP parameters (cerebral blood flow [CBF]; cerebellar blood volume [CBV]; time at maximum intensity [Tmax]) at different thresholds were estimated using post-processing RAPID software. Final stroke volume was quantified on follow-up imaging using the DWI sequence or plain CT. Good functional outcome was defined as using the mRS of 0-2 at 90 days.

Results:

Out of 81 patients with posterior circulation LVO who underwent MT, 23 had CTP on arrival along with follow-up brain imaging (16 had MRI, and 7 had CT) and were included in the final analysis. Lower age, BMI, NIHSS on arrival, and faster time to reperfusion were significantly associated with better mRS at 90 days ($p < 0.05$). Tmax > 6 ($p = 0.08$) and Tmax > 8 (0.057) seconds trended towards predicting good mRS at 90 days. None of the CTP parameters showed a predictive value for final stroke volume on follow-up imaging.

Conclusions:

Age, NIHSS on arrival, and time to reperfusion were superior to neuroperfusion parameters in predicting good mRS at 90 days in patients who underwent MT in posterior circulation LVO. Since CTP might have limitations in the posterior fossa for accurate estimation of ischemic volumes, plain CT or acute MRI brain may represent a diagnostic tool for patient selection in posterior circulation strokes at this moment.

Keywords: Acute Stroke, Ct Perfusion, Vascular Imaging

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

Contrast-Enhanced Transcranial Doppler Ultrasonography Versus Transesophageal Echocardiography as Screening Tool in Embolic Stroke.

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Introduction:

Right-to-left (RtL) intracardiac and intrapulmonary shunts are associated with embolic stroke. Although contrast-enhanced transcranial doppler ultrasonography (ceTCD) and transesophageal echocardiography (TEE) are used in embolic stroke work up, there are no standardized guidelines as to which test should be considered as 'gold standard'. Our objective is to evaluate the sensitivity of contrast-enhanced TCD and TEE in detecting right-to-left shunt to determine respective utilities as screening tools.

Methods:

Electronic medical records of subjects presenting with acute neurological symptoms who had ceTCD and TEE were evaluated. Sensitivity and specificity were calculated. Based on the respective prevalence of intracardiac and intrapulmonary shunts, positive predictive value, negative predictive value, and test accuracy were determined for ceTCD and TEE. Social Science Statistics was used for data analysis.

Results:

From June 2016 to August 2021, of 7,498 ischemic stroke patients, 260 patients were suspected of having strokes related to right to left shunts and underwent ceTCD and TEE for detection of cardioembolic sources for stroke. A positive right-to-left shunt was detected in 83 subjects. Detection by ceTCD was confirmed by the operator for 81 patients while 2 were considered false positive results (delayed sporadic High Intensity Transient Signals (HITS)). Sensitivity of ceTCD was 97.65% (95% CI [91.76%, 99.71%]). No safety concerns were identified in patients undergoing ceTCD. Of those with positive ceTCD (68.57%, n=35) were detected by Valsalva, and all of those 35 patients had negative TEE. TEE had sensitivity of 70.34% (95% CI [61.23%, 78.39%]).

Conclusions:

Contrast-enhanced TCD has superior sensitivity, is cost-effective, practical, and a safe alternative to TEE in identifying intracardiac or intrapulmonary shunts. Screening superiority of ceTCD may lie in ability to elicit shunts during Valsalva maneuvers. To our knowledge this is the largest single center series confirming ceTCD as a gold standard tool for screening of right to left shunts.

Keywords: TCD, Transcranial Doppler, Vascular Imaging, Ischemic Stroke

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

High Resolution Vessel Wall Imaging and Cerebrovascular Plaques: Comparison with DSA, MRA, and CTA

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Introduction:

Current imaging modalities might underestimate the presence and severity of intracranial atherosclerosis (ICAD). High resolution vessel wall imaging (HR-VWI) MRI emerged as a powerful tool to diagnose plaques not detected on routine imaging. We aim to compare different imaging modalities (HR-VWI MRI; digital subtraction angiogram (DSA); Time-of-flight (TOF) MRA; and CTA) in the identification and characterization of intracranial atherosclerotic culprit plaques.

Methods:

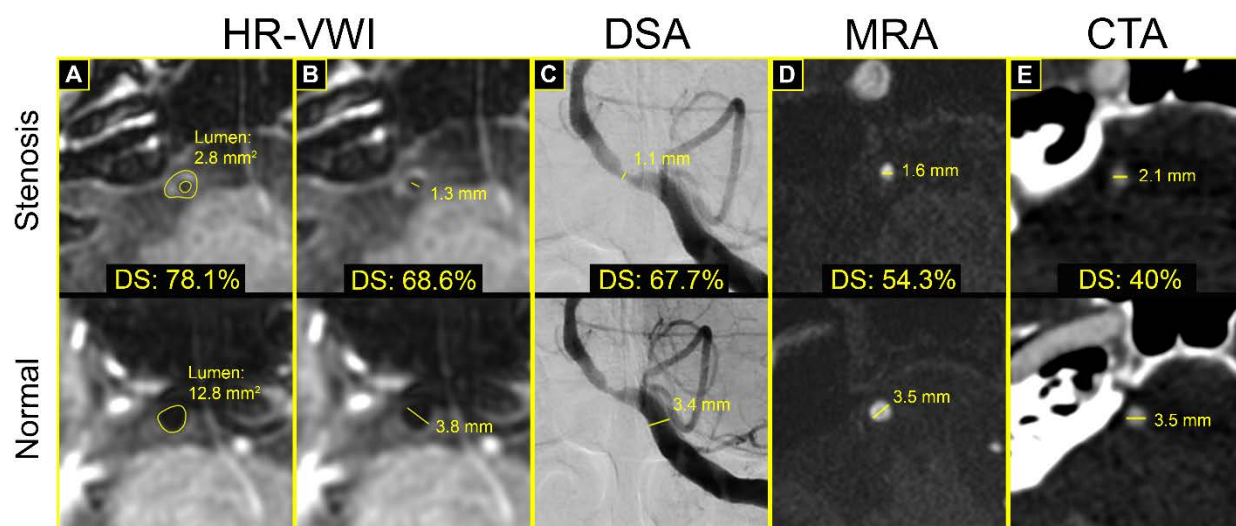
Patients diagnosed with ICAD were prospectively imaged with HR-VWI MRI. Culprit plaques were identified based on the likelihood of causing the stroke. Using cross-sectional images of intracranial vessels, regions of interest (ROI) were delineated. Then, diameters and ROI areas were measured for the purpose of calculating the following variables: degree of stenosis (DS) at the plaque level, plaque burden (PB), and remodeling index (RI). Additional imaging modalities (DSA, TOF MRA, and CTA) were identified retrospectively for each patient. The sensitivity of detecting a culprit plaque as well as the correlations between the different variables were analyzed for each modality. Linear regression analysis was used to determine the association of DS with PB and RI. Interobserver agreement on the determination of a culprit plaque on every imaging modality was evaluated.

Results:

A total of 44 patients who underwent HR-VWI had ICAD and were included in the final analysis. Of those, 34 had CTA, 18 had TOF-MRA, and 18 had DSA. Using HR-VWI as gold standard, the sensitivity for culprit plaque detection was 88% for DSA, 78% for TOF MRA, and 76% for CTA. We found no difference between the DS in all four modalities using measured cross-sectional diameters, but difference was found when measuring ROI areas to calculate DS. There was a significant positive correlation between PB and DS on HR-VWI MRI ($p < 0.001$), but not on the DSA ($p = 0.168$), MRA ($p = 0.144$), or CTA ($p = 0.253$), and a significant negative correlation between RI and DS on HR-VWI MRI ($p = 0.003$), but not on DSA ($p = 0.783$), MRA ($p = 0.405$), or CTA ($p = 0.751$). PB and RI predicted the degrees of stenosis on HR-VWI, but not on the other modalities. There was good inter-rater agreement for culprit plaque detection on HR-VWI ($k = 0.48$, $p = 0.001$), but no agreement was found on the other modalities.

Conclusions:

HR-VWI MRI can locate otherwise undetectable plaques on conventional imaging through the ability to measure plaque burden, an essential component for characterization of plaques severity and a strong predictor of stenosis. HR-VWI also showed more accurate measurements of degree of stenosis through measurement of ROI areas, and had good inter-rater agreement for accurate plaque detection, compared to DSA, MRA, and CTA.



Keywords: MRI, Angiogram, Angiographic Ct, MRA, Vascular Imaging

Financial Disclosures: The authors had no disclosures.

Grant Support: Pilot Research Grant from the Society of Vascular and Interventional Neurology (SVIN)

Poster

Hyperintense Acute Reperfusion Marker and Hemorrhagic Conversion in Stroke Patients Undergoing Mechanical Reperfusion

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Introduction:

Endovascular thrombectomy (EVT) is a highly effective treatment to improve clinical outcome in patients with acute ischemic stroke due to large vessel occlusion (AIS-LVO). However, blood-brain barrier (BBB) disruption causing hemorrhagic transformation and reperfusion injury can potentially negate the beneficial effect of reperfusion. Studying determinants, frequency, and outcomes of the hyperintense acute reperfusion marker (HARM) sign, a biomarker of BBB disruption, would help to identify individual patients at increased risk, as well as developing therapies to prevent BBB breakdown.

Methods:

In consecutive AIS-LVO patients with AIS-LVO who underwent EVT followed by MRI within the next 24 hours, we evaluated frequency, determinants, and outcomes of HARM sign.

Results:

Among 81 patients meeting study criteria, age was 71.0 (SD 19.7), 58% female, mean NIHSS was 14.5 (SD 6.8), and time from last known well to treatment was 355 min (IQR 206.5 - 664). HARM sign was observed in 64% (52/81) of patients. On multivariate logistic analysis, presence of HARM sign was independently associated with greater periventricular white matter hyperintensity, higher pre-EVT ischemic core volume, more proximal target vessel occlusion, and achievement of successful reperfusion or better. Hemorrhagic conversion was seen in 31.8% of patients with HARM sign and 26.7% of patients without HARM sign. Multivariate analysis identified higher blood glucose, lower ASPECT, score and greater post-EVT ischemic core volume as independent predictors of hemorrhagic conversion. HARM sign was identified to correlate with poor clinical outcome in bivariate analysis, but multivariate analysis only identified less neurological deficits, lower baseline systolic BP, lower degree of periventricular white matter hyperintensities, shorter time to device deployment and reduced post EVT ischemic core volume as independent predictors of good clinical outcome (mRS 0-2) upon discharge.

Conclusions:

The HARM sign indicating disruption of the blood-brain barrier following EVT is common, present in about 6 of every 10 treated patients. Independent risk factors for HARM sign are chronic ischemic microangiopathy, greater acute ischemic core, and successful reperfusion. HARM sign presence is associated with worse functional outcome.

Keywords: Mechanical Thrombectomy, MRI, Acute Ischemic Stroke Intervention

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

Imaging Characteristics for Post Stroke Delirium

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Introduction:

Delirium after acute ischemic stroke (AIS) is a common clinical occurrence, present in 13-48% of patients. Post-stroke delirium is associated with longer hospital admissions, worse functional outcomes, and increased mortality in the short term and has been associated with worse long-term outcomes. Prior studies have shown right-sided strokes are more associated with delirium, but very few other imaging characteristics of post-stroke delirium have been described. We conducted a prospective study evaluating imaging characteristics for patients with delirium.

Methods:

Between Sept 2019 and June 2021, patients diagnosed with AIS within 48 hrs of stroke onset were prospectively evaluated for delirium using the Confusion Assessment Method (CAM)-ICU daily for the first eight days of their hospital stay. Patients with severe stroke and expected mortality within the first month at the time of admission or with severe aphasia unable to follow commands were excluded. Data regarding demographics, comorbidities, hospital stay, stroke metrics, lab work and medications were analyzed. Imaging characteristics were adjudicated by authors based on either the patient's first MRI or the 24 hr CT after admission. Infarct size measured based on ABC/2 formula based on diffusion-weighted imaging on MRI or stroke appearance on CT.

Results:

Over the course of 12 non-consecutive months, we evaluated 213 patients, of which 177 could be assessed with the CAM-ICU. Delirium was present in 88 (49.7%). There were no statistically significant differences in age, gender, race, co-morbidities, or TOAST etiology among patients with and without delirium (Table 1). Patients with delirium had higher NIHSS and were more likely to receive tPA. Patients with delirium were more likely to have MCA territory strokes, strokes involving the insula, and to have infarct sizes ≥ 10 cc. On multivariate modeling, NIHSS (OR 1.07; 95% CI 1.01, 1.13), MCA territory stroke (OR 2.62; 95% CI 1.09, 6.30), and infarct size ≥ 10 cc (OR 3.23; 95% CI 1.46, 6.90) were associated with delirium.

Conclusions:

In a cohort of AIS patients without significant expected mortality on admission, the incidence of delirium is high. On evaluation, infarct size ≥ 10 cc and in the MCA territory were more associated with delirium than NIHSS. These imaging characteristics should be considered in any future predictive models for identifying patients at risk for delirium.

Table 1 Baseline and Imaging characteristics

Variable	No Delirium N=89	Delirium N=88	pvalue
Age, median (Q1, Q3)	64 (58, 67)	73 (54, 84)	0.31
Female Gender, n(%)	40 (45%)	38 (43%)	0.76
Race, n(%)			
White	39 (44%)	34 (39%)	0.47
Black	33 (37%)	34 (39%)	
Pre-morbid mRS 0-1	67 (75%)	66 (75%)	0.85
NIHSS, median (Q1, Q3)	6 (3, 11)	11 (6, 16)	<0.0001
Endovascular therapy	22 (25%)	28 (32%)	0.29
tPA	29 (33%)	41 (47%)	0.05
Past Medical History, n(%)			
Ischemic stroke	17 (19%)	20 (23%)	0.55
Coronary Artery Disease	11 (12%)	18 (20%)	0.15
Hypertension	70 (79%)	66 (75%)	0.56
Atrial Fibrillation	16 (18%)	14 (16%)	0.71
Hypercholesterolemia	21 (23%)	28 (32%)	0.22
Diabetes	33 (37%)	29 (33%)	0.57
TOAST Etiology			
Large Vessel Atherosclerosis	16 (18%)	14 (16%)	0.28
Small Vessel Arteriopathy	12 (13%)	5 (6%)	
Cardioembolic	24 (27%)	28 (32%)	
Cryptogenic	14 (16%)	22 (25%)	
Other	19 (21%)	18 (20%)	
Imaging elements			
Stroke side			
Right	34 (38%)	32 (36%)	0.27
Left	26 (29%)	43 (49%)	
Leukoaraiosis	15 (17%)	24 (27%)	0.09
Past infarcts	15 (17%)	19 (22%)	0.42
Brain regions			
MCA territory	62 (70%)	77 (88%)	0.004
ACA territory	5 (6%)	5 (6%)	0.99
Insula	17 (19%)	29 (33%)	0.04
Brainstem	10 (11%)	6 (7%)	0.31
Multiple territories	11 (12%)	9 (10%)	0.65
Infarct <10 cc	63 (71%)	37 (42%)	<0.0001

P< 0.05

For continuous variables, the Mann-Whitney test was employed for statistical comparison.

For categorical variable chi-square test or Fisher's exact test were employed for statistical comparison.

Keywords: Imaging, Ischemic Stroke**Financial Disclosures:** The authors had no disclosures.**Grant Support:** None.

Poster

Initial Experience Implementing the Transradial Approach for Diagnostic Cerebral Angiography

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Introduction:

The transradial approach (TRA) has gained acceptance among interventionists due to the lower operative complication rates, less operative time and better patient comfort. Our study aimed to analyze our experience in the implementation of the TRA for diagnostic cerebral angiographies.

Methods:

Between March 2020 and July 2021, consecutive patients who underwent TRA in two institutions were selected and data was retrospectively collected. Demographics, technical details of the procedure, duration of the procedure, fluoroscopy time and radiation exposure were analyzed.

Results:

A total of 76 angiographies using the TRA were done. The mean age was 47.5 ± 16.8 years (8 – 82 years). Women represented 57% of cases. Successful radial artery (RA) catheterization was done in 94% (85 patients/80 successful). A preoperative cocktail was used in all the cases. Subcutaneous lidocaine and a 5F sheath were used in 46% and 57% of cases, respectively. The Simmons 2 catheter was used in all the cases. Glidecath, followed by Merit were used in 40% and 32% of the cases, respectively. Right internal carotid artery (ICA), left ICA, right vertebral artery (VA), left VA, right external carotid artery (ECA) and left ECA were studied in 95%, 91%, 76%, 20%, 20% and 15% of the cases, respectively. Post-operative vasospasm occurred in 29% of the cases, which resolved with intra-arterial verapamil. Vasospasm was not associated with sheath diameter ($p=0.129$) or local anesthesia ($p=0.065$). The mean fluoroscopy time was 16 minutes. Conversion to TFA was done in 9 patients (10.6%), of which the RA was successfully catheterized in 4 patients: 1 patient had an atheroma in the brachial artery, 1 patient had a thrombus in the subclavian artery and 2 patients presented severe pain in the forearm. In the remaining 5 patients, there were 2 radial dissections and in 3 the RA could not be approached.

Conclusions:

The TRA is a safe and effective alternative to perform diagnostic cerebral angiographies with conversion rates according to the literature. The use of appropriate catheters is necessary in order to lower fluoroscopy times when this technique is chosen.

Keywords: New Innovation, New Technique, Angiogram

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

Larger Functional Shunts are associated with greater Cerebrovascular Disease Burden

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Introduction:

The relationship between embolic stroke and patent foramen ovale (PFO) is well-established. Our objective was to evaluate the association between high intensity transient signals (HITS) in contrast-enhanced transcranial doppler ultrasonography (ceTCD), baseline MRI brain small vessel ischemic changes, and rates of acute ischemic stroke in the setting of focal neurological deficits.

Methods:

Electronic medical records of subjects with acute onset neurological symptoms who had ceTCD and MRI brain were evaluated. Subjects without a reported Spencer grade and/or MRI brain without available DWI and FLAIR sequences were excluded. Acute stroke rates and baseline Fazekas score in low-grade (Spencer grade 1-2) and high-grade (Spencer grade 3-5) shunts were analyzed using Z score for 2 population proportions and Mann-Whitney U test, respectively. Social Science Statistics was used for data analysis.

Results:

From June 2016 to August 2021, of 7,498 consecutive ischemic stroke patients, 132 patients were identified as possible strokes related to PFO and were hospitalized with focal neurological deficit, underwent ceTCD and MRI brain. Acute stroke was confirmed on DWI in 60% of Spencer grade 1 (n=73), 72.2% of grade 2 (n=19), 72.7% of grade 3 (n=29), and 80% of grades 4 and 5 shunts (n=11). Acute stroke rates between low grade (grades 1-2) and high grade shunts (grades 3-5), did not reach statistical significance (z= -0.9181; p=0.17879). There was no significant difference in periventricular white matter disease (z= 0.85697; p=0.19489). Fazekas scores assessing deep white matter disease were statistically significant between low- and high-grade shunts (z=1.92818; p=0.0268).

Conclusions:

A trend towards statistical significance was observed in high-grade shunt association with higher rate of acute stroke. Deep white matter disease burden may be significantly higher in high-grade shunts. Further prospective studies are needed to corroborate our findings.

Keywords: TCD, Ischemic Stroke, MRI, Transcranial Doppler

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

Rare Anterior Inferior Cerebellar Artery Origin of Middle Meningeal Artery.

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Introduction:

Middle meningeal artery (MMA) anatomy has very important surgical implications during endovascular and open based skull procedures. Various anatomical origins have been identified in the literature besides its most common origin as the largest branch of the maxillary artery. It runs parallel and close contact of the lateral skull face therefore during trauma to this area is prone to rupture resulting in subdural hemorrhage(SDH). In our case report, we present its peculiar origin from anterior inferior cerebellar artery which has never been reported before. The origin of MMA may reflects the risk involved with embolization therapy for chronic SDH.

Methods:

A case of MMA originated form AICA. A literature review was conducted of reports of MMA origins.

Results:

A 35-year-old male with a history of alcohol abuse presented to the ED after falling down from the stairs. In the ED, the patient had multiple episodes of seizures along with respiratory distress therefore was intubated due to concern of airway protection. CT head showed bilateral SDH. Patient underwent diagnostic angiogram for possible bilateral embolization of MMA. During the procedure, the left MMA origin was seen from the AICA whereas the right MMA arising from the external carotid artery. Embolization of the left MMA was aborted. Patient remained intubated and was later transferred to a long term care facility.

Conclusions:

In the last 80 years, the anatomy of the MMA has been part of the discussion of various literature. Seeger et.al, highlighted the embryological changes manifested as anastomosis between Sphenomaxillary artery and lateral pontine artery resulting in origin of MMA from Basilar artery along with absence of foramen spinosum. Since 1973, multiple literature highlighted the origin of MMA including the lacrimal artery, ICA, ascending pharyngeal artery, ophthalmic and occipital arteries. Recently, In 2011 Kuruvuilla et.al showed the origin of MMA from posterior inferior cerebellar artery. MMA clinical significance can be seen in multiple diseases. Older populations with chronic subdural hematomas, embolization of MMA has shown to be a less invasive and cost effective procedure. In patients with anterior and middle cranial fossa meningiomas embolization of MMA has been a crucial part of management. Similarly, understanding of its anatomy is also important while treating MMA aneurysm or pseudoaneurysms. In our case, the origin of middle meningeal artery from AICA has been significant as it supplies the posterior fossa structures and was not reported in the literature before, hence the procedure was aborted. This anatomical variant has shown us a new light upon embryological evolution and has helped us widen the horizons of our approach towards brain vasculature. This finding

will help the future Interventionists to develop new ways of embolization of the MMA and understanding its anatomy.



Keywords: Interventional Neuroradiology, Diagnostic Neuroradiology, Embolization, SDH,

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

Systematic CT-Perfusion acquisition in all Suspected Stroke Patients Increases Vascular Occlusion Detection and Thrombectomy Rates

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Introduction:

In acute ischemic stroke patients, current guidelines recommend noninvasive vascular imaging to identify intracranial vessel occlusions (VO) that may benefit from endovascular treatment (EVT). However, VO can be missed in CT angiography (CTA) readings. We aim to evaluate the impact of consistently including CT perfusion (CTP) in admission stroke imaging protocols on VO diagnosis and EVT rates.

Methods:

We included patients with a suspected acute ischemic stroke that underwent urgent non-contrast CT, CTA and CTP from April to October 2020. Hypoperfusion areas defined by Tmax>6s delay (RAPID software), congruent with the clinical symptoms and a vascular territory, were considered due to a VO (CTP-VO). Cases in which mechanical thrombectomy was performed were defined as therapeutically relevant VO (EVT-VO). For patients that received EVT, site of VO according to digital subtraction angiography was recorded. Two experienced neuroradiologists blinded to CTP but not to clinical symptoms, retrospectively evaluated NCCT and CTA to identify intracranial VO (CTA-VO). We analyzed CTA-VO sensitivity and specificity at detecting CTP-VO and EVT-VO respectively. We performed a logistic regression to test the association of Tmax>6s volumes with CTA-VO identification and indication of EVT.

Results:

Of the 338 patients included in the analysis, 157 (46.5%) presented a CTP-VO, (median Tmax>6s: 73 [29-127] ml). CTA-VO was identified in 83 (24.5%) of the cases. Overall CTA-VO sensitivity for the detection of CTP-VO was 50.3% and specificity was 97.8%. Higher hypoperfusion volume was associated with an increased CTA-VO detection, with an odds ratio of 1.03 (95% confidence interval 1.02-1.04) (figure). DSA was indicated in 107 patients; in 4 of them no EVT was attempted due to recanalization or a too distal VO in the first angiographic run. EVT was performed in 103 patients (30.5%. Tmax>6s: 102 [63-160] ml), representing 65.6% of all CTP-VO. Overall CTA-VO sensitivity for the detection of EVT-VO was 69.9%. The CTA-VO sensitivity for detecting patients with indication of EVT according to clinical guidelines was as follows: 91.7% for ICA occlusions and 84.4% for M1-MCA occlusions. For all other occlusion sites that received EVT, the CTA-VO sensitivity was 36.1%. The overall specificity was 95.3%. Among patients who received EVT, CTA-VO was not detected in 31 cases, resulting in a false negative rate of 30.1%. False negative CTA-VO cases had lower Tmax>6s volumes (69[46-99.5] vs 126[84-169.5]ml, p<0.001) and lower NIHSS (13[8.5-16] vs 17[14-21], p<0.001).

Conclusions:

Systematically including CTP perfusion in the acute stroke admission imaging protocols may increase the diagnosis of VO and rate of EVT.

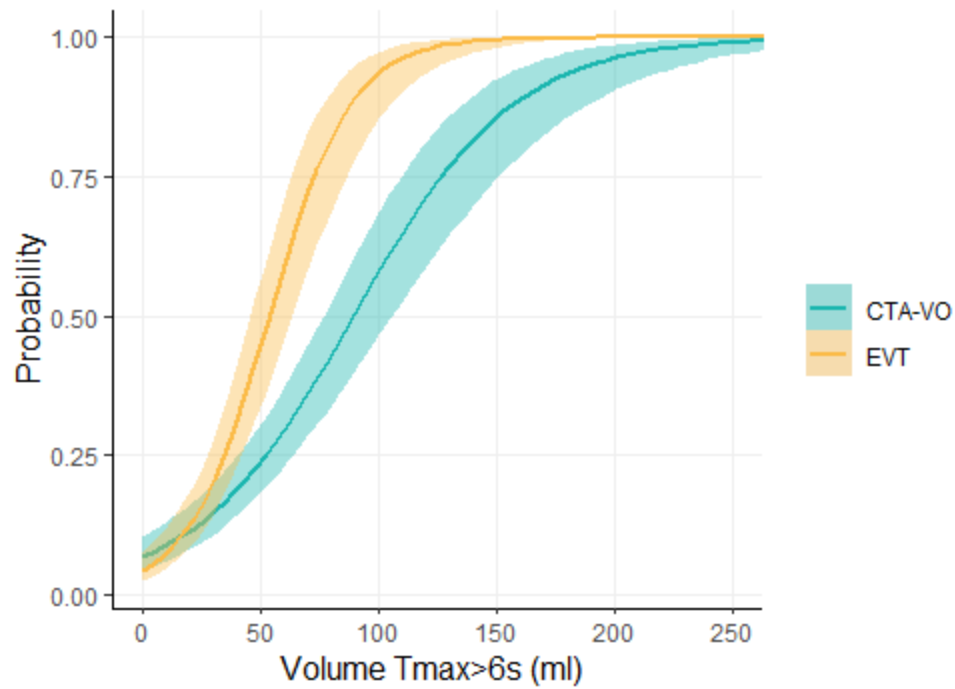


Figure1: Probability of CTA-VO diagnosis and probability of EVT according to Tmax volume

Keywords: Angiographic Ct, Vascular Imaging, Endovascular Therapy

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Grant Support: None.

Poster

White Matter Tract Integrity After Vascular Insult: Longitudinal Analysis of Hemorrhagic vs Ischemic Lesions

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Introduction:

White matter tract (WMT) injury occurs in patients with acute cerebrovascular disorders. In this study, we elucidate longitudinal differences in mechanism of injury and repair between ischemic stroke (ISC) and intracerebral hemorrhage (ICH).

Methods:

Twenty patients (10 ISC and ICH) were prospectively imaged at 1, 3, and 12 months of onset on a 3T MRI. 3D anatomical and DTI images were obtained and integrity of the corticospinal tract (CST) assessed at the ipsi and contralesional posterior limb of internal capsule (PLIC). Fractional anisotropy (FA), mean diffusivity (MD) and pixel volume were recorded. A linear regression model was applied for statistical analysis.

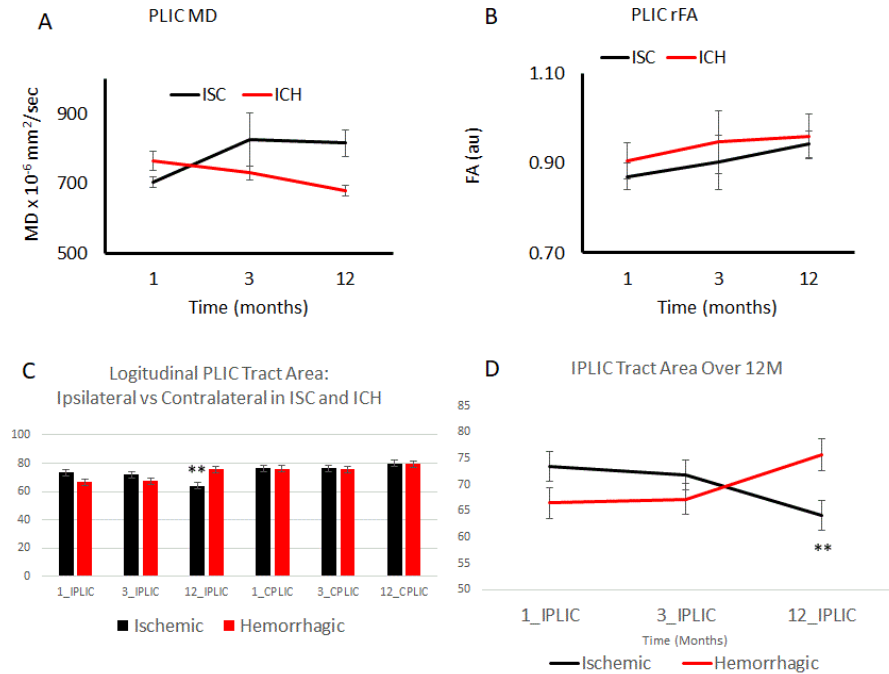
Results:

ISC group had 4 men, 6 women whereas ICH group had 7 men, 3 women, both with average age 52. Baseline NIHSS in ISC was 11 (IQR=4.5–20) and ICH 6 (IQR=2–13). All lesions were unilateral, hemispheric, completely subcortical or with a significant subcortical component. The average lesion and hematoma volume at 1 month was 37 and 39 cc in ISC and ICH, respectively. The MD in the PLIC of the ISC increased from 1 to 3m ($P < 0.05$) then plateaued, whereas it decreased in ICH over the entire 12m (Fig 1A). The rFA showed a similar pattern of initial injury and then improvement over time in both ISC and ICH (Fig 1B). The ISC group showed 12% WM atrophy in the PLIC at 12m, whereas 13% expansion ($P < 0.05$) in ICH over this period, after an initial contraction of 14% at 1m (fig 1C-D). Structural changes of the PLIC correlated with changes in mRS/NIHSS ($p < 0.05$).

Conclusions:

ISC and ICH display unique patterns of WMT changes over one year in which ICH injury reflects a compression of the CST that resolves over time, while in ISC our data show degeneration and microstructural injury. These changes reflect different mechanisms of injury and remodeling on a cellular level. A better understanding of these changes could improve recovery therapies. Larger studies are needed to better characterize long term WMT changes in IS and ICH.

Figure 1 summarizes post ISC and ICH temporal changes in the PLIC in ISC vs ICH. A: demonstrates MD changes. ICH improves linearly while ISC worsens initially then plateau at 3m. B: rFA of PLIC shows similar pattern suggesting maintenance of axonal integrity over time in both pathologies. C + D: PLIC volumes correlate with MD and rFA findings. After initial contraction due to compression IPLIC expands in ICH. In ISC the tract shrinks overtime representing reduced myelination however without permanent axonal injury. This in contrast to CPLIC that remains constant and similar in both pathologies. * ** = P <0.05
 * ICH volume over time
 ** ISC volume over time
 Compared to time matched contralateral PLIC



Keywords: Cerebral Blood Flow, Hemorrhage, MRI, Vascular Imaging, Diagnostic Neuroradiology

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

Chiropractor Manipulation Leading to Bilateral Vertebral Artery Dissection and Acute Ischemic Stroke

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Introduction:

Traumatic cervical artery dissection is one of the leading causes of stroke in patients under the age of 45. Recent chiropractic neck manipulation is associated with risk of vertebral artery dissection (VAD). The V3 segment of the vertebral artery is highly susceptible to the bending forces during forced manipulation leading to intimal damage.

Methods:

N/A

Results:

This is a case presentation of a 44 year old male who was transferred from another emergency department for left homonymous inferior quadrantanopia noted on an optometrist visit. He reported sudden onset left homonymous hemianopia after receiving a high velocity cervical spine adjustment at a chiropractor appointment for chronic neck pain a few days prior. CT angiogram of the head and neck revealed bilateral vertebral artery dissection at left V2 and right V3 segments. MRI brain confirmed an acute infarct in the right medial occipital lobe. His right PCA stroke was likely embolic from the injured right V3 but possibly from the left V2 as well. As the patient reported progression from a homonymous hemianopia to a quadrantanopia, he likely had a migrating embolus.

Conclusions:

Arterial dissection accounts for about 2% of all ischemic strokes, but may be between 8-25% in patients less than 45 years old. VAD can result from trauma of varying severities - from sports, motor vehicle accidents, and chiropractor neck manipulations to violent coughing/sneezing. It is estimated that 1 in 20,000 spinal manipulation results in vertebral artery aneurysm/dissection. In the United States, patients who have multiple chronic conditions are reporting higher use of complementary or alternative medicine, including chiropractic manipulation. Education about the association of VAD and chiropractor maneuvers can be beneficial to the public as these are preventable acute ischemic strokes. In addition, vertebral artery dissection symptoms can be subtle and patients presenting to chiropractors may have distracting pain masking their deficits. Evaluating for appropriateness of cervical manipulation in high-risk patients and detecting early clinical signs of VAD by chiropractors can be beneficial in preventing acute ischemic strokes in young patients.

Keywords: Vertebral, Ischemic Stroke

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Grant Support: None.

Poster

Demographic and Pharmacological Characteristics of Alzheimer Dementia Patients with Mild Cognitive Impairment stratified by Gender

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Introduction:

The role that specific clinical factors play in contributing to gender differences in Alzheimer's patients with mild cognitive impairment (MCI) is not yet fully understood. In this study, we tested the hypothesis that pharmacological, demographic, and risk factors may contribute to gender difference in Alzheimer's patients with MCI.

Methods:

Methods Data collected for 5 years was analyzed using a retrospective data analytical approach on 33,064 Alzheimer patients, including 13,569 men and 19,495 women that presented with MCI. Receiver operating characteristic (ROC) curve analysis and multivariate regression models were used to identify specific factors that contribute to gender differences in MCI patients.

Results:

Results Our records indicate that women that presented with MCI were more likely to be taking Buspirone (OR=0.767, 95% CI, 0.683-0.861, P<0.001) while men within this population were more likely to be taking Galantamine (OR=0.559, 95% CI, 0.382-0.818, P<0.001). ETOH use was associated with MCI in both men (OR=0.696, 95% CI, 0.638-0.760, P<0.001) and women with Alzheimer's Dementia (OR=0.484, 95% CI, 0.442-0.529, P<0.001).

Conclusions:

Conclusion Our findings reveal gender differences in men and women that presented with MCI. Management strategies should consider identified factors to provide better care for Alzheimer patients with MCI.

Keywords: Epidemiology

Financial Disclosures: The authors had no disclosures.

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Poster

Dural Arteriovenous Fistula and Implications in Aneurysmal Genesis

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Introduction:

There is a reported association of cerebral arteriovenous malformations and aneurysms, however, data regarding patients presenting with dural arteriovenous fistulas (dAVF) and aneurysms is limited. Here, we present a patient who was incidentally diagnosed with 2 aneurysms in addition to a dAVF; and her treatment course. Previous to her diagnosis, she denied any and all symptomatology that would prompt further evaluation.

Methods:

Case description: 60-year-old female with history of hypertension, hypothyroidism and gastroesophageal reflux disease who initially presented to an outside hospital after a motor vehicle collision in 2016, at that time she reports being diagnosed with multiple aneurysms; but was lost to follow up. In 2020 she was referred to interventional neuroradiology and underwent diagnostic digital cerebral angiogram. Which reported a 13 x 12 x 13.3 mm left para-ophthalmic internal carotid artery (ICA) aneurysm with a 7 mm neck. A 5.7 x 7.7 x 6.1 mm basilar tip artery aneurysm with a 5.6 mm neck and a right Cognard type four occipital dAVF, with feeding vessels from the right posterior cerebral artery and right occipital artery and antegrade drainage to the dural sinuses. From the time of diagnosis to the initiation of interventions, patient denied any concerning symptomatology. Treatment was initiated 4 months after diagnostic angiogram. She received 5 days of Dual Antiplatelet therapy (DAPT) with aspirin and Plavix previous to the deployment of a woven endobridge device (WEB™ 8-3mm) into the basilar tip aneurysm; as this was felt to be the aneurysm with highest probability of rupture. Post-operative course was unremarkable and DAPT was discontinued. Three months after WEB™ deployment, the patient underwent embolization of the right occipital dAVF with a liquid embolic agent (onyx™). Post operatively, she developed decreased peripheral vision in her left eye, though the rest of her hospitalization was unremarkable. 3 months after embolization, she underwent left para-ophthalmic artery aneurysm flow diversion with a pipeline™ (4-18mm) flow diverter, with an uncomplicated admission. She was subsequently evaluated by neuro-ophthalmology who has reported a stable peripheral left eye left inferior quadrantic defect along with a supertemporal defect in her right eye.

Results:

Discussion: Interestingly, the patient presented 2 aneurysms, one in the anterior circulation and the most concerning, located in the posterior circulation. One could draw conclusions that the dAVF was associated with the basilar aneurysm. As dAVFs are acquired lesions, it is feasible to assume that there may be an association between both types of lesions, perhaps due to flow or pressure being exerted on weakened vessel walls, thus leading to aneurysmal formation.

Conclusions:

Conclusion: Because a potential for implication in the flow dynamics of the dAVF in aneurysmal formation. We have opted to use computational fluid dynamics to analyze said flow within the dAVF to better understand the causal relationship between aneurysms and dural fistulae. In the long run research into genesis of aneurysms secondary to coexisting vascular lesions could further elucidate the mechanisms by which aneurysms develop.

Keywords: Aneurysm, Embolization, Onyx, Vascular Imaging, Cerebral Arteriovenous Malformations

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

Gender in Dementia Patients With Lewy Body Dementia and Parkinson's Disease With Dementia

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Introduction:

Gender differences in dementia patients have been investigated extensively, however, demographic, risk, and pharmacological factors associated with gender differences in dementia patients associated with Lewy Body Dementia(LBD) and Parkinson's disease with dementia (PDD) are not fully understood. We tested the hypothesis that specific factors may contribute to the observed gender differences in LBD and PDD patients.

Methods:

A 5-year retrospective data analytical study was conducted using 4526 men and 3676 women collected from a regional hospital database. We performed logistic regression analysis to determine factors associated with gender differences in LBD and PDD patients. Multicollinearity and significant interactions between independent variables in the model were examined using variance inflation factors, while a Cox & Snell classification was applied to check the model fitness.

Results:

In the adjusted analysis, African-American men (AAM) (OR=0.249, 95% CI, 0.088-0.703, P=0.009) were more likely to present with PDD, while women with increasing age (OR=1.042, 95% CI, 1.025-1.058, P<0.002) were more likely to present with LBD. Escitalopram was associated with LBD in men (OR=1.444, 95% CI, 1.079-1.932, P=0.014) and PDD in women (OR=0.651, 95% CI, 0.468-0.906, P=0.011).

Conclusions:

Our findings revealed gender differences in LBD and PDD. More men presented with. PDD based on race, while women presented with LBD more based on age.

Keywords: Epidemiology

Financial Disclosures: The authors had no disclosures.

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Poster

Intracranial bleeding in a Juvenile nasopharyngeal angiofibroma stage IVb

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Introduction:

The trigeminocardiac reflex has been reported in craniofacial, neurosurgery, ophthalmological surgeries, and recently at endovascular procedures. Therefore, it has been called by other names also as trigeminal depressor reflex, reflex vagal trigeminal, or oculocardiac reflex. It is provoked by the stimulation of branches of the trigeminal nerve and presents cardiovascular alterations such as hypotension, bradycardia, cardiac arrhythmias, which can lead to asystole. This reflex originates at the brainstem and occurs as a rare autonomic dysfunction triggered by the stimulation of baroreceptors. Some factors predispose the appearance of this type of reflex, such as hypercapnia, hypoxemia, superficial anesthetic depth, and acidosis, among others. During these procedures is recommended continuous monitoring of the ECG and PAM. It is always essential to know the patient and modify the risk factors, or even stop the stimulus notifying the surgeon, if there is no adequate response, anticholinergic therapy, such as atropine, and the use of vasopressors should be applied.

Methods:

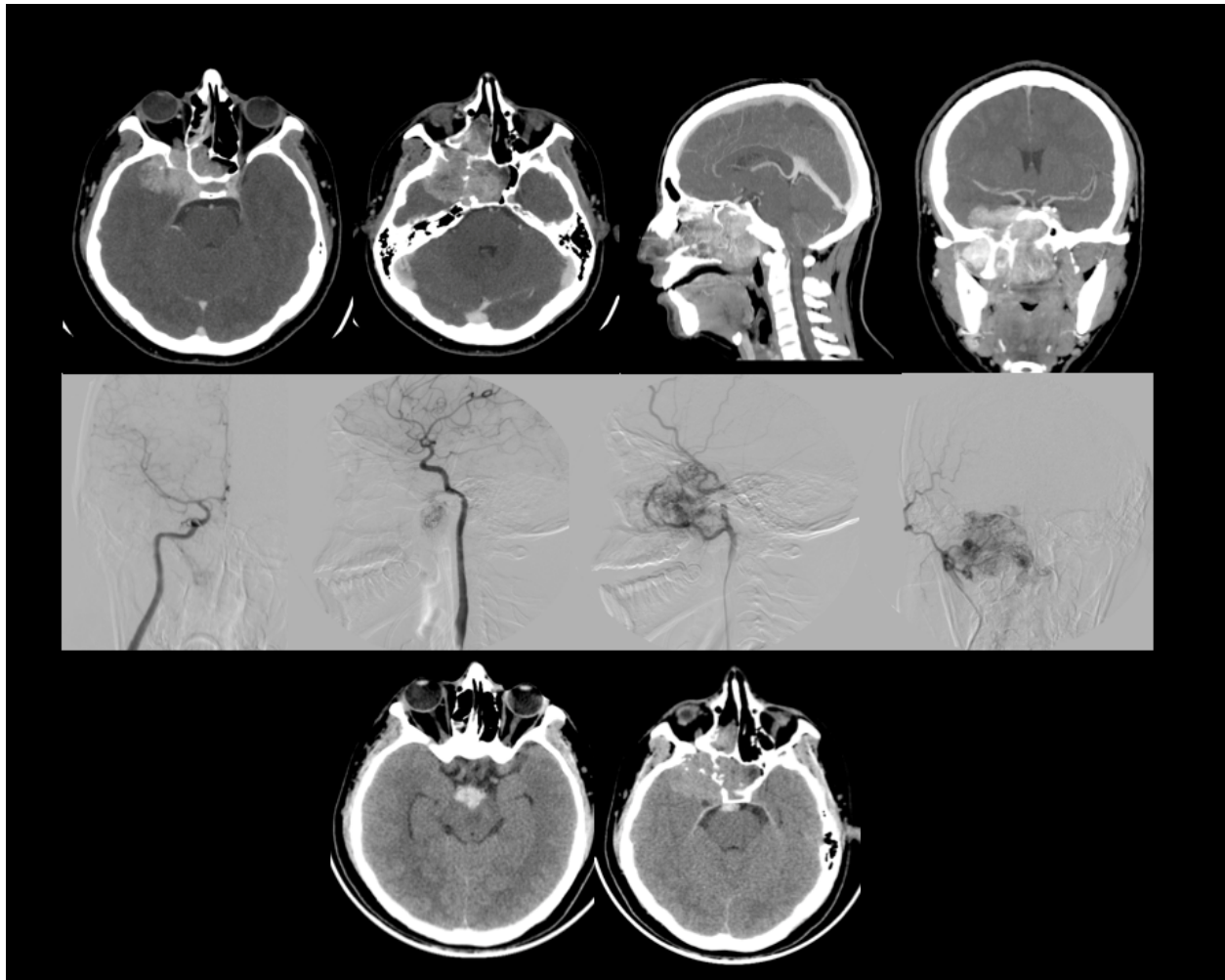
We report a clinical case of an 18-year-old male with a history of 3 years of recurrent epistaxis diagnosed with a Juvenile nasopharyngeal angiofibroma stage IVB, who underwent diagnostic cerebral angiography for surgical planning.

Results:

Angiography was performed under conscious sedation. When we placed the JB2 diagnostic catheter in the external carotid artery, the patient presented bradycardia of 40bpm. The catheter was removed, and the heart rate improved; we made a second attempt again with bradycardia, for which atropine was administered, and continued with the procedure without incident. We evaluated the vascular supply to the tumor and ruled out the involvement of the ipsilateral internal carotid artery. An occlusion test was also performed, which was positive. No aneurysms were found during angiography. At the end of the angiography, the patient presented anisocoria and left hemiparesis, so due to the suspicion of a thromboembolic event, a new femoral approach was performed to assess the intracranial circulation we found adequate patency. A non-contrast head CT was performed, a subarachnoid hemorrhage in the prepontine and the interpeduncular cistern was observed. Medications used for sedation were discontinued to assess his neurological status at that time with GCS of 12. 48 hrs later, the patient was neurologically intact and without sequelae. In the literature review, we did not find reports of intracranial hemorrhage as complications in nasopharyngeal angiofibroma with intracranial extension or secondary to the presentation of the trigeminocardiac reflex. However, we suspected that it could result from a transient elevation of arterial hypertension due to the administration of anticholinergic therapy.

Conclusions:

Neuroanesthesiologists and endovascular surgeons must be aware of its manifestations and management to avoid complications due to the presentation of this reflex.



Keywords: Interventional Neuroradiology, Tumor Embolization, Intracerebral Hemorrhage

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

Pharmacological and Clinical Factors Associated with Gender Difference in Alzheimer Dementia Patients

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Introduction:

Alzheimer dementia (AD) has been reported in both men and women. However, factors contributing to gender differences are not fully understood. We tested the hypothesis that specific pharmacological, demographic, and risk factors contribute to gender difference in AD.

Methods:

A retrospective analytical approach was used to analyze data from 12,632 AD patients, comprising 4,584 men and 8,048 women. Univariate and multivariate analyses determined the factors contributing to the gender difference in AD patients.

Results:

About 36% of AD patients were men, and 64% were women. Citalopram (OR=1.187, 95% CI, 1.044 – 1.350, P=0.009) was associated with men, while escitalopram (OR=1.213, 95% CI, 1.119 – 1.315, P<0.001) was associated with women. In both men and women, increasing age (OR=1.075, 95% CI, 1.071 – 1.079, P<0.001/OR=1.096, 95% CI, 1.093 – 1.100, P<0.001), tobacco use (OR=1.150, 95% CI, 1.054 – 1.254, P=0.002/OR=1.150, 95% CI, 1.073 – 1.233, P<0.001), and black patients (OR=2.380, 95% CI, 2.120 – 2.674, P<0.001/OR=1.395, 95% CI, 1.268 – 1.535, P<0.001) were associated with AD.

Conclusions:

Our findings reveal similarities and differences in factors associated with both men and women AD patients, suggesting the development of management strategies for the care of AD.

Keywords: Basic/Translational Vascular Science

Financial Disclosures: The authors had no disclosures.

Grant Support: NIH/NIA R25 GRANT

Poster

Simultaneous Transarterial-Transvenous Contrast Injection to Reveal Connection Point for Treatment of Carotid Cavernous Fistula

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Introduction:

Cavernous sinus (CS) via inferior petrosal sinus (IPS) access can present a challenge in the treatment of carotid-cavernous fistulas (CCF) due to anatomical variations, tortuosity, and/or difficult visualization of IPS given high retrograde flow through the fistulous connection.

Methods:

A 58-year-old male was referred to our academic medical center for three weeks of right eye pain, now complicated by redness, diplopia and blurry vision. Magnetic Resonance Imaging (MRI) brain at the outside hospital revealed hemorrhagic lesion in right parietotemporal region. Computerized tomography-angiogram (CTA) of the head revealed filling of cavernous sinus during an arterial phase suspicious for CCF. Under general anesthesia, after accessing right common femoral artery, 4 French (F) cook catheter (Cook Medical LLC, Bloomington, IN) was advanced over 0.035 angled glide wire to the proximal right internal carotid artery. Contrast injected through the ICA showed the CS but not the IPS (Fig. 1A). Through the left common femoral vein, access was obtained using an Infinity guide catheter (Stryker Neurovascular, Fremont, CA) and Catalyst 5 (Stryker Neurovascular, Fremont, CA) distal access catheter. A Synchro 2 soft microwire (Stryker Neurovascular, Fremont, CA) was advanced through Echelon 10 (Medtronic, Minneapolis, MN) microcatheter. The venous guide catheter was advanced into right internal jugular vein (IJV) and the distal access catheter was placed into sigmoid jugular junction. Injection of contrast revealed the IPS, but not the CS (Fig. 1B). A subsequent simultaneous hand injection with the microcatheter within the IPS and the diagnostic catheter in the left ICA elucidated the venous-venous connection (Fig. 1C,) allowing for subsequent navigation and complete treatment of the fistula through IPS using target coils (Fig. 1D).

Results:

Given the arterial system is a high-pressure system and the usual direction of flow of contrast would be from the high-pressure ICA to the low-pressure CS, injecting a simultaneous contrast bolus from the venous end would oppose the arterial contrast flow. As a result, the fistulous connection that was previously obscured became visible allowing roadmap imaging guiding navigation into the CS.

Conclusions:

Use of simultaneous trans-arterial/trans-venous contrast injection is relatively simple compared to other reported techniques to reveal an obscure connection point. It also shortens the duration of endovascular tools in the bloodstream and thus, reduces the potential complication rate. Further use of this technique on larger study samples is important to validate its general use.

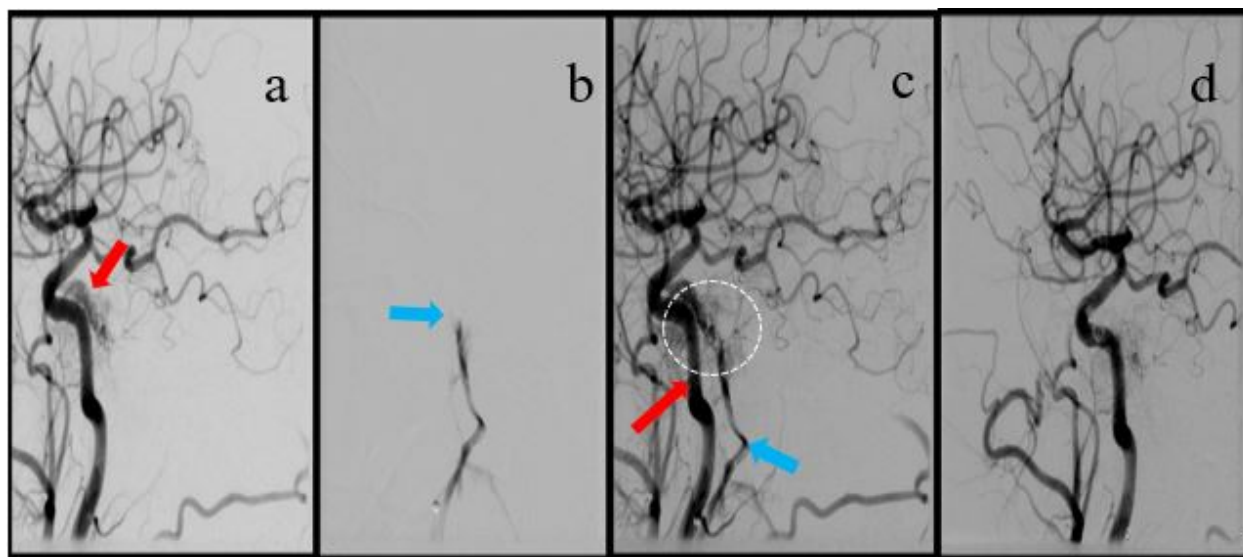


Fig. 1: (a) There is flow into cavernous sinus, but no visible flow through the IPS (b) Injection into right IJV opacifies half of IPS, but not the fistulous point or cavernous sinus (blue arrow) (c) Simultaneous contrast injection into the right ICA (red arrow) and right IJV (blue arrow) opacifying the connection allowing subsequent navigation (white dashed circle) (d) Right ICA injection after successful coil embolization showing resolution

Keywords: Endovascular Therapy, Embolization, Carotid, New Technique

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

Spinal Dural Arterio-Venous Fistula: A Masquerade as a Longitudinal Myelitis

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Introduction:

SDAVF are rare and frequently misdiagnosed due to their nonspecific symptomatology and delay of presentation on imaging. Spinal digital subtraction angiogram is the gold standard diagnostic test. Delayed diagnosis and treatment of SDAVF can lead to irreversible neurologic damage.

Methods:

None

Results:

Two female patients, 69 and 74 years old, each developed recurrent episodes of subacute worsening myelopathy and urinary retention. The subacute onset of symptoms and longitudinal appearance on cord imaging raised concern for inflammatory myelitis. Despite a negative CSF analysis, and the absence of serum inflammatory, metabolic and infectious markers, the working diagnosis was seronegative neuromyelitis optica spectrum disorder. In accordance, both patients were treated with plasma exchange and IV rituximab, initially displaying stabilization on imaging. However, further worsening and extension of the myelopathy alongside the presence of flow voids in one patient's repeat MRI nine months post-presentation raised the question of an alternate etiology. A spinal angiogram was ordered for the patient, revealing SDAVF. Subsequently, the patient underwent complete Onyx embolization of the right L2 feeder and surgical clipping of the right L1 feeder. This resulted in stabilization and improvement of symptoms. Although the second patient did not display flow voids in their MRI, they were ordered a spinal angiogram due to their similar clinical course, indeed confirming SDAVF. The patient underwent successful complete embolization of the L3 segmental artery on the right resulting in improvement of symptoms.

Conclusions:

Clinicians should have a high index of suspicion for SDAVF when a patient presents with a longitudinally extensive transverse myelitis negative for inflammatory markers and is unresponsive to treatment. While the appearance of flow voids on imaging is a helpful diagnostic feature, these may not be present in patients.



Fig 1. 69 y.o. Image 1:At presentation, abnormal STIR signal from T7-L2. Image 2: 1 year later T2 flow-voids T9-T12. Image 3: STIR image 3 months Post-embolization



Fig 3. 74 y.o. Image 1:At presentation, abnormal STIR signal from T10-conus with mild cord expansion. Image 2: 1 year later with T2 hyper intense signal T9-L1. Image 3:T2 image 5 months Post embolization

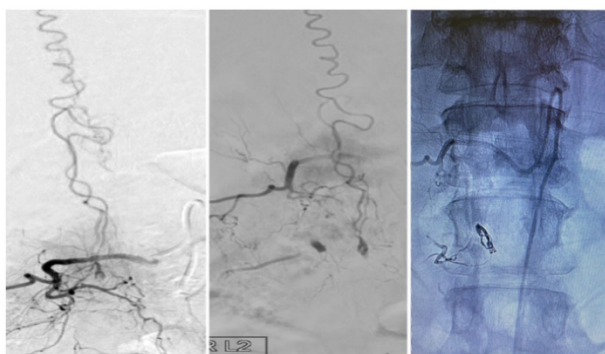


Fig 2. 69 y.o. First panel is the right L2 injection showing the shunt. Second panel shows residual filling of the shunt via right L1 after treating with onyx from right L2. Third panel Onyx-18 cast post embolization via right L2 perimedullary branch and surgical clip at site of arteriovenous fistulous connection with resultant complete obliteration of the fistula as demonstrated by post-op right L1 unsubtracted angiography

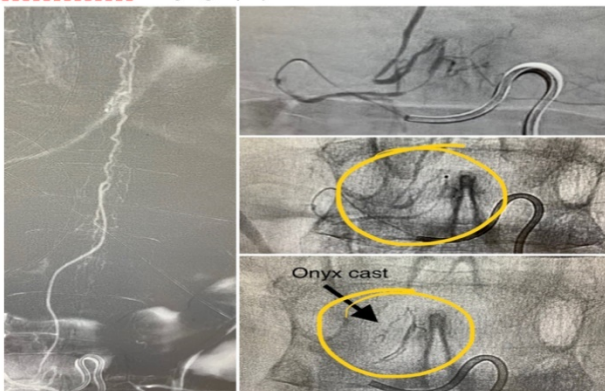


Fig 4. 74 y.o. Fistula supplied by right L3 segmental artery perimedullary branch. Direct embolization of AV shunt with Onyx-18, complete closure

Keywords: Embolization, Onyx, Spinal Malformation Therapy, Interventional Neuroradiology, Clipping

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

The Importance of Performing Venous Pressure Measurements Following Venous Sinus Stenting for Idiopathic Intracranial Hypertension

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Introduction:

Although venous sinus stenting is an established treatment for medically refractory idiopathic intracranial hypertension, a subset of patients shows little or no improvement of symptoms after stenting. While this could be related to a number of factors, failure to sufficiently address the pressure gradient is one that can be recognized during the treatment procedure. We describe two patients who had a persistent venous pressure gradient after stent placement. Once identified, a second stent was placed with subsequent resolution of the pressure gradient.

Methods:

This retrospective chart review identified patients at a single institution who underwent venous sinus stenting and required immediate placement of a second venous sinus stent for a persistent pressure gradient.

Results:

Two patients with refractory idiopathic intracranial hypertension underwent cerebral angiography with venous manometry. In the first patient, unilateral venous sinus stenosis was present with a maximum pressure of 50 mmHg, which only decreased to 30 mmHg after placement of a right transverse-sigmoid sinus stent. Subsequent manometry revealed a persistent gradient between the superior sagittal sinus and the right transverse sinus, which resolved after placement of a second stent in this location. In the second patient, bilateral stenosis was observed at the transverse-sigmoid sinus junction; the maximum venous pressure was 40 mmHg, and a gradient of 30 mmHg was measured at the right transverse-sigmoid junction, where a venous sinus stent was placed. Venous sinus pressure measurements performed immediately after the stent placement demonstrated a persistent pressure gradient of 20 mmHg in the contralateral transverse-sigmoid sinus junction, which resolved after contralateral stent placement. Both patients showed sustained improvement in their symptoms at 1 year follow up.

Conclusions:

In some patients with idiopathic intracranial hypertension and venous sinus stenosis, a single stent may not sufficiently reduce the pressure gradient. A second stent may be required; however, this is only detectable with post-stent pressure measurements. Performing manometry after stent placement should be routinely performed in order to detect persistent venous pressure gradient.

Keywords: New Technique, Treatment, Stenting

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

Unusual Multicompartmental Intracranial Hemorrhage After Tenecteplase Administration

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Introduction:

The 2019 AHA/ASA updated Guidelines for the Early Management of Patients with Acute Ischemic Stroke mention tenecteplase (TNK) as a reasonable therapy in patients without contraindications for IV fibrinolysis who are also eligible to undergo mechanical thrombectomy. We describe a case of acute left MCA ischemic stroke treated with IV TNK (IV bolus of 0.25 mg/kg) followed by mechanical thrombectomy with subsequent multicompartmental intracranial hemorrhages unrelated to area of infarction.

Methods:

A retrospective review at a single center university hospital was performed for all intravenous TNK administrations outside of a clinical trial setting from October 2020 to July 2021.

Results:

A 61-year-old male with history of HTN and cardiomyopathy (EF<20%). Presented with sudden onset right sided weakness, aphasia and left gaze. Presenting NIHSS was 28. CT head with hyperdense left MCA sign and ASPECTS score of 10. CTA confirmed proximal left MCA M1 segment occlusion. IV TNK was given within 01:23 hours of symptoms onset. Subsequently, patient underwent emergent mechanical thrombectomy for disabling large vessel occlusion stroke. Spontaneous near complete recanalization of left MCA occlusion was noted on initial angiography run with small non flow limiting distal thrombi visualized in the distal MCA territories. Immediate post procedure CT head was negative for any intracranial hemorrhage. Patient's exam was noted to improve to NIHSS of 2. Approximately 6 hours after the TNK administration, patient became acutely unresponsive with NIHSS of 26. With Glasgow Coma Scale 7 patient required emergent intubation. CT head revealed bilateral cerebellar intraparenchymal hemorrhages, extensive subarachnoid hemorrhage in basal cisterns and within the sulci in bilateral frontotemporal regions, as well as subdural hemorrhages along the falx and tentorial dural folds. Hypertonic saline was administered followed by emergent extraventricular drain placement. Tranexamic acid 1000 mg was given as emergent reversal, fibrinogen level was 155 mg/dL. Despite aggressive medical management and over following 24 hours, exam worsened with loss of pupillary reflexes. Patient was terminally extubated 2 days after initial presentation in accordance with his advance directives.

Conclusions:

Tenecteplase was a reasonable choice in this case given LVO and disabling stroke. The patient's neurological exam improved significantly after TNK with evidence of spontaneous recanalization. However, patient's multicompartmental intracranial hemorrhages unrelated to area of infarction were unusual in the absence of any vascular lesions to predispose hemorrhage based on CT and conventional

angiography. Further observational studies are warranted to evaluate similar complications of Tenecteplase administration and their occurrence rates.

Keywords: Fibrinolytics, Acute Stroke, Hemorrhage, SAH, SDH

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

A Latin American Model of the PHASES Score

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Introduction:

The PHASES score was developed to predict the 5-year risk of rupture for intracranial aneurysms (IAs). However, only populations from North America, Europe, and Japan were included in the original study. As the population of origin is an item in the score, it has yet to be applied in a Latin American population. We aimed to determine the best approximation to employ this model in this previously unstudied population.

Methods:

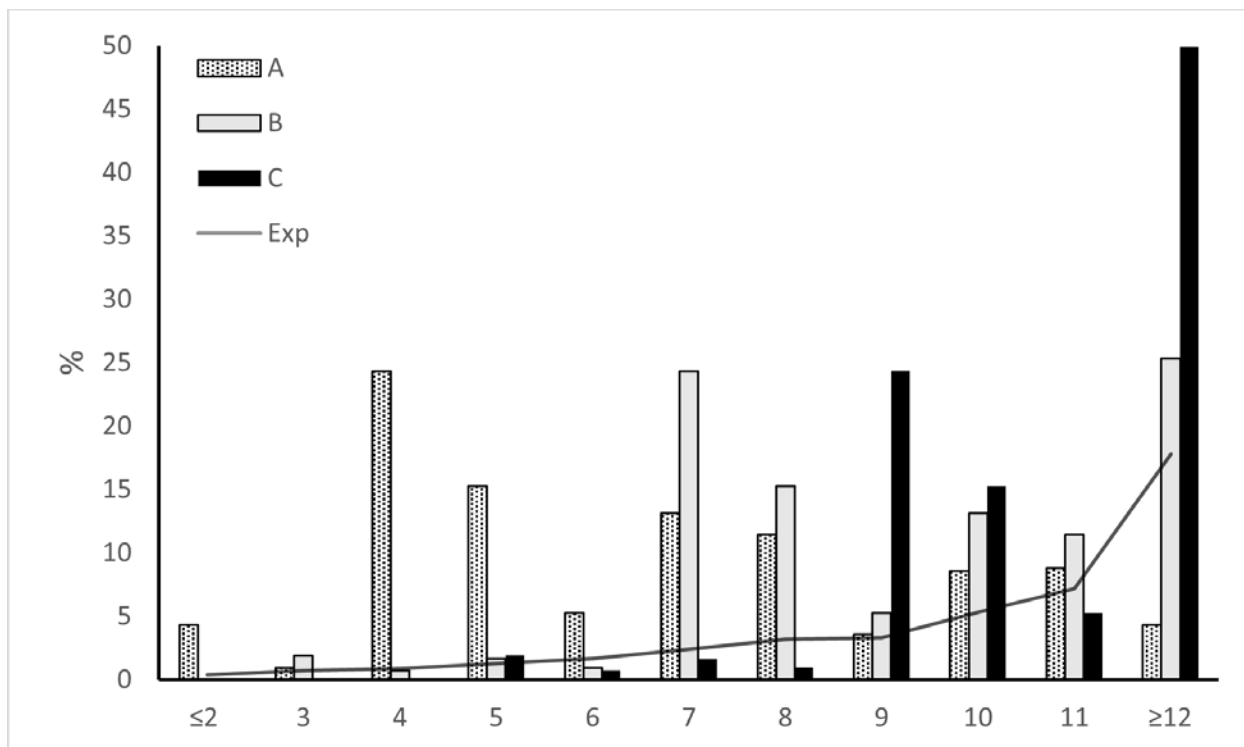
We extracted the data of 848 Peruvian patients with ruptured (n=486) and unruptured (n=362) IAs from 2010 to 2020. According to the PHASES score, the North American and European (other than Finish), Japanese, and Finnish populations are rated with 0, 3 and 5 points, respectively. Therefore, we developed three PHASES-derived models in which our Peruvian population is rated with 0 (Model A), 3 (Model B), and 5 (Model C) points. We compared the observed probability of each model to the expected probability reported by the original PHASES score using a scatter plot. We then compared the goodness-of-fit of each model using the Hosmer-Lemeshow test in STATA version 14.

Results:

Nineteen percent of the patients were female. Hypertension was found in 34% of patients and 15% were >70 years. Fifty-four percent of the aneurysms were smaller than 7mm, 25% ranged between 7 and 9.9mm, 18% were between 10 and 19.9mm, and 3% were larger than 20mm. Previous subarachnoid hemorrhage was found in 4%. The location of the aneurysms was the internal carotid artery in 4%, the middle cerebral artery in 4%, and arteries of the anterior and posterior circulation (including the anterior and posterior communicating artery) in 92%. When Model A was applied, 63% of the patients among the ruptured subgroup have an estimated 5-year risk of rupture of <3% while 77% of the patients have an estimated risk of <3% in the unruptured subgroup. When Model B was applied, 30% of the patients among the ruptured subgroup have an estimated 5-year risk of rupture of <3% and 42% of patients among the unruptured subgroup have an estimated risk of <3%. When Model C was applied, 96% of the patients among the ruptured subgroup have an estimated 5-year risk of rupture of >3% while in the unruptured subgroup an estimated risk of <3% was observed only in 4% of the patients. When comparing observed to expected frequencies, model B presented a better calibration to the values reported by the original PHASES score. Additionally, the Hosmer-Lemeshow showed Model B to have improved goodness-of-fit, compared to other models, although all presented adequate fit.

Conclusions:

We found that rating the Peruvian population with 3 points was the best approximation to the estimated risk calculated by the PHASES score to predict the 5-year risk of rupture for IAs.



Keywords: Aneurysm, Ruptured, Hemorrhage, Subarachnoid Hemorrhage, Intracerebral Hemorrhage

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

Coiling Of Wide-Necked Ruptured Aneurysms: A Subset Analysis Of The SMART Registry

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Introduction:

The purpose of this study was to assess the 1-year clinical outcomes of wide-necked ruptured aneurysms treated with coiling.

Methods:

Data on patients with a wide-necked ruptured aneurysm were extracted from a prospective multicenter registry (SMART) that enrolled patients with intracranial aneurysm or other neurovascular abnormality who underwent coiling. A wide neck was defined as a neck width of at least 4 mm or as a dome-to-neck ratio (largest diameter / neck width) of less than 2. Enrollment was not limited by Hunt and Hess grade. The primary safety outcome was device-related serious adverse events within 24 hours, and the primary effectiveness outcome was retreatment through follow-up.

Results:

Of the 995 adults enrolled in the SMART registry, 144 had a wide-necked ruptured aneurysm (Table). Average patient age was 59.3 years (SD 14.3), and 74.3% were female. Lesion locations were internal carotid artery, 31.3%; anterior communicating artery, 31.9%; middle communicating artery, 10.4%; and posterior circulation, 26.4%. Aneurysm sizes were small, 27.1%; medium, 54.2%; large, 18.1%; and giant, 0.7%. The most common aneurysm type was saccular (88.8%, 127/143). Coiling was stent assisted in 10.4% of patients and balloon assisted in 36.1% of patients. The rate of device-related serious adverse events within 24 hours was 3.5%. The rate of retreatment through follow-up was 20.6% (20/97). At 1 year, 82.6% (76/92) of patients had a Raymond–Roy Occlusion Classification of I or II, 32.6% (30/92) had progressive occlusion, and 46.7% (43/92) had stable occlusion. The 1-year all-cause mortality rate was 12.5%. At 1-year follow-up, 58.3% (42/72) of patients had a modified Rankin Scale score of 0 to 2.

Conclusions:

Treatment of wide-necked ruptured aneurysms with coiling has acceptable occlusion and retreatment rates at 1-year follow-up.

	Wide-necked ruptured aneurysms (N = 144)
Baseline data	
Age, years (mean (SD))	59.3 (14.3)
Female	74.3% (107/144)
Lesion location	
Internal carotid artery	31.3% (45/144)
Anterior communicating artery	31.9% (46/144)
Middle communicating artery	10.4% (15/144)
Posterior circulation	26.4% (38/144)
Aneurysm characteristics	
Size group*	
Small	27.1% (39/144)
Medium	54.2% (78/144)
Large	18.1% (26/144)
Giant	0.7% (1/144)
Neck width ≥ 4 mm	46.5% (67/144)
Hunt and Hess Grading Scale	
Grade I	18.3% (26/142)
Grade II	34.5% (49/142)
Grade III	23.9% (34/142)
Grade IV	15.5% (22/142)
Grade V	7.7% (11/142)
Aneurysm type	
Saccular	88.8% (127/143)
Fusiform	1.4% (2/143)
Dissecting	0.7% (1/143)
Other	9.1% (13/143)
Adjunctive technologies used[†]	
None (unassisted coiling)	55.6% (80/144)
Stent-assisted coiling	10.4% (15/144)
Balloon-assisted coiling	36.1% (52/144)
Primary outcomes	
Device-related serious adverse events within 24 h	3.5% (5/144)
Retreatment through follow-up	20.6% (20/97)
Additional outcomes	
Mortality within 24 h of procedure	0.0% (0/144)
Raymond–Roy Occlusion Classification at 1 y	
Class I-II	82.6% (76/92)
Class I	52.2% (48/92)
Class II	30.4% (28/92)
Class III	17.4% (16/92)
Change in occlusion from immediately after procedure to 1 y	
Better (progressive occlusion)	32.6% (30/92)
Stable	46.7% (43/92)
Worse (recanalization)	20.7% (19/92)
All-cause mortality at 1 y	12.5% (18/144)
Modified Rankin Scale score of 0-2 at 1-year follow-up	58.3% (42/72)

*Small: ≤ 4 mm in the largest diameter. Medium: >4 mm to ≤ 10 mm in the largest diameter. Large: >10 mm to ≤ 25 mm in the largest diameter. Giant: >25 mm in the largest diameter.

[†]Subjects may appear in more than one category.

Keywords: Aneurysm Embolization, Coiling, Endovascular Therapy, Penumbra, Ruptured

Financial Disclosures: Consulting: Penumbra, Stryker, Terumo. Research support: Medtronic, Penumbra, Stryker.

Grant Support: None.

Poster

Comparison of Surgical Clipping vs Endovascular Coiling for Posterior Projecting Anterior Communicating Artery Aneurysm

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Introduction:

We wanted to evaluate the feasibility and results of endovascular treatment in patients with a posteriorly projecting A Com aneurysm and compare surgical clipping with endovascular coiling for posterior projecting anterior communicating artery aneurysm in terms of peroperative technical feasibility and possible complications such as rupture ,perioperative complications and postoperative mortality and morbidity.

Methods:

.Total 6 cases were studied ,3 of them (n=3, 50%)were operated by surgical clipping and 3 (n=3.50%) underwent endovascular coiling.Average age was 52yrs, 90% were hypertensive, 80% were smokers. All presented through emergency with subarachnoid hemorrhage.2 of the patients in each surgical and endovascular group presented at ER with Hunt and Hess grade 3 (n=2,33.3%) the others were at Hunt and Hess grade 2 (n=4,66.6%). The average time from hemorrhage to surgery and coiling was 25days. Outcome assessed using modified Rankin score and a score of 2 was considered satisfactory.

Results:

In the surgically treated arm 2 patients had mRS of 2 while the 3 rd one had 4.In the endovascular coiling group 1 had mRS of 1,1 had mRS2 and 3 rd had m RS of 3. Despite the very small sample size the outcome in terms of mRS indicated slightly better results for patients undergoing coiling Conclusion: Endovascular coiling is better in the treatment of posteriorly projecting anterior communicating artery aneurysm.

Conclusions:

Endovascular coiling is better in the treatment of posteriorly projecting anterior communicating artery aneurysm.

Keywords: Coiling, Coiling, Aneurysm

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

Differences of Morphological and Hemodynamic Rupture Risk Factors in Cerebral Aneurysms between pre- and post-Rupture

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Introduction:

Morphological and hemodynamic characteristics have been reported to be involved in the rupture of cerebral aneurysms. Therefore, geometrical measurements of cerebral aneurysms and blood flow analysis using computational fluid dynamics (CFD) have been conducted. Some previous studies investigated the rupture risk factors from cerebral arterial geometries that were taken before the rupture (pre-rupture), and the others used geometries taken after the rupture (post-rupture). However, aneurysm rupture may alter arterial geometries and CFD simulation results. The aim of this study is to evaluate the morphological and hemodynamic alternations due to cerebral aneurysm rupture.

Methods:

We identified 21 cerebral aneurysms (ICA: 9, MCA: 3, ACA: 4, BA: 3, VA: 2) which had ruptured during the follow-up terms. Each case had at longest two-years term between the rupture date and the latest angiographic date before the aneurysm rupture (pre-rupture). The post-rupture arterial geometries were acquired preoperatively for subarachnoid hemorrhage. We used the arterial geometries reconstructed from computed tomography angiography or digital subtraction angiography images for conducting morphological measurements and CFD simulations. We performed transient blood flow simulations for two heart pulse cycles in the CFD simulations. We obtained five morphological parameters and 24 hemodynamic parameters considered as the rupture risk factors. Finally, we conducted Wilcoxon's signed-rank sum test between the parameters obtained from pre- and post-rupture aneurysms to specify altered parameters due to the aneurysm rupture. We also calculated the change rate (CR) based on the value in pre-rupture for parameters that had a statistical significance to investigate the alternation in detail.

Results:

The aneurysmal volume (V), height (H), aspect ratio (AR), and spatial averaged, maximum, and minimum wall shear stress of the aneurysm dome normalized by the spatially averaged wall shear stress of the parent vessel ($NWSS_{ave}$, $NWSS_{max}$, and $NWSS_{min}$) were significantly altered between pre- and post-rupture. In particular, the morphological parameters increased after the rupture (average CR of V , H , and AR were 25.8 %, 13.4 %, and 15.9 %, respectively). These results indicate that the aneurysm shapes tended to increase lengthwise after the rupture. On the other hand, the $NWSS$ tended to decrease (average CR of $NWSS_{ave}$, $NWSS_{max}$, and $NWSS_{min}$ were -21.0 %, -13.7 %, and -22.7 %, respectively). These results imply that the aneurysm rupture altered the aneurysm to a more complicated shape, and thereby the blood flow became stagnated that introduced lower WSS . In contrast, there were some cases in which $NWSS$ increased, and these cases had vasospasm at their parent arteries caused by the

rupture (i.e., 5 of 21 cases had vasospasm, and the average *CR* of *NWSSave* was 14.1 %). The parent vessel proximal to the aneurysm was shrunk due to the vasospasm, resulting in increased flow velocity and thus increased *NWSS*.

Conclusions:

The cerebral aneurysm rupture deformed the aneurysms into longitudinal and led to increased volumes. The *NWSSs* in CFD simulations using post-rupture geometries tended to decrease in comparison with pre-rupture. When studying rupture factors of cerebral aneurysms using geometrical measurements and CFD simulations, special attention should be paid to the clinical image and rupture characteristics standardization criteria.

Keywords: Aneurysm, Cerebral Blood Flow, SAH, Vascular Imaging

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

Direct carotid artery cutdown and flow diversions for the bilateral dissecting pseudo-aneurysms.

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Introduction:

flow diverters (FD) have been used for the treatment of the dissecting pseudo aneurysm (DSA) via trans femoral or transradial approach. Both trans femoral and transradial approaches require aortic arch as a relay to access the internal carotid artery (ICA). Presence of an aortic arch stent prevents navigating to the ICA. Therefore, alternative option such as direct Carotid artery Cutdown (DCAC) and FD for the treatment of the DSA in the ICA is not known.

Methods:

Case report and Retrospective chart review.

Results:

67 years old man with history of hypertension, hyperlipidemia, smoking, and repair of the aortic arch aneurysm using a and aortic arch stenting. Patient was diagnosed with bilateral internal carotid artery DSA by a CT angiogram when complained of neck pain, headaches and dizziness. Right ICA DSA was in multi-level extending from cervical carotid artery to the skull base measured 19x15x20 mm and the left was 16x9x22 mm. An angiogram was attempted for the better evaluation of the DSA, which failed due to the presence of aortic arch stent. Considering the severity of the disease and the presence of symptoms, it was planned to have a DCAC by vascular surgeon followed by the repair of the aneurysms using FD by neurovascular surgeon (NES) in a staged fashion. Preparation: blood pressure was controlled and smoking was ceased. Patient was given 4 chewable baby aspirin and 300 mg clopidogrel on the day of the procedure. Activated coagulation time was kept 2 times of baseline. A 6F sheath was placed from right common carotid artery (CCA) to right ICA by a vascular surgeon and the placement was confirmed by NES by angiography. A CAT5 intermediate catheter was navigated to the ICA beyond DSA. FD was achieved using Surpass streamline measuring 4x50 mm x2 and a 5x40 mm to cover the entire DSA and diseased ICA. The DCAC site was sutured by vascular surgeon and patient was extubated. Patient was discharged home in 48 hours with NIHSS 0 and mRS 1 as baseline. Using similar techniques, Left-sided dissecting pseudoaneurysm repaired using 5x50 mm surpass streamline flow diverter. Patient was discharged in 24 hours. Patient continued 325 mg of aspirin and 75 mg of aspirin for six months followed by 81 mg baby aspirin and 75 mg of clopidogrel. Six-month follow-up MR angiogram demonstrates complete obstructions of the bilateral DPA and remodeling of the internal carotid arteries.

Conclusions:

When transfemoral or transtibial approach is not feasible, DCACW could be an alternative option for the treatment of the symptomatic and life-threatening DSA of the Internal carotid artery. Further studies are required.

Keywords: Flow Diverter, Aneurysm, Endovascular

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

Effects of Patient-specific Blood Properties and Inflow Conditions on Hemodynamics in Cerebral Aneurysms

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Introduction:

Computational Fluid Dynamics (CFD) simulation is an effective tool to investigate pathologies and clinical outcomes of cerebral aneurysms from the hemodynamic perspective. However, simulation conditions such as the blood properties and boundary conditions are usually referred to in the literature do not consider patient-specific values. In this study, we measured blood properties and extracted the inflow conditions from four-dimensional digital subtraction angiography (4D-DSA) images for patients who underwent flow diverter (FD) deployment. Then, we conducted CFD simulations considering the deployed FD geometry to investigate the effect of patient-specific conditions on aneurysmal hemodynamics.

Methods:

We took whole blood samples of five patients with intracranial aneurysms just before the surgery and measured the blood density and viscosity with a densitometer and a falling needle rheometer. The patients underwent 4D-DSA imaging, from which we calculated the patient-specific inflow velocity of each patient using an in-house flow extraction program. We used in-house virtual FD deployment software to reproduce the FD geometry for each patient. We then defined the computational domain including the FD geometry. Four CFD simulations were performed for each of the five patients: (1) a steady CFD simulation under a referred Newtonian blood model and previously published inflow conditions as a basic simulation pattern (2) a CFD simulation including the patient-specific non-Newtonian blood properties only, (3) a CFD simulation including the inflow conditions only, and (4) a CFD simulation including both the patient-specific blood properties and inflow conditions. We calculated the mean velocity in the aneurysm normalized by the mean velocity in the parent artery and the wall shear stress (WSS) of the aneurysm. We compared the results of the four CFD simulations and calculated their differences based on the values for the basic simulation pattern.

Results:

Based on the visual evaluation, the flow structures of the four CFD simulation patterns differed only slightly from each other, but a quantitative comparison revealed that there were large differences in the hemodynamic parameters. For the velocity, there was an average 14.2% difference with the steady CFD simulation results when the patient-specific blood properties are considered, and an average 35.8% difference when the patient-specific inflow conditions are considered. There was an average 60.7% difference when both the patient-specific blood properties and inflow conditions are taken into account. For the WSS, there was an average 8.75% difference when including the patient-specific blood

properties and an average 66.8% difference in including the patient-specific inflow conditions. There was an average 69.3% difference in including both conditions are considered. It appeared that the effect of including patient-specific inflow conditions was more substantial than that of including the patient-specific blood properties, and most robust when both conditions were included.

Conclusions:

The hemodynamics obtained from CFD simulations with the deployed FD appears to strongly depend on both the blood properties and the inflow conditions. This result implies that CFD simulations with the referred conditions may not accurately reproduce the hemodynamics. It was confirmed that patient-specific conditions should be included in CFD simulations.

Keywords: Intracerebral Aneurysm, Flow Diverter, Aneurysm

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

Endovascular Coiling Versus Neurosurgical Clipping for Treatment of Ruptured and Unruptured Intracranial Aneurysms During Pregnancy

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Introduction:

Management of intracranial aneurysms during pregnancy is challenging. The hemodynamic changes during pregnancy increase the risk of intracranial aneurysm rupture. Further, the selection of an appropriate surgical strategy requires a careful review of the potential risks to the mother and fetus. Yet, there is limited data to guide the treatment decisions in this patient population. In this study, we aimed to compare the safety profiles of endovascular coiling (EC) and neurosurgical clipping (NC) in this patient population.

Methods:

Pregnancy-related hospitalizations with age ≥ 18 years undergoing surgical intervention for intracranial aneurysms were identified from the Nationwide Readmissions Database 2016-2018. Hospitalizations with diagnoses of arteriovenous malformation, cerebral arteritis, and traumatic SAH were excluded. Logistic regression analysis was used to compare outcomes between EC and NC.

Results:

There were 11829044 pregnancy-related hospitalizations, of which 348 met the study inclusion criteria (mean $\pm$ SD age: 31.8 $\pm$ 5.9). Among 168 patients treated for ruptured aneurysms, 115 (68.5%) underwent EC and 53 (31.5%) underwent NC. Whereas among 180 patients treated for unruptured aneurysms, 140 (77.8%) underwent EC and 40 (22.2%) underwent NC. There were no statistically significant differences in the demographics, clinical presentation, and hospital-level characteristics between patients undergoing EC versus NC for either ruptured or unruptured aneurysm groups. Among patients with ruptured aneurysms, 11.9% patients had perioperative ischemic stroke, 22.6% patients required mechanical ventilation for >24 hours, 6.5% patients underwent tracheostomy, 6.5% patients had acute kidney injury, 20.2% patients had infectious complications, 4.2% patients underwent gastrostomy tube placement, 30.0% patients had discharge disposition other than to home, 10.1% patients had in-hospital mortality, and 4.8% patients had non-elective readmission within 30 days of discharge. These outcomes were comparable between patients with EC and NC, except patients undergoing EC were less likely to develop ischemic stroke [odds ratio (OR): 0.21, 95% confidence interval (CI): 0.05-0.98] (Figure 1A). None of the 30-day readmissions were due to procedural complications and a majority (75%) of them were due to pregnancy-related conditions. Among patients with unruptured aneurysms, 5.6% patients had perioperative ischemic stroke, 5.0% patients required mechanical ventilation for >24 hours, 6.1% patients had infectious complications, 11.1% patients had discharge disposition other than to home, 0.01% patient had in-hospital mortality, and 0.01% patient had non-elective readmission within 30 days of discharge. There were no significant differences in these outcomes or in the average length of hospital stay among patients undergoing EC versus NC for unruptured aneurysms (Figure 1B).

Conclusions:

Surgical treatment of intracranial aneurysms during pregnancy is safe with a relatively low rate of early complications. While a majority of patients undergo EC, we found that the safety profiles of NC and EC are largely comparable. Future large studies are needed to further evaluate the advantages and disadvantages of these procedures in detail in this patient population.

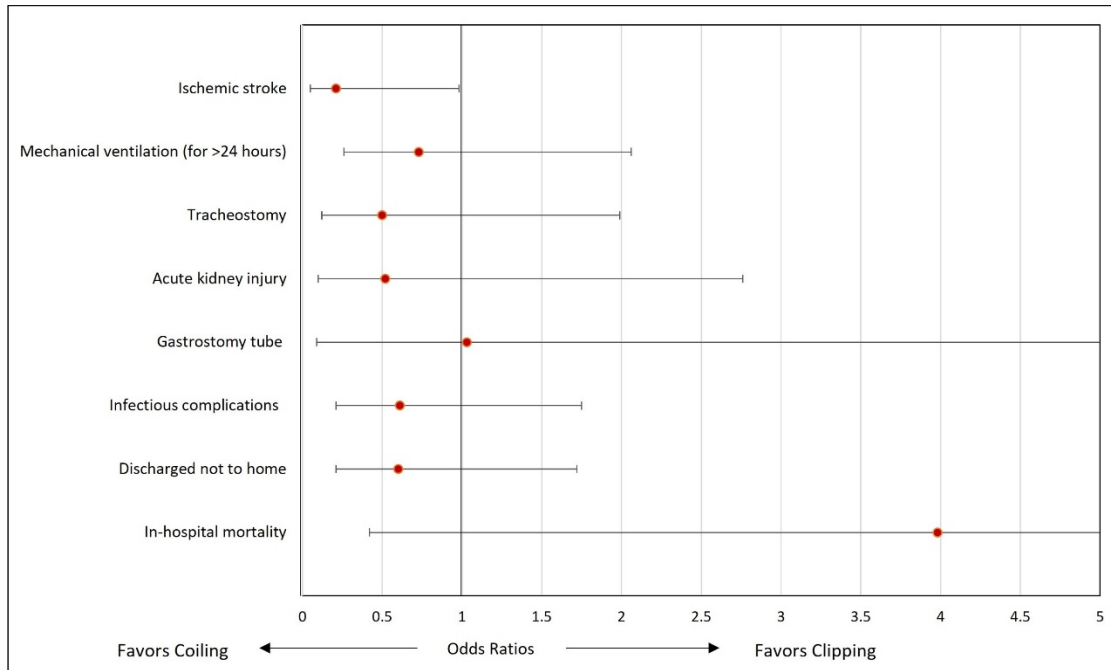


Figure 1A. Clinical outcomes in clipping versus coiling for ruptured aneurysms

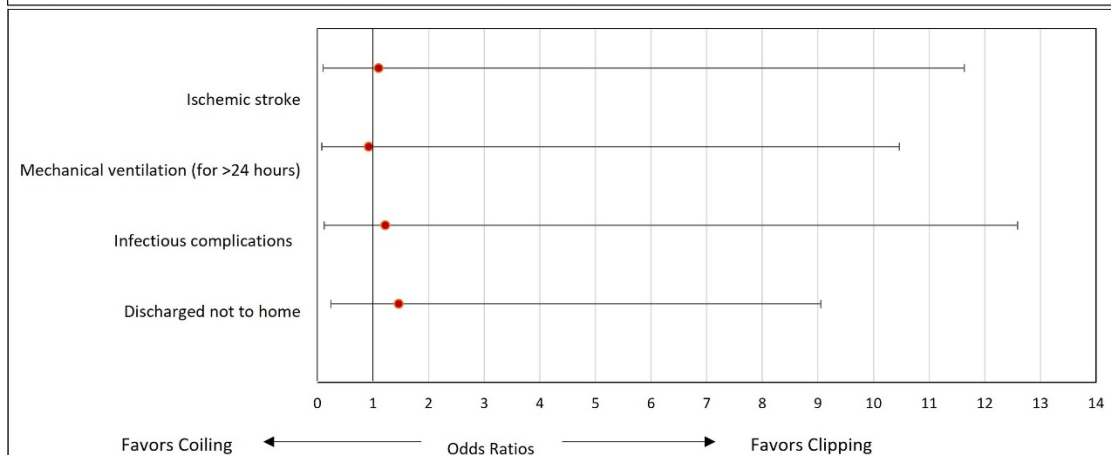


Figure 1B. Clinical outcomes in clipping versus coiling for unruptured aneurysms

Keywords: Aneurysm, Endovascular Therapy, ICH, Intracerebral Aneurysm, SAH

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Poster

Endovascular Treatment of Large Intracranial Aneurysms Using Large Volume Coils: Safety and Efficacy

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Introduction:

Large volume coils in the treatment of intracranial aneurysms have demonstrated better packing density, shorter operative times, less number of coils per aneurysm and better cost-effectiveness. However, most of the studies evaluated these coils in small or medium sized aneurysms. Therefore, our study aimed to determine our experience using large volume coils in the treatment of large intracranial aneurysms and determine its safety and efficacy.

Methods:

We retrospectively reviewed consecutive cases of intracranial aneurysms treated with Penumbra Coils 400 (PC400) at our institution between May 2016 and September 2019. Aneurysms > 12 mm in maximal diameter were selected according to the ISUIA trial. Clinical and radiological variables were collected. The modified Rankin Scale (mRS) was used to determine the clinical outcome and was dichotomized (good clinical outcome: mRS ≤2; poor clinical outcome: mRS >2). The Raymond Roy occlusion classification (RROC) was used to determine obliterations rates. An adequate obliteration was defined as RROC 1 or 2. Categorical variables were expressed as percentages and continuous variables as mean ± standard deviation. Stata v14 software was used for the analysis.

Results:

Eighteen patients harboring 18 intracranial aneurysms were treated. The mean age was 55 ± 12 years and 14 patients (78%) were women. A good preoperative clinical condition was found in 13 patients (72%). Ten aneurysms were unruptured (56%) and eight were dysplastic (44%). Paraclinoid aneurysms were the most frequently treated (61%). The mean number of coils were 6.2/aneurysm. The mean maximal diameter and neck were 18.9 ± 4.3 mm, and 5.7 ± 2.6 mm, respectively. The mean aspect ratio (AR) was 4 ± 1.9. Coiling was used in 10 cases (56%) followed by stent-assisted coiling in 7 cases (39%) and balloon-assisted coiling in 1 case. An immediate adequate obliteration rate was found in 8 cases (44%). Intraoperative complications occurred in two patients in which a coil loop migrated to the parent artery and a stent was placed without clinical consequences. In twelve patients (67%), angiographic follow-up was performed. The mean follow-up duration was 9.7 months. Nine patients (75%) showed a complete obliteration (RROC 1), whereas in three patients a residual aneurysm was still present. A good postoperative clinical outcome at discharge was found in 14 patients (78%). Procedure-related morbidity and mortality were not reported.

Conclusions:

Embolization with large volume coils is a safe and effective alternative to conventional coils, with high obliteration rates at mid-term follow-up. Longer duration of angiographic follow-up are needed in order to confirm the results presented here.

Keywords: Coiling, Aneurysm, Endovascular Therapy

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

Enterprise™ 1 versus Enterprise™ 2 Stent-assisted Coiling in Treating Ruptured Intracranial Aneurysms: A Real-World Study

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Introduction:

Enterprise™ 2 is an innovative, self-expandable nitinol stent system used in stent-assisted coiling (SAC) for treating intracranial aneurysms and was formally introduced into clinical use since 2018 in China in replace of Enterprise™ 1, the first-generation stent being used for a decade. There is a lack of evidence to compare Enterprise™ 1 with Enterprise™ 2 in the real-world setting. The objective of this study was to investigate clinical effectiveness and safety in treating ruptured intracranial aneurysms (RIA) with Enterprise™ 2 stent (E2 group) versus Enterprise™ 1 stent (E1 group) in China.

Methods:

We conducted a retrospective analysis of an electronic medical record database at Yijishan hospital of Wannan Medical College. Patients included were those diagnosed with RIA and underwent SAC procedure with Enterprise™ 1 stent or Enterprise™ 2 stent from January 2013 to November 2020 with at least one follow-up visit post discharge. Main outcomes were immediate complete occlusion (ICO) rate (Raymond-Roy Occlusion Classification), patient functional outcomes (modified Rankin Score (mRS)), and perioperative procedural-related complications, operating time and length of stay (LOS) and recurrence rate. Student's t-test was used for continuous variables and the Chi-Square test or Fisher Exact test was used for categorical variables to test significance where appropriate. Factors associated with perioperative procedural-related complications were explored by logistic regression. Aneurysm recurrence rate was estimated using the Life Table method.

Results:

A total of 361 eligible patients (E2 group = 91; E1 group = 270) were included in the analysis. There were no differences in demographic characteristics between E2 and E1 groups (mean age: 59.9 vs. 58.4 years; male gender: 27.5% vs. 29.3%). The stent deployment was successful in all patients in both groups. ICO was similar (E2 vs. E1: 79.1% vs. 75.1%, $P=0.629$) and most of patients achieved good function outcomes ($mRS \leq 2$) at discharge (E2 vs. E1: 77.8% vs. 81.1%, $P=0.592$). Overall, E2 group had a lower perioperative procedural-related complication rate compared with E1 (7.7% vs. 16.4%, $P=0.042$). After controlling for age and underlying severity of disease (presence of hypertension, Hunt-Hess Scale, Fisher Grade, and size and height of aneurysms), patients in E2 group had a significantly lower risk of perioperative procedural-related complications compared with those receiving E1 ($OR=0.35$; 95% CI: 0.14-0.88). The operating time was significantly shorter (165.7 ± 51.6 vs. 190.3 ± 79.6 minutes, $P=0.006$) in E2 vs. E1 group. While LOS was also shorter in E2 group (16.7 ± 9.7 vs. 19.2 ± 12.6 days), the difference was not statistically significant ($P=0.082$). By six-month post discharge, patients receiving E2 had similar good

functional outcomes and aneurysm recurrence compared with those in E1 group (80.2% vs. 81.9%; 13.3% vs. 14.9%, respectively).

Conclusions:

Compared with the Enterprise™ 1, Enterprise™ 2 had similar clinical effectiveness but with a lower perioperative procedural-related complication risk. Use of E2 also appeared to be associated with improved clinical efficiency with shorter operating time in treating patients with RIA. The application of Enterprise™ 2 stent demonstrated encouraging clinical benefits in treating RIA in China.

Keywords: Stent Assisted, Aneurysm, Hemorrhage

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

Flow diversion of cerebral aneurysms via direct carotid artery cutdown: a case series.

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Introduction:

Flow diversion (FD) of the cerebral aneurysms (CA) are performed either by trans femoral or transradial approach. Safety and feasibility of an alternative option such as direct Carotid artery Cutdown (DCAC) and FD for the treatment of the CA in a situation when tradition approaches are not feasible is not well described.

Methods:

Retrospective review.

Results:

First patient; 67 years old man with history of hypertension, hyperlipidemia, smoking, and stenting of the aortic arch aneurysm was diagnosed with symptomatic bilateral ICA DSA by a CT angiography. Right ICA DSA was in multi-level extending from cervical carotid artery to the skull base measured 19x15x20 mm and the left was 16x9x22 mm. Considering the severity of the disease and the presence of symptoms, planned for a DCAC by vascular surgeon followed by FD by neurovascular surgeon (NES) in a staged fashion. A 6F sheath was placed from right common carotid artery (CCA) to right ICA by a vascular surgeon. A CAT5 catheter was navigated to the ICA beyond DSA. FD was achieved using Surpass streamline measuring 4x50 mm x2 and a 5x40 mm. The DCAC site was sutured by vascular surgeon and patient was extubated. Using similar techniques, Left-sided DPA was repaired using 5x50 mm surpass streamline flow diverter in 3 months. Second patient; 75 years old women's left ICA ophthalmic (ICA-O) aneurysm grown from 8 mm to 12 mm with headaches. TF and TR approaches failed, underwent DCAC and FD with pipeline flex (PF) 5x30 mm using phenom plus and phenom XT27 microcatheter. Third patient; 65 years old women with LICA-O 9 mm symptomatic aneurysm with occlusions femoral and radial arteries due to smoking underwent FD with PF of 4x30 mm. There were no clinical events, first patient's right ICA radiographic dissection was repaired by VS prior to extubation. Patients were discharged home in 48 hours with NIHSS 0 and achieved baseline mRS. Patients were continued full antiplatelets for six months followed by an 81 mg baby aspirin and 75 mg of clopidogrel. Follow-up MR angiogram demonstrate complete oblations of the aneurysms without stenosis.

Conclusions:

Our case series demonstrate that DCAC for the FD of the intracranial aneurysm is feasible and safe when performed carefully and in coordination with a multidisciplinary team. Further studies are required.

Keywords: Flow Diverter, Aneurysm, Carotid, Endovascular Therapy, Cerebrovascular Disease

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

Flow Diverter Use in acutely presented Dissecting Aneurysms, 2 years follow up of 53 cases

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Introduction:

Acute dissecting aneurysms are among the uncommon causes of subarachnoid hemorrhage. Established endovascular treatment options include parent artery occlusion and stent-assisted coiling, but appear to be associated with an increased risk of ischemic stroke. reconstruction of the vessels with flow diverters is an alternative therapeutic option.

Methods:

This is a retrospective analysis of 53 consecutive acutely ruptured dissecting aneurysms treated with flow diverters. The primary end point was favorable aneurysm occlusion, defined as OKM C1-3 and D . Secondary end points were procedure-related complications and clinical outcome.

Results:

23 aneurysms (43.4%) arose from the intradural portion of the vertebral artery, 10 (18.8%) were located on the posterior inferior cerebellar artery and 3 (5.6%) posterior cerebral artery, 7 (13.2%) MCA , (18.8%) ICA .

45 aneurysms presented by SAH while 8 presented by Ischemic manifestation.

Flow diverter placement was technically successful in all cases . immediate postoperative rerupture occurred in two case (3.7%), thromboembolic complications in 3 cases (5.7%). Median clinical follow-up was 640 days and median angiographic follow-up was 690 days. ten patients (18.9%) with poor-grade subarachnoid hemorrhage died in the acute phase. Favorable clinical outcome (modified Rankin scale ≤ 2) was observed in 27 of 53 patients (51%) and a moderate outcome (modified Rankin scale 3/4) was observed in 12 of 53 patients (22.6%). All aneurysms showed complete occlusion at follow-up.

Conclusions:

Flow diverters might be a feasible, alternative treatment option for acutely symptomatic dissecting aneurysms and may effectively prevent rebleeding in ruptured aneurysms.

Keywords: Flow Diverter, Aneurysm, Stenting

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

FlowDiverter:A Study Safety and Efficacy in a Consecutive Group of 53 Patient and 60 aneurysm

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Introduction:

Endovascular flow diverters are increasingly used for the treatment of cerebral aneurysms. We assessed the safety and efficacy of the Flow Diverters in a consecutive series of 53 patients and 60 aneurysms.

Methods:

Inclusion criteria were wide-neck, blister-like, or fusiform aneurysms independent of size, treated with the FRED, PIPELINE and SILK between December 2014 and Junho 2021. Assessment criteria were aneurysm occlusion, manifest ischemic stroke, bleeding, or death. The occlusion rate was assessed at 6 months and 1 year with DSA by using the Raymond classification and the O'Kelly-Marotta grading scale.

Results:

Fifty three patients (mean age 54.3 years;81.1% female) with 60 aneurysms were treated with 9 Silk, 38 FREDs and 13 Pipeline. Aneurysm size ranged from 2.5 to 30 mm. Deployment of the Flow diverters was successful in 52 aneurysms. Three patient developed mild stroke symptoms that fully receded within days, 4 patients occlusion total carotid because resistant antiagregation and another patient's development Swelling syndrome. There has been one death. Initial follow-up at 6 months showed complete occlusion in 90% of the overall study group and 93,33% at 1 year.

Conclusions:

The flow diverter is a safe device for the treatment of cerebral aneurysms of various types. Our data reveal high occlusion rates at 6 months and 1 year. Long-term occlusion rates are expected.

Keywords: Aneurysm, Aneurysm Embolization, Intracerebral Aneurysm, Embolization, Stenting

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

Impact of Age on Outcomes Following Endovascular vs Clipping of Ruptured and Unruptured Cerebral Aneurysms

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Introduction:

Age is an important determinant of outcome in patients with unruptured or ruptured cerebral aneurysms. Advancements in endovascular therapies have significantly impacted patient selection and treatment of patients with cerebral aneurysm. Recent release of the National claims data for 2017-2018 provides the opportunity to explore novel population-level outcomes following clipping vs endovascular treatment of ruptured and unruptured cerebral aneurysms in different age groups.

Methods:

Analysis of US National Inpatient Sample of hospitalizations with aneurysmal subarachnoid hemorrhage (aSAH) or unruptured aneurysms treated with clipping or endovascular therapy from January 1, 2017 to December 31, 2018. Pre-defined age strata included: younger than 50 years; 50-64 years; 65-79 years; and 80 years or older. Primary outcomes included in-hospital mortality and favorable outcome defined as discharge to home.

Results:

Overall, 34,955 hospitalizations with unruptured aneurysm treatment, (26,695 endovascular and 8,260 surgical clipping), and 17,525 hospitalizations with aSAH were identified in the study period. In unruptured aneurysm group, endovascular therapy was associated with significantly higher favorable outcome across all age groups, and lower mortality in those 65 years or older (all $P < 0.001$) when compared to clipping. Median hospital length-of-stay was 1 day (IQR 1-4) in endovascular vs 4 days (IQR 3-8) in clipping group ($P < 0.001$). In aSAH group, endovascular therapy was associated with higher favorable outcome in 50-80 years age groups when compared to clipping, with no significant differences for in-hospital mortality outcome (Table). Significantly more favorable outcomes were achieved with coiling vs clipping in those aged 65 or above with unruptured aneurysms.

Conclusions:

In 2017-2018 in US, unruptured aneurysm patients treated with endovascular therapy had significantly lower morbidity and mortality compared to those treated with surgical clipping, and differences were more pronounced with age. Similar but less strong association was observed in patients with aSAH.

Age group	In-hospital mortality			Discharge home		
	Endovascular	Microsurgical	p	Endovascular	Microsurgical	p
Aneurysmal SAH	n = 13,155	n = 4,370		n = 13,905	n = 4,365	
< 50	9.2%	8.1%	0.57	59.5%	56.2%	0.30
50 – 64	11.6%	12.7%	0.55	48.7%	40.4%	0.007
65 – 79	16.3%	15.8%	0.72	29.1%	22.7%	0.04
≥ 80	25.4%	14.8%	0.13	13.6%	11.1%	0.72
Unruptured aneurysms	n = 24,135	n = 7,205		n = 24,115	n = 7,190	
< 50	0.4%	0.6%	0.51	94.7%	86.7%	<0.001
50 – 64	0.6%	0.7%	0.81	93.4%	80.6%	<0.001
65 – 79	0.5%	2.8%	<0.001	90.8%	71.4%	<0.001
≥ 80	2.2%	10%	<0.001	73.9%	50.0%	<0.001

Keywords: Aneurysm, Aneurysm Embolization, Clipping, Subarachnoid Hemorrhage

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

Initial Experience Of Using A Large-Bore (0.096" Inner Diameter) Access Catheter In Neurovascular Interventions

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Introduction:

Larger-bore access catheters can improve endovascular therapy by facilitating delivery of interventional devices and reducing the number of exchange maneuvers needed. Advances in technology have allowed for the manufacture of larger-bore access catheters that maintain necessary performance characteristics, such as a stiffer proximal segment for stability and a flexible distal segment for vessel catheterization. The purpose of this study was to report our initial experience of using a large-bore (0.096" inner diameter) access catheter in neurovascular interventions.

Methods:

Data were prospectively collected from 7 sites in the US for procedures performed using a large-bore (0.096" inner diameter) access catheter from January 15, 2020, to April 21, 2021. Effectiveness outcome was technical success, defined as successful access to the target vessel. Safety outcomes were access-related and device-related related complications.

Results:

One hundred and fourteen patients were included in this study (Table). The mean age of the patients was 67.6 years (SD 16.1), and about half (49.6%, 56/113) were female. The most common treatment conditions were stroke, 64 (56.1%); aneurysm, 24 (21.1%); carotid atherosclerosis, 19 (16.7%); and intracranial atherosclerosis, 3 (2.6%). Most approaches were by the femoral (66.4%, 73/110) or radial (33.6%, 37/110) artery and the most common target vessels were the left (49.1%, 55/112) or right (42.9%, 48/112) carotid artery. Anatomic variations included severe vessel tortuosity (32.1%, 26/81), type 2 aortic arch (19.3%, 17/88), type 3 aortic arch (15.9%, 14/88), bovine arch (15.4%, 16/104), severe angle (<30°) between the subclavian and target vessel (14.9%, 11/74), and subclavian loop (8.9%, 7/79). The median access time to branch was 18 minutes (IQR 11-28, N=75). The most common treatments were mechanical thrombectomy, 51 (44.7%); stenting, 25 (21.9%); Pipeline/flow diversion, 10 (8.8%); and stent-assisted coiling, 8 (7.0%). Technical success was achieved in most (94.7%, 108/114) patients. Access site complications occurred in 3 patients (2.6%). Two complications (1.8%) were related to the large-bore access catheter.

Conclusions:

A large-bore (0.096" inner diameter) access catheter could be used with both femoral and radial arterial approaches, had a high technical success rate, and had a low rate of periprocedural complications.

	Large-bore (0.096") access catheter (N=114)
Demographics	
Age, years (mean (SD))	67.6 (16.1)
Female	49.6% (56/113)
Treatment conditions*	
Stroke	56.1% (64/114)
Aneurysm	21.1% (24/114)
Carotid atherosclerosis	16.7% (19/114)
Intracranial atherosclerosis	2.6% (3/114)
Other [†]	3.5% (4/114)
Arterial approach*	
Femoral	66.4% (73/110)
Radial	33.6% (37/110)
Carotid	0.9% (1/110)
Other	0.9% (1/110)
Target vessel*	
Left carotid artery	49.1% (55/112)
Right carotid artery	42.9% (48/112)
Right vertebral artery	3.6% (4/112)
Left vertebral artery	2.7% (3/112)
Other	2.7% (3/112)
Anatomic variations	
Severe vessel tortuosity	32.1% (26/81)
Kink	27.2% (22/81)
Loop	4.9% (4/81)
Aortic type	
Type 2 aortic arch [‡]	19.3% (17/88)
Type 3 aortic arch [§]	15.9% (14/88)
Bovine arch	15.4% (16/104)
Severe angle (<30°) between subclavian and target vessel [¶]	14.9% (11/74)
Subclavian loop	8.9% (7/79)
Access time to branch view, min (median [IQR])	18 [11-28] (N=75)
Treatments*	
Mechanical thrombectomy	44.7% (51/114)
Stenting	21.9% (25/114)
Pipeline/flow diversion	8.8% (10/114)
Stent-assisted coiling	7.0% (8/114)
Other interventions	7.0% (8/114)
Other aneurysm embolization	5.3% (6/114)
Balloon-assisted coiling	4.4% (5/114)
Not reported	4.4% (5/114)
Coiling plus Pipeline/flow diversion	3.5% (4/114)
Coiling alone (unassisted)	2.6% (3/114)
Technical success[#]	94.7% (108/114)
Periprocedural complications	
Access site complications	2.6% (3/114)
Complications related to large-bore access catheter	1.8% (2/114)

*Multiple responses allowed.

[†]1 each (0.9%) of arteriovenous malformation, parent vessel sacrifice, pseudotumor, and sinovenous thrombosis.

[‡]1× to 2× common carotid artery diameter.

[§]Greater than 2× common carotid artery diameter.

[¶]Common carotid artery or vertebral artery.

[#]Successful access to the target vessel.

Keywords: Aneurysm, Aneurysm Embolization, Endovascular Therapy, Penumbra

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Poster

Large and Giant Intracranial Aneurysms, Clinico-radiological Outcome and Predictors with Flow Diverter Stent.

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Introduction:

Endovascular treatment for large and giant aneurysms has included either a reconstructive approach or a deconstructive approach by parent artery occlusion. 1,2 Stent-assisted coiling and balloon-assisted coiling were alternative techniques developed to deal with such complex aneurysms, but studies have shown less expected efficacy. This study aims to assess the safety and efficacy of the flow diverter stents for treating large and giant intracranial aneurysms and to examine possible predictors for radiological and clinical outcomes such as location and presence of branching artery, bifurcation, and adjuvant coiling.

Methods:

This study had been conducted on 65 consecutive patients with 65 large and giant aneurysms (size ≥ 10 mm) treated with flow diverters; Periprocedural complications were reported in all patients and clinical outcomes. Follow-up angiography was done for 60 patients (92.3%) at 12 months.

Results:

The study included 65 patients who harbored 65 aneurysms. The median age was 55.5 years (IQR: 44.25 - 62.75 years), the female represented 70.8 % of all patients. The clinical presentation had been reported (Headache, cranial nerve palsy, motor deficit, seizures, and visual field defect in 40 patients (61.5%), nine patients (13.8%), seven patients (10.8%), five patients (7.7%), and four patients (6.2%) respectively. The vascular risk factors had been reviewed (HTN, DM, smoking, and Hyperlipidemia in 25 patients (9.2%), Six patients (9.2%), sixteen (24.6%), and 10 patients (15.4%) respectively). The median size of aneurysms was 16.4 mm (IQR: 12.50 - 23.85 mm) and the median neck width was 7.15 mm (IQR: 5.85-10.24 mm). Fourteen aneurysms (21.4 %) had previous treatment, eleven aneurysms (16.9%) were treated by coils only, one case (1.5%) by assisted procedure, one case (1.5%) by previous FDS, and parent artery occlusion in one case (1.5%). Complete occlusion in 50 from 60 aneurysms (83.4%), neck remnant in 8 aneurysms (13.3%), and sac remnant in two aneurysms (3.3%). Periprocedural problems were encountered in 14 patients (21.5%) with morbidity in six patients (9.2%) and mortality in one patient (1.5%). Univariate and multivariate logistic regression analysis was used to discover possible predictors of combined mortality and morbidity and occlusion in Table (1).

Conclusions:

From this study, it could be concluded that Endovascular treatment of the large and giant aneurysms with flow diverters represents a safe method for treating this kind of complex intracranial aneurysms. Complex aneurysms with branching artery and bifurcation were associated with aneurysm persistence

and complications respectively while the location of the aneurysm was the only predictor for clinical outcome.

Table (3): - Multivariate logistic regression of variables affecting outcome

Predictor variable	Unadjusted OR	Adjusted OR	95% CI of OR	P value
Adjuvant coiling	0.195	0.263	0.047 - 1.484	0.130
Anterior versus posterior	0.056	0.160	0.070 – 0.011	0.006

OR: odds Ratio, CI: Confidence intervals,

Keywords: Aneurysm, Coiling, Endovascular Therapy, Flow Diverter, Intracerebral Aneurysm

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Poster

Long-Term Outcomes Of Anterior Communicating Artery Aneurysm Treated With Coiling: Subset Analysis Of SMART Registry

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Introduction:

The purpose of this study was to assess the long-term clinical outcomes of anterior communicating artery (ACoA) aneurysm treated with coiling.

Methods:

Data on patients with an ACoA aneurysm were extracted from a prospective multicenter registry (SMART) that enrolled patients with intracranial aneurysms or other neurovascular abnormalities who underwent coiling. The primary effectiveness outcome was retreatment through follow-up, and the primary safety outcome was procedural device-related serious adverse events within 24 hours.

Results:

Of the 995 adults enrolled in the SMART registry, 230 had an ACoA aneurysm (Table). The average patient age was 59.1 years (SD 12.5), and 62.6% were female. A modified Rankin Scale score of 0 to 2 was present in 89.6% of patients. Most aneurysms were small (93.9%) and saccular (87.8%). The aneurysm was wide necked in 57.7% of patients and was ruptured in 35.7%. Coiling was stent assisted in 39.1% of patients and balloon assisted in 14.8%. Retreatment through follow-up occurred in 8.1% (15/185) of patients—6.8% (12/176) of patients with a small aneurysm, 33.3% (3/9) of patients with a large aneurysm, 4.0% (5/126) of patients with an unruptured aneurysm, 16.9% (10/59) of patients with a ruptured aneurysm, 9.9% (9/91) of patients with unassisted coiling, 5.6% (4/71) of patients with stent-assisted coiling, and 7.4% (2/27) of patients with balloon-assisted coiling. Procedural device-related serious adverse events within 24 hours occurred in 5.2% of patients—5.1% (11/216) of patients with a small aneurysm, 7.1% (1/14) of patients with a large aneurysm, 6.1% (9/148) of patients with an unruptured aneurysm, 3.7% (3/82) of patients with a ruptured aneurysm, 3.6% (4/111) of patients with unassisted coiling, 5.6% (5/90) of patients with stent-assisted coiling, and 11.8% (4/34) of patients with balloon-assisted coiling. No deaths occurred within 24 hours of the procedure. At 1 year, 91.8% (167/182) of patients had a Raymond–Roy Occlusion Classification of Class I or II. From immediately after the procedure to 1 year, progressive occlusion was observed in 29.1% (53/182) of patients, and stable occlusion was observed in 56.6% (103/182) of patients. At 1 year, the all-cause mortality rate was 4.3%, and at a 1-year follow-up, a modified Rankin Scale score of 0 to 2 was present in 86.2% (112/130) of patients.

Conclusions:

Coiling of ACoA aneurysm was safe and had durable 1-year results.

	Anterior communicating artery aneurysms (N = 230)
Baseline data	
Age, years (mean (SD))	59.1 (12.5)
Female	62.6% (144/230)
mRS of 0-2 at admission	89.6% (138/154)
Aneurysm characteristics	
Size group	
Small [†]	93.9% (216/230)
Large [‡]	6.1% (14/230)
Wide neck [‡]	57.7% (131/227)
Neck width ≥4 mm	20.6% (47/228)
Ruptured	35.7% (82/230)
Aneurysm type	
Saccular	87.8% (201/229)
Dissecting	0.4% (1/229)
Other	11.8% (27/229)
Adjunctive technologies used[§]	
Unassisted coiling	48.3% (111/230)
Stent-assisted coiling	39.1% (90/230)
Balloon-assisted coiling	14.8% (34/230)
Primary outcomes	
Retreatment through follow-up	8.1% (15/185)
Small aneurysm [†]	6.8% (12/176)
Large aneurysm [‡]	33.3% (3/9)
Unruptured aneurysm	4.0% (5/126)
Ruptured aneurysm	16.9% (10/59)
Unassisted coiling	9.9% (9/91)
Stent-assisted coiling	5.6% (4/71)
Balloon-assisted coiling	7.4% (2/27)
Procedural device-related serious adverse events within 24 hours	5.2% (12/230)
Small aneurysm [†]	5.1% (11/216)
Large aneurysm [‡]	7.1% (1/14)
Unruptured aneurysm	6.1% (9/148)
Ruptured aneurysm	3.7% (3/82)
Unassisted coiling	3.6% (4/111)
Stent-assisted coiling	5.6% (5/90)
Balloon-assisted coiling	11.8% (4/34)
Additional outcomes	
Mortality within 24 hours of the procedure	0.0% (0/230)
Raymond–Roy Occlusion Classification at 1 year	
Class I-II	91.8% (167/182)
Class I	68.1% (124/182)
Class II	23.6% (43/182)
Class III	8.2% (15/182)
Change in occlusion from immediately after the procedure to 1 year	
Better (progressive occlusion)	29.1% (53/182)
Stable	56.6% (103/182)
Worse (recanalization)	14.3% (26/182)
All-cause mortality at 1 year	4.3% (10/230)
mRS of 0-2 at 1-year follow-up	86.2% (112/130)

mRS: Modified Rankin Scale score

[†]Largest diameter ≤10 mm

[‡]Largest diameter >10 mm and ≤25 mm

[‡]Neck width ≥4 mm or dome-to-neck ratio (largest diameter / neck width) <2

[§]Subjects may appear in multiple categories

Keywords: Aneurysm Embolization, Coiling, Endovascular Therapy, Penumbra, Thrombosis

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Poster

Periprocedural Safety Of Intracranial Aneurysm Embolization With Extra Soft Coils: Interim Analysis Of SURF Study

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Introduction:

Coiling with extra soft coils is a widely accepted safe and durable treatment option for intracranial aneurysms but lacks prospective real-world outcomes. Extra soft coils are specifically designed as fill and finish coils. The primary objective of the SURF study, a postmarket registry, is to assess the real-world experience of extra soft coils as fill and finish coils to support adequate aneurysm occlusion at 1-year follow-up. This study is an interim analysis of periprocedural safety results and ramp-up of a trial during the COVID-19 pandemic.

Methods:

The SURF trial is a postmarket, prospective, multicenter, single-arm, observational trial aiming to enroll about 800 patients. Patients undergoing embolization of intracranial aneurysm with an extra soft coil as the finishing coil were enrolled at 34 centers globally from November 2019 through July 20, 2021, and will be followed up for approximately 1 year. During the first wave of COVID-19 in the US, enrollment was behind expectations but has caught up with projections as of July 2020. The primary safety endpoints for this interim analysis were serious adverse events (SAEs) within 24 hours after the procedure and device-related SAEs up to 7 days after the procedure or to discharge.

Results:

This interim analysis is for 346 enrolled patients, characterized by a mean age of 60.1 years and being predominantly (73.1%) female. Medical history included 62.4% of patients with hypertension and 18.2% of patients with a previous history of stroke. The most common aneurysm locations were the internal carotid artery (35.2%) and the anterior cerebral artery (31.1%). Unassisted coiling was the modality of choice in 49.6% of procedures, followed by stent-assisted coiling in 30.0% and balloon-assisted coiling in 16.9%. The rate of SAEs within 24 hours after the procedure was 7.8% (27/346; 95% CI, 5.0%-10.6%). Device-related SAEs occurred in 1.4% (5/346; 95% CI, 0.2%-2.7%) of patients up to 7 days after the procedure or to discharge. The rate of major ipsilateral stroke up to discharge was 0.6% (2/346; 95% CI, 0.0%-1.4%), and the rate of symptomatic intracerebral hemorrhage was 1.4% (5/346; 95% CI, 0.2%-

2.7%), including 2 intraprocedural ruptures and 3 patients who had ruptured aneurysm at baseline and had intraventricular and intracerebral hemorrhage. Patient follow-up is ongoing.

Conclusions:

We report interim outcomes from the SURF study. This postmarket registry evaluates the safety of extra soft coils as fill and finish coils in the treatment of intracranial aneurysms. Trial ramp-up, despite temporary delay during the initial COVID-19 wave, has been progressing along with expectations.

	Intracranial aneurysms (N=346)
Demographics	
Age, years (mean (SD))	60.1 (13.0)
Female	73.1% (250/342)
Target aneurysm characteristics	
Aneurysm size, mm (median [IQR])	5.5 [4.0-7.7]
Wide-neck aneurysm*	56.8% (184/324)
Ruptured target aneurysm	39.8% (135/339)
Aneurysm type	
Saccular	80.5% (269/334)
Fusiform	2.1% (7/334)
Dissecting	1.8% (6/334)
Bi-lobed	7.2% (24/334)
Multi-lobed	5.1% (17/334)
Other type	3.3% (11/334)
Aneurysm location	
Extradural internal carotid artery	2.1% (7/338)
Internal carotid artery	35.2% (119/338)
Anterior cerebral artery	31.1% (105/338)
Middle cerebral artery	16.3% (55/338)
Posterior circulation	12.1% (41/338)
Other	3.3% (11/338)
Treatment type	
Unassisted coiling	49.6% (167/337)
Stent-assisted coiling	30.0% (101/337)
Balloon-assisted coiling	16.9% (57/337)
Stent- and balloon-assisted coiling	2.7% (9/337)
Coiling plus flow diverter	0.9% (3/337)
Packing density, median [IQR]	32.6% [23.8%-42.2%]
Safety outcomes [95% CI]	
SAEs within 24 hours post-procedure	7.8% (27/346) [5.0%-10.6%]
Device-related SAEs up to 7 days or to discharge	1.4% (5/346) [0.2%-2.7%]
Major ipsilateral stroke up to discharge	0.6% (2/346) [0.0%-1.4%]
Symptomatic intracerebral hemorrhage	1.4% (5/346) [0.2%-2.7%]

SAEs: Serious adverse event.

*Neck width ≥ 4 mm or dome-to-neck ratio (defined as largest diameter / neck width) < 2 .

Keywords: Aneurysm, Aneurysm Embolization, Endovascular Therapy, Penumbra,

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Poster

Postoperative Recanalization Factors of Coil Embolization for Cerebral Aneurysms with Comparable Volume Embolization Ratio

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Introduction:

Volume embolization ratio (VER) has been reported to be involved in postoperative recanalization of coil embolization. However, despite comparable VER, some cases remained stable, and the others showed recanalization. Hemodynamic and morphological factors, as described in previous studies, may also influence recanalization in addition to VER. In this study, we focused on cerebral aneurysms treated by coil embolization with comparable VER. Blood flow analysis using computational fluid dynamics (CFD) and geometrical measurements were performed to investigate the recanalization factors.

Methods:

We focused on the aneurysms that underwent coil embolization with 15-20% VER. The criteria for the case selection were that the size of the aneurysms was 5-10 mm and that the aneurysm was treated by only coil (i.e., the stent-assisted cases were excluded). Aneurysms that recanalized after coil embolization and underwent additional coil deployment were defined as "recanalized", and aneurysms that remained stable after coil embolization without coil compaction were defined as "stable". Finally, we selected 7 recanalized cases (ICA: 1, MCA: 3, ACA: 3) and 18 stable cases (ICA: 6, MCA: 3, ACA: 9). CFD analysis and morphometry were performed on the vessel geometry after coil embolization. The coil shape was modeled by the virtual coil technique. We calculated three morphological parameters and 34 hemodynamic parameters, then we compared them between the recanalized and stable cases using the Mann-Whitney U test to identify recanalization factors. In addition, we reconstructed the coil shape from medical images and compared its structure and flow characters for stable and recanalized cases.

Results:

The average VER for the cases analyzed in this study were 16.7% for recanalized cases and 17.7% for stable cases. As hemodynamic parameters, the spatially averaged velocity normal to the neck plane into the cerebral aneurysm (NV_{neck}), and the ratio of the area where blood flows into the cerebral aneurysm after the coil embolization to the area of the neck surface (inflow area ratio: IAR) showed significant difference. Although the hemodynamic parameters were significantly different, morphological parameters did not show statistically significance. In the recanalized case, NV_{neck} tended to be higher (mean value, recanalized: 0.931, stable: 0.822, $P < 0.05$), and IAR tended to be lower (mean value, recanalized: 0.319, stable: 0.408, $P < 0.01$). The high NV_{neck} and low IAR indicate that the aneurysm had concentrated flow with a high velocity at the neck surface. There was the concentrated blood flow with the high velocity that collided with the modeled coil in a CFD result for the recanalized case. The area where the blood flow impinged on the modeled coil coincided with the compacted coil region

reconstructed from medical images. Therefore, a large force on the coil indicated by these hemodynamic parameters may cause the postoperative recanalization.

Conclusions:

Even with the same level of VER, there was a possibility of recanalization in aneurysms with a high velocity and concentrated flow into the aneurysm. It is necessary to consider not only VER but also hemodynamic factors to investigate recanalization factors after the coil embolization.

Keywords: Aneurysm, Coiling, Aneurysm Embolization, Cerebral Blood Flow

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Poster

Prediction of Risk of Rupture of Intracranial Aneurysms in a Latin-American Population: a Restrospective Study

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Introduction:

The Population, Hypertension, Age, Size, Earlier Subarachnoid Hemorrhage (SAH), Site (PHASES) score was developed in North America, Europe, and Japan and it is a widely used model in day-to-day clinical practice for intracranial aneurysm (IA) rupture risk stratification. Here, we aimed to determine the predictors of aneurysm rupture and assess the components of the PHASES score in a Latin American population.

Methods:

Four hundred eighty-six Peruvian patients presented at our institution with ruptured IAs between 2010 and 2020. We retrospectively collected the following variables: age, sex, a hypertension or diabetes mellitus history, previous SAH, the aneurysm size in millimeters (<5, 5-6.9, 7-9.9, 10-19.9, and ≥20), aneurysm morphology (saccular or non-saccular), neck diameter (≤4 and >4), presence of a pseudoaneurysm, and aneurysm location. We then performed two separate multivariate analysis. For the first one, we included variables using a stepwise approach with a cut-off p-value of 0.2 in univariate logistic regression. For the second one, we evaluated the PHASES score components. A p-value of 0.05 was considered statistically significant.

Results:

The median age was 56 years old, and 114 females were included. One hundred seventy-five patients had a hypertension history, 21 had a diabetes history, and 11 had a previous SAH. Seventy-eight patients had an aneurysm with <5mm, 118 with 5-6.9mm, 125 with 7-9.9mm, 85 with 10-19.9, and 10 patients with an aneurysm >20mm. There were 372 patients with a saccular aneurysm and an associated pseudoaneurysm was found in 197 patients. The most common location was posterior communicating artery (n=219), followed by the anterior cerebral artery (n=125), the middle cerebral artery (MCA) (n=58), branches from the posterior circulation (n=33), and finally by a paraclinoid aneurysm (n=33). In our initial multivariate analysis, only the presence of an associated pseudoaneurysm was an independent predictor for aneurysm rupture (OR 7.93; 95% CI 3.45 – 18.25). An age >70 years (OR 1.12; 95% CI 0.3 – 4.12), the male sex (OR 1.39; 95% CI 0.54 – 3.62), a hypertension history (OR 1.14; 95% CI 0.53 – 2.44), a size of 10-20mm (OR 1.46; 95% CI 0.46- 4.64), and location in the MCA (OR 1.07; 95% CI 0.25 – 4.57) also predicted a higher rupture risk but without statistical significance. When we performed a multivariate logistic regression of the factors making up the PHASES score, we found that only the age (OR 1.79; 95% CI 1.11- 2.88) and a hypertension history (OR 1.61; 95% CI 1.14 – 2.27) were independent predictors of aneurysm rupture.

Conclusions:

Based on our findings and its limitations, we observed that the presence of an associated pseudoaneurysm was a predictor for aneurysm rupture. Moreover, we found that only two of the five components of the PHASES score were predictors of the event in our population: the age and a hypertension history. Therefore, new research should be carried out in the Latin American population to establish predictors for the development of clinical predictive models in this field.

Keywords: Intracerebral Aneurysm, Aneurysm, Subarachnoid Hemorrhage

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Poster

Presence of Blebs Associated with Reduced Aneurysm Wall Tension and Increased Wall Enhancement

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Introduction:

Aneurysm wall enhancement using high-resolution vessel wall imaging (HR-VWI) may provide new surrogate biomarkers for instability. Finite element analysis (FEA) paired with HR-VWI can provide more insight into complex morphological features that ultimately lead to aneurysm growth and rupture.

Methods:

Unruptured intracranial aneurysms were reconstructed in 3D from CE-MRA imaging. Shells were created assuming a uniform wall thickness of 86 μm and FEA was conducted with a 3rd order polynomial material model, assuming the wall to be isotropic, homogenous, and similar between subjects. The 95th percentile wall tension was defined as high wall tension to account for mesh artifacts. Low wall tension was identified from nodal values and verified on contour plots. Regions of high and low wall tension were characterized from contour plots. Aneurysms were measured and classified as enhancing ($\text{CR}_{\text{stalk}} \geq 0.6$) or non-enhancing ($\text{CR}_{\text{stalk}} < 0.6$), using manual ROI measurements from 3T HR-VWI T1 postcontrast imaging.

Results:

Of the twenty-three aneurysms analyzed, fourteen were classified as enhancing ($\text{CR}_{\text{stalk}} \geq 0.6$) and nine as non-enhancing. Enhancing aneurysms had a significantly higher 95th percentile wall tension ($m = 0.89 \pm 0.32 \text{ N/cm}$) compared to non-enhancing aneurysms ($m = 0.48 \pm 0.10 \text{ N/cm}$, $p < 0.001$). Wall enhancement remained a significant predictor of wall tension while accounting for the effects of aneurysm size ($p = 0.046$). High wall tension was consistently concentrated at the neck of the aneurysm, while low wall tension concentrated at the dome. (Figure 1). Aneurysms with blebs ($N = 7$) had significantly lower minimal wall tension ($m = 0.13 \pm 0.02 \text{ N/cm}$) than those without ($m = 0.21 \pm 0.10 \text{ N/cm}$, $p = 0.033$). Enhancing aneurysms had significantly higher minimal wall tensions ($m = 0.23 \pm 0.10 \text{ N/cm}$), than non-enhancing aneurysms ($m = 0.13 \pm 0.02 \text{ N/cm}$, 0.003). Minimal wall tension was less strongly correlated with diameter and neck size (Spearman's $r = 0.564, 0.378$ respectively) than 95th percentile wall tension (Spearman's $r = 0.756, 0.541$ respectively).

Conclusions:

Large and irregular aneurysms are subject to complex mechanical loading. The resultant stress concentrators may prompt the histological remodeling response observed in areas of growth, like the aneurysm neck. Low wall tension indicative of wall degradation in areas more prone to rupture colocalized with aneurysm wall enhancement and blebs.

Wall Tension (N/cm)

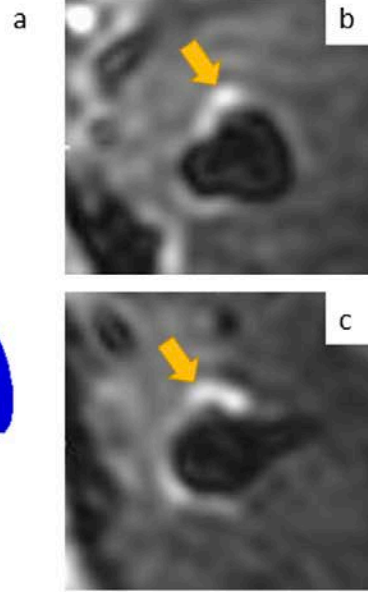
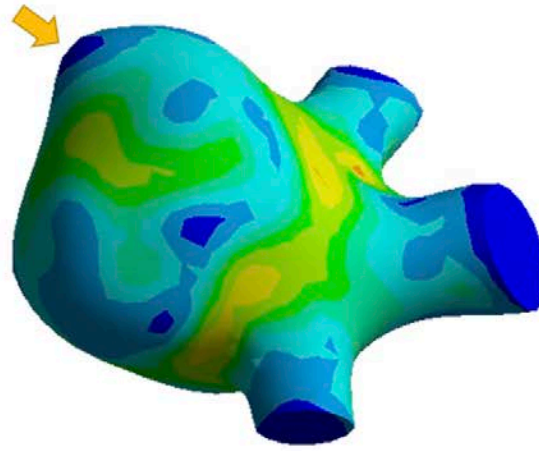
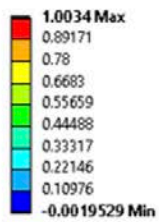


Figure. An MCA aneurysm with a bleb shows low wall tension (Panel a) colocalizing with focal enhancement on sagittal (b) and coronal (c) views.

Keywords: Aneurysm, Cerebrovascular Disease, Intracerebral Aneurysm, MRI, Cerebral Physiology

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

Recurrent Carotid Cavernous Fistula Requiring Complex Repair of Ruptured Cavernous Carotid Aneurysm: A Case Report

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Introduction:

There are no studies investigating the safety and efficacy of covered stent grafts, particularly the newly developed stents such as the PK Papyrus stent, for endovascular treatment of direct carotid cavernous fistulas (CCFs).

Methods:

We present a case of a 75-year-old female who presented to the hospital with a three-week history of worsening left eye vision, chemosis, proptosis, and partial third nerve palsy. Patient was found to have left direct Type A CCF secondary to ruptured cavernous segment carotid aneurysm.

Results:

The CCF was treated with coil embolization and pipeline Shield stent embolization devices with immediate stagnation and improvement of symptoms. Patient had history of an aortic mechanical valve and thus was started on warfarin and ASA. After achieving INR level of 2.5-3.5, patient started to have recurrent swelling of the left eye associated and decreased visual acuity. Repeated diagnostic cerebral angiogram revealed residual CCF. Onyx liquid embolization and a Surpass Evolve Flow Diverter were attempted to slow the fistulization with no success. Multiple attempts for direct percutaneous superior ophthalmic vein cannulation were also unsuccessful. At this point, two coronary graft-covered PK Papyrus stents were implanted across the fistula pouch, which resulted in immediate resolution of the CCF with evidence of persistent normal flow within left ophthalmic artery. Patient's visual acuity and left eye movement improved.

Conclusions:

This case report highlights the effectiveness and safety of covered stent grafts, particularly more flexible stents such as the PK Papyrus stent, in navigating the carotid vasculature and closing direct CCFs and may be used as a first-line technique. More large-scale studies are warranted to investigate the safety and efficacy of using such stent grafts to treat direct CCFs in the setting of antithrombotic agents and anticoagulation.

Keywords: Aneurysm, Stenting, Carotid, Endovascular Therapy

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

Remote Learning for Neuroendovascular Procedures During the COVID-19 Pandemic

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Introduction:

Telemedicine coupled with teleproctoring have been a novel practice in the last months given the restrictive mobilization orders worldwide due to the COVID-19 pandemic, generating the impossibility to travel and learn new techniques or bring a proctor to perform procedures on-site. Previous papers have reported the benefits of remote proctoring for endovascular procedures using online platforms, whereas others proposed the use of more simple platforms and applications for telemedicine such as Zoom[®], WhatsApp[®] or Google Glass[®]. Our study aimed to describe our experience in the implementation of remote learning for endovascular treatment of vascular lesions using a multicamera system streamed by a web-based platform.

Methods:

Endovascular treatment of aneurysms, arteriovenous malformations, and chronic subdural hematomas were streamed through a multicamera system installed in the angiosuite and shared via Zoom[®] platform. Four main cameras projected the angiography monitors, the operator's hands and the overview of the room.

Results:

Eleven cases were performed. Aneurysms, arteriovenous malformations and chronic subdural hematomas were treated by endovascular means. Preoperative angiographic setup, intraoperative endovascular technique and postoperative management were discussed during the live streaming. No technical problems were reported.

Conclusions:

Remote learning with online platforms is nowadays an important tool but not a substitute to hands-on learning for endovascular procedures. We recommend its implementation during the COVID-19 pandemic as a temporary substitute especially for trainees who do not have access to advanced endovascular interventions.

Keywords: Neurointerventional Training, Neurointerventional Education, New Innovation

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

Satellite Model for the Management of Aneurysms to Desaturate the Third Level Health System

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Introduction:

The Centro Medico Nacional 20 de Noviembre is the most complex centre of the Mexican public health system. The SARS COV-2 pandemic has progressively saturated health services at all levels, impacting chronic non-communicable diseases 1. Aneurysmal subarachnoid haemorrhage has a mortality rate of up to 35% if not treated 2. Endovascular management of aneurysms provides a therapeutic possibility that shortens the time and reduces complications if implemented in an outpatient system with high standards of patient choice and reduces the chances of complications 3. We present a case series of patients with ruptured and unruptured brain aneurysms treated in a satellite system to reduce in-hospital days and complications.

Methods:

A retrospective analysis was carried out of 66 patients admitted on an outpatient basis at the Centro Medico Nacional "20 de noviembre" between May 2020 to June 2021. The patients were entered into a "satellite" system for coils' endovascular management or flow diverter, previously diagnosed with digital subtractor angiography and computed tomography angiogram. The analysis of variables was done using the Shapiro-Wilk test to determine the normality of the sample distribution. The correlation of variables was done using Chi-square.

Results:

The mean age of the patients was 53.8 years SD 14.31 years. 71.2% of the patients were female, and 28.2% were male. There was a 59.1% left predominance regarding the aneurysm side, 37.9% on the right side, and 3.0% was a single vessel. The arterial predominance was 77.3% anterior circulation. 95.5% of the patients underwent embolization with the placement of coils, and 4.5% had a flow diverter. The mean time of admission was 23.3 hours SD 12.4 hours. Complications occurred in 13.6% of the population studied, the most frequent being vasospasm, arterial occlusion, hydrocephalus, and death from aspiration pneumonia. The modified Rankin scale at 90 days was 0.38 SD 1.13. There was a significant relationship ($p = 0.05$) between the left side and complications.

Conclusions:

The management of aneurysms with a short in-hospital time is a feasible solution in reducing the decongestion of tertiary health systems. Endovascular management with coils results in a low rate of complications, which is why this therapeutic route can be followed to desaturate third-level health systems and a flow diversion in high well-selected patients. The relationship between complication rates related to the left side of aneurysms is likely due to the more significant number of aneurysms on this side, not due to anatomical vessel idiosyncrasy.

Keywords: Aneurysm Embolization, Flow Diverter, Care, Subarachnoid Hemorrhage

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

The Pennsylvania Post-Market Multicenter Experience with Flow Re-direction Endoluminal Device (FRED)

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Introduction:

The Flow Re-direction Endoluminal Device (FRED) is a novel self-expanding double-layer nitinol braided flow diverter that recently received FDA approval. Early post-market studies from the US literature are currently lacking and we here report our short-term multicenter experience results.

Methods:

Series of consecutive patients undergoing FRED treatment for intracranial aneurysms were queried from prospectively maintained registries in 4 North-American Centers in the State of Pennsylvania from February 2020 to June 2021. The pertinent baseline demographics, aneurysmal characteristics, and procedural outcomes were collected and analyzed, with primary outcome of aneurysmal occlusion, and secondary outcome of safety and complications.

Results:

Sixty-one patients (median age 58, 82% females) underwent 65 FRED treatment procedures for harbored 72 aneurysms. The majority (86.1%) of aneurysms were unruptured; 80.5% were saccular in morphology and 87.5% were located in the internal carotid artery, with a median size of 7.2 mm (IQR 5.2-11.9mm). Radiographic follow-up was available in 80.5% of the aneurysms, showing complete occlusion in 79.3%, and near-complete occlusion in 6.9% of the cases (median follow-up of 6 months), with a retreatment rate of 2.8%. Permanent ischemic complications were encountered in 2.8% of the cases, with no procedural mortality, and a modified Rankin Scale of 0-2 documented in 98.1% of the patients at the last clinical follow-up.

Conclusions:

The results of the early post-market experience with the FRED device show reasonable safety and adequate aneurysmal occlusion rates comparable to other flow diverters. Larger multicenter studies with longer follow up data are needed to assess the long-term safety and durability of the device.

Keywords: Aneurysm, Flow Diverter

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

Trends in Intervention Modality for Patients with Mycotic Aneurysms: A Nationwide Analysis

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Introduction:

Mycotic aneurysms, also known as infectious intracranial aneurysms, are sometimes responsible for intracranial hemorrhage in patients with infective endocarditis. Data regarding when and how to treat mycotic aneurysms most effectively are sparse. Given the widespread adoption of endovascular treatments for non-infectious intracranial aneurysms and acute stroke, we hypothesized that endovascular treatment is increasingly utilized for patients with mycotic aneurysms. We examined trends in endovascular versus open neurosurgical treatment of mycotic aneurysms in patients with infective endocarditis.

Methods:

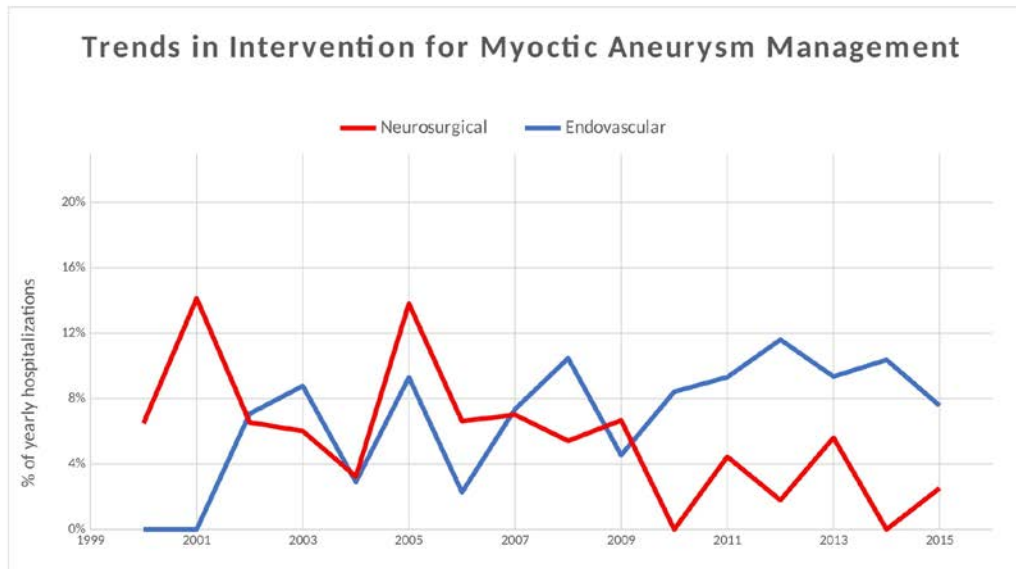
We performed a trends analysis using data from 2000-2015 from the National Inpatient Sample. The National Inpatient Sample is an all-payer database that includes data for a representative sample of hospitalizations to non-federal hospitals in the United States. We included all hospitalizations for patients with ruptured (on the basis of subarachnoid hemorrhage) or unruptured cerebral aneurysms alongside a diagnosis of infective endocarditis; diagnoses were ascertained using ICD-9-CM codes. Treatment modalities were categorized as endovascular versus open neurosurgical repair based on ICD-9-CM procedure codes. National Inpatient Sample survey weights were used to calculate nationally representative estimates. Logistic regression was used to evaluate the association between calendar year and intervention rate, presented as an odds ratio for each additional year.

Results:

We identified 1,015 hospitalizations for patients with a ruptured or unruptured cerebral aneurysm in the setting of infective endocarditis. Their mean age was 54.6 years (SD, 16.6), and 60.1% were male. The overall rate of intervention was 11.9% (95% CI, 9.6-14.2%), and this rate did not change appreciably over time ($p=0.772$). In comparing intervention modalities over time, there was a decrease in open neurosurgical repair (OR, 0.89; 95% CI, 0.84-0.95; $p=0.001$), offset by an increase in endovascular repair (OR, 1.07; 95% CI, 1.01-1.14; $p=0.023$) (Figure).

Conclusions:

Rates of mycotic aneurysm intervention during hospitalizations for infective endocarditis have not changed. However, the use of endovascular treatment has become more commonplace while the use of open neurosurgical treatments has decreased. Further directions include understanding whether this shift has improved patients' outcomes and ultimately enumerating best practices for patients with mycotic aneurysms.



Keywords: Intracerebral Aneurysm, Clipping, SAH, Endovascular, Embolization

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

Trends in the Endovascular Treatment of Intracranial Aneurysms in a Single Institution During 10 Years

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Introduction:

Endovascular treatment of intracranial aneurysms has increased compared to microsurgery since the creation of the Guglielmi Detachable Coils (GDC), and is the treatment of choice in several centers worldwide. Our study aimed to analyze the trends over time of number of patients, number of aneurysms, rupture status, location, size and endovascular technique employed in a retrospective cohort of consecutive intracranial aneurysms treated during a 10-year period.

Methods:

Data extracted from clinical records, surgical reports, angiographies and CT scans of 765 consecutive patients who underwent endovascular treatment of 845 intracranial aneurysms at our institution between January 2010 and December 2020 was carried out. The Mann-Kendal test was used to assess time trends. The moving average technique was also employed, using one lagged observation, the current observation and one forward observation in order to create smoother curves. The statistical software Stata v14.0 (StataCorp, College Station, TX, USA) was used.

Results:

We evaluated 765 patients who underwent 845 endovascular treatments of intracranial aneurysms. Women represented 81% of the cohort. Mean age was 53.9 ± 14.6 years. We identified a significant increase in the number of patients ($p = 0.016$; p for moving average = 0.005) and in the number of aneurysms over time ($p = 0.003$; p for moving average = 0.003). For ruptured aneurysms, we did not find changes in the trends over time ($p = 0.117$; p for moving average = 0.1), whereas in the case of unruptured aneurysms, we identified a significant increase in their treatment ($p = 0.029$; p for moving average = 0.001). Posterior communicating ($p = 0.042$; p for moving average = 0.002), paraclinoid ($p = 0.06$; p for moving average = 0.019) and posterior fossa aneurysms ($p = 0.813$; p for moving average = 0.028) increased their frequency of treatment over time. Anterior communicating ($p = 0.235$; p for moving average = 0.21), middle cerebral artery ($p = 0.431$; p for moving average = 0.347) and internal carotid artery aneurysms ($p = 1$; p for moving average = 0.754) did not show differences over time. We did not identify changes over time in large ($p = 0.31$; p for moving average = 0.213), as well as width ($p = 0.35$; p for moving average = 0.876) and neck diameter ($p = 1$; p for moving average = 0.815). Balloon-assisted coiling ($p = 0.01$; p for moving average = 0.003), flow diverters ($p = 0.016$; p for moving average < 0.001) and stent-assisted coiling ($p = 0.531$; p for moving average = 0.014) showed a positive trend over time. Simple coiling ($p = 0.75$; p for moving average = 0.184) did not show significant variations over time.

Conclusions:

We identified a positive trend in the endovascular treatment of unruptured aneurysms, as well as posterior communicating artery, paraclinoid and posterior fossa aneurysms. Assisted-coiling techniques and flow diverters also showed a positive trend over time. These results are in accordance with the increasing trends in endovascular treatment of intracranial aneurysms worldwide.

Keywords: Aneurysm, Aneurysm Embolization, Embolization, Intracerebral Aneurysm

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

Endovascular Intervention for a Thrombotic Adverse Event During Andexanet alfa infusion

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Introduction:

Andexanet alfa is the only specific reversal agent for factor Xa inhibitors and received FDA approval in 2018. Here we report an early infusion adverse event in a patient with acute intraventricular hemorrhage (IVH) that received Andexanet alfa, with an unfavorable outcome.

Methods:

A 73-year-old male presented to our emergency department (ED) after he developed sudden onset of severe headache without other associated neurological symptoms. An outpatient brain MRI showed IVH, that remained stable in size (2.4 cm³) on a follow-up head CT performed in our ED. CT angiogram showed a 60% stenosis of the left supraclinoid internal carotid artery. The patient was taking apixaban 5 mg twice daily for atrial fibrillation (last dose 5.5 hours prior to presentation).

Results:

The anticoagulation was reversed with Andexanet alfa, 400 mg bolus given at 18:30, followed by 480 mg infusion over 2 hours started at 19:00 (12 hours from last apixaban dose). At 19:00, he developed left middle cerebral artery (MCA) ischemic stroke symptoms (global aphasia) that resolved with head-of-the-bed flattening. CT perfusion demonstrated left ICA territory mismatch (342 ml) and 76 ml core. Shortly after CT perfusion, the patient developed a persistent complete left MCA stroke syndrome with NIH stroke scale (NIHSS) score 23. Decision was made to perform emergent cerebral angiogram which demonstrated a large, fresh thrombus in the left cervical ICA. Thrombectomy was successful with TICI score 2B. Patient's neurological status initially improved. However, despite this intervention, patient developed a large territory infarct. As neurologic status remained poor, family withdrew care and patient died.

Conclusions:

ANNEXA-A and ANNEXA-R were parallel trials of Andexanet alfa for factor Xa inhibitor reversal that demonstrated a transient increase in prothrombotic factors post Andexanet alfa infusion. Neither of these phase 3 trials nor the previous phase 2 trials reported a clinical thrombotic event very early during the infusion. The ANNEXA-4 trial (Phase 3) enrolled subjects with active major bleeding on a factor Xa inhibitor and 10% developed a thrombotic event during the 30-day follow-up period. 41% of the thrombotic complications were acute ischemic stroke (AIS), 35% (5 patients) experienced an AIS in the first six days post-administration and the earliest reported thrombotic event occurred day 1 post infusion. Our case report illustrates an early cerebrovascular thrombotic event with dismal outcome despite timely and effective mechanical reperfusion therapy, which could be due to vessel re-obstruction in setting of a hypercoagulable state. We aim to make vascular neurologists, neurointensivists and neurosurgeons aware of this possible occurrence when reversing patients with factor Xa-related intracranial hemorrhages.

Keywords: Drugs Side Effects, Interventional Neuroradiology, Recanalization, ICH, Acute Ischemic Stroke Intervention

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

Predictors of Hemorrhagic Transformation after Mechanical Thrombectomy in Large Vessel Occlusion Ischemic Stroke

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Introduction:

Stroke is a major cause of morbidity and mortality around the globe. Mechanical thrombectomy (MT) is the standard of care for patients with large vessel occlusion strokes. However, mechanical thrombectomy is associated with a number of complications. Symptomatic intracranial hemorrhage is one of the most feared complications of mechanical thrombectomy. In the pooled analysis of five trials, 4.4% of patients developed symptomatic intracranial hemorrhage. Treating physicians should have a good understanding of the potential complications of MT in order to optimize the safety and benefits of this procedure. Yet, the causes of hemorrhagic transformation are largely unknown and the predictors identified in previous studies vary. The goal of our study is to identify the rate and reliable predictors of radiological hemorrhagic transformation (RHT) and symptomatic hemorrhagic transformation (sICH) post mechanical thrombectomy in large vessel ischemic strokes.

Methods:

This was a retrospective analysis of consecutive large vessel occlusion acute ischemic stroke patients undergoing mechanical thrombectomy in a comprehensive stroke center (spanning 02/2015 - 09/2018). Outcome measures included radiological hemorrhagic transformation (RHT) and symptomatic hemorrhagic transformation (sICH). sICH was defined as RHT with worsening of 4 points in 24-36h NIHSS (ECASS II criteria) and by at least 1 point (NINDS criteria). RHT was further classified according to Heidelberg-bleeding classification as HI1, HI2, PH1, PH2, and SAH. Independent covariates predictive of RHT or symptomatic hemorrhage (sICH) were identified with multivariable logistic regression. Clinical opinion and the existing literature were used to reduce the number of variables collected at baseline to those considered potentially predictive of stroke progression.

Results:

Out of 341 patients who underwent thrombectomy, 32% had a radiological hemorrhagic transformation. The median age was 71. Smoking, IV tPA, longer procedure time, and lower TIC1 scores were associated with RHT. On a separate multivariate analysis, coronary artery disease was a separate predictor of hemorrhagic transformation. Patients with RHT had higher inpatient mortality and less mRs < 3 at discharge.

Conclusions:

RHT is associated with poor functional outcomes and inpatient mortality. Factors such as smoking, IV tPA, longer procedure time, and lower TIC1 scores were associated with RHT.

Keywords: Acute Stroke

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

Scheduled Head CT In Neurologically Stable Spontaneous ICH Patients May Be Unnecessary.

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Introduction:

Obtaining serial head computed tomography (CTH) imaging for patients with spontaneous intracerebral hemorrhage (sICH) is commonly utilized to monitor for hematoma expansion (HE), defined as an increase in ICH volume by 33%. Obtaining recurrent CTH in the ICU setting may burden nursing and transport staff, expose patients to radiation, and inflate healthcare costs. It remains unclear whether utilizing scheduled CTH for sICH patients is more advantageous than targeted CTH, which is prompted by a decline in neurological status. We reviewed clinical factors and imaging studies in patients with and without HE.

Methods:

This retrospective cohort study conducted over two years identified 171 sICH patients. Patient demographics, clinical and neuroimaging data were recorded (including the reason for repeat imaging). These variables were then compared and analyzed in relation to HE using SPSS version 26, chi-square tests for categorical variables, and independent-samples t-tests were used for continuous variables.

Results:

Patients were predominantly male (65%), with a mean age of 65±14 years, a median GCS of 14, a median ICH score of 1, and a median ICH volume of 12.1 ccs. Repeat CTH was obtained within 14 hours after the initial imaging on average. Admission blood pressure (BP), BP-lowering interventions, pre-admission use of anticoagulant and antiplatelet therapy, GCS on admission, ICH volume, ICH score, and presence of spot signs were similar between the two groups. 15% of total patients (26/171) had HE. In the group that underwent scheduled repeat CTH, only 7% (9 patients) had HE, while the remaining 93% (119 patients) did not. Patients who underwent a second scan following a change in the neurologic assessment included 39% (17 patients) who had HE, compared to 61% (26 patients) that did not. HE detection was significantly lower in patients that underwent scheduled CTH ($p < 0.0001$).

Conclusions:

In patients with a stable exam, scheduled head CT only showed HE in 6% of patients; thus, the excess burden, radiation, and costs may not be necessary for these patients. Hematoma expansion is significantly lower in patients who underwent scheduled imaging than those prompted by a decline in neurologic status. However, our sample size is small and additional studies with larger population sizes are required to validate our findings.

Keywords: Cerebrovascular Disease, Hemorrhage

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

Stereotactic IntraCerebral Underwater Blood Aspiration Improves Survival Following Intracerebral Hemorrhage as Compared to Predicted Mortality

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Introduction:

Intracerebral hemorrhage (ICH) is a devastating form of neurological injury with substantial mortality. Recent publications on minimal invasive surgery (MIS) for hematoma evacuation have suggested survival benefits in select patients. Since 2015, our center has been performing an MIS technique using continuous irrigation with aspiration through an endoscope (SCUBA). SCUBA does not require a stability scan and can be performed despite hematoma expansion, intraventricular hemorrhage or radiographic spot sign. We present the 30-day mortality of our initial experience and compare it to predicted mortality by presenting ICH score.

Methods:

We performed a retrospective review of consecutively admitted patients with spontaneous non-traumatic supratentorial ICH who underwent SCUBA between 12/2015 – 03/2019. The primary outcome was observed 30-day mortality compared to predicted mortality by ICH score on presentation. Key secondary outcomes were operative markers, hospital length of stay, and discharge disposition.

Results:

One hundred and fifteen patients were identified, with mean (SD) ICH volume of 51.4mL (33.9mL) and median ICH score of 2. The median evacuation was 97% of the hematoma volume and 85% of patients had a residual clot burden of less than 15mL. Twelve patients died within one month of SCUBA for an overall mortality rate of 10.4%. This was significantly lower than the predicted mortality by ICH score of 35.1%, with an absolute risk reduction of 24.7%. When analyzed by presenting ICH score, significant mortality benefits were observed for all ICH scores > 2, with more pronounced differences at higher ICH scores (Table 1).

Conclusions:

This study suggests that MIS with the SCUBA technique for ICH may reduce predicted 30-day mortality, with a number need to treat of 4 to prevent one mortality. Further evaluation of this technique in a randomized clinical trial is required.

Table 1: Outcomes of SCUBA patients vs predicted Mortality Rates Across Cohorts by ICH Score

ICH Score	Predicted	SCUBA (N=115)	p-Value
0	0%	0/5 (0%)	-
1	13%	1/32 (3%)	0.162
2	26%	4/46 (9%)	0.046
3	72%	6/27 (22%)	<0.001
4+	97%	1/5 (20%)	<0.001
Overall	35%*	12/115 (10%)	<0.001

Table 1: Predicted and observed 30-day mortality rates by initial ICH score. *Predicted mortality for the SCUBA cohort. Observed mortality was significantly less than predicted for the overall cohort as well as for ICH score ≥ 2 .

Keywords: Intracerebral Hemorrhage, Hemorrhage, New Innovation,

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

Rescue Intracranial Stenting in Acute Ischemic Stroke

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Introduction:

Rescue treatment for failed thrombectomy in patients with acute ischemic stroke (AIS) from large vessel occlusion (LVO) remains controversial. We report our institutional experience with using intracranial stenting of occlusion refractory to aspiration and stent retriever thrombectomy.

Methods:

We performed a retrospective review of our prospectively maintained thrombectomy database to identify the LVO AIS patients who underwent intracranial stenting during endovascular thrombectomy at our comprehensive stroke center between January 2015 and July 2021. Modified Rankin scale (mRS) at 90 days was used as primary outcome. A good neurologic outcome was defined as mRS 0-3, and a poor neurologic outcome is defined as mRS score between 4-6. Secondary outcomes included symptomatic intracerebral hemorrhage (sICH) based on ECASS criteria, and in-hospital mortality.

Results:

We identified 52 acute ischemic stroke patients who underwent intracranial stenting acutely. Thirty-three patient (63.4%) are males. Median age was 64 years (Interquartile range (IQR 57-74), median baseline mRS was 0 (IQR 0-1), median NIHSS score was 13 (IQR 7-18), and median ASPECTS was 9 (IQR 8-10). Thirty six percent of the patients had a vertebrobasilar occlusion, 34% had a middle cerebral occlusion (M1 segment), and 14% had an M2 segment occlusion. The median number of thrombectomy passes prior to stenting was 3 (IQR 2-4). In 48% of patients, a combination of aspiration and stent retriever techniques were used prior to intracranial stenting. The Enterprise stent was the most commonly used stent (51.9%), followed by Wingspan stent (25%), and Neuroform Atlas stent (21.5%). Majority of the patients (93%) were loaded with anti-thrombotics intraoperatively, with rectal Aspirin and intravenous Integrilin being the most commonly used agents. Successful recanalization (TICI 2 B or better) was achieved in 96% of the patients, while the remaining 2 patients were graded as TICI 2A recanalization. Fifty percent of the patients had good outcome at 90 days. A total of 4 patients (8%) developed a sICH, with a 90 day mortality of rate of 15.4% (8/52).

Conclusions:

Rescue intracranial stenting appears to be a safe and effective approach in patients with emergent large vessel occlusion refractory to thrombectomy. Larger studies are warranted to further establish the safety and efficacy of this approach.

Keywords: Intra Caranial Stenosis, Intracranial Stenosis Stenting And Angioplasty, Acute Ischemic Stroke Intervention,

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Poster

Revisiting The Role Of Angioplasty And Stenting For Symptomatic Intracranial Stenosis - A Case Series

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Introduction:

Early and long-term results of the SAMMPRIS trial showed superiority of aggressive medical management over stenting in patients with symptomatic intracranial stenosis, in part due to the high risk of periprocedural complications. However, even with maximal medical management, the risk of recurrent TIA or stroke in patients with high-grade stenosis often remains elevated.

Methods:

A review of our stroke database was conducted, identifying three relevant cases.

Results:

CASE 1: A 69 year-old man with multiple vascular risk factors and atrial fibrillation on apixaban presented with several months of multiple stereotyped episodes of limb-shaking TIAs affecting the left leg, often leading to falls. CT angiogram revealed 70-80% stenosis of A2 segment of right ACA. Symptoms completely resolved after stenting with Neuroform Atlas stent. Repeat angiogram at 6 months showed excellent vessel caliber. CASE 2: A 78 year-old man with hypertension, DM, CAD, and known left ICA occlusion presented with recurrent episodes of aphasia and right arm weakness while on maximal medical therapy. CT angiogram showed severe right supraclinoid ICA stenosis which was corrected with Resolute Onyx DES stent with improvement of symptoms. CASE 3: A 77 year-old with hypertension, DM, CAD and aortic dissection on dual antiplatelet therapy and high-intensity statin was admitted with stereotyped, blood pressure-dependent episodes of aphasia and right face/arm weakness secondary to high-grade stenosis of both M2 divisions of the left MCA. Successful angioplasty and Y-stenting with Neuroform EZ and Wingspan stents led to complete resolution of symptoms.

Conclusions:

At high-volume centers and with newer interventional devices and techniques, intracranial angioplasty and stenting should be considered as a valuable therapeutic option in patients with symptomatic intracranial stenosis refractory to maximal medical therapy.

Keywords: Angioplasty, Stenting, Intracranial Stenosis Stenting And Angioplasty, Stroke, Atherosclerosis

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Grant Support: None.

Poster

24-hours NIHSS as a Predictor of 90-day Outcome in the STRATIS Registry

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Introduction:

Previous studies have suggested that 24-hour NIHSS may serve as a surrogate marker for functional outcomes in acute ischemic stroke patients. Here, we examine if 24-hour NIHSS is a predictor of 90-day mRS in the prospective Systematic Evaluation of Patients Treated With Neurothrombectomy Devices for Acute Ischemic Stroke (STRATIS) Registry.

Methods:

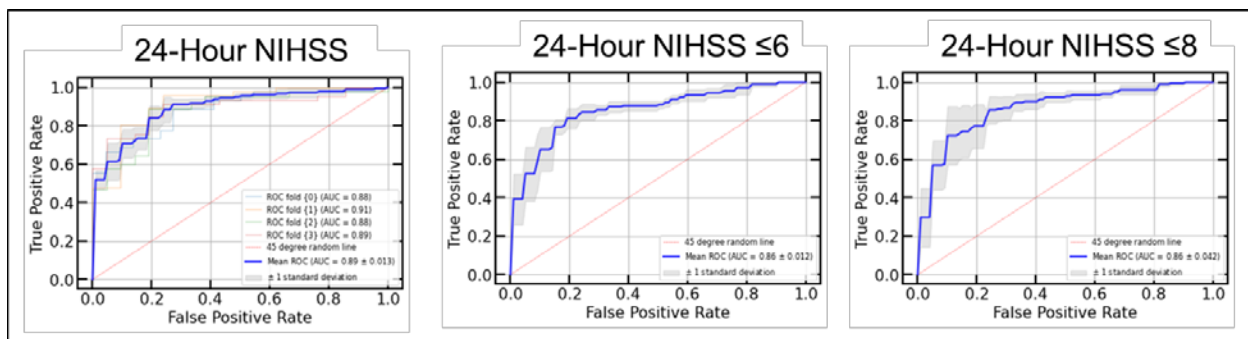
Data from the STRATIS Registry, a multicenter, non-randomized, observational study of AIS LVO patients treated with the Solitaire stent-retriever as the first-choice therapy within 8 hours from symptoms onset, were analyzed. Patients with premorbid mRS>2, posterior circulation stroke, missing 24 NIHSS or 90-day mRS were excluded from the analysis. The ability of 24-hour NIHSS (continuous and thresholds ≤ 6 and ≤ 8) to predict 90-day mRS using logistic regression was examined. The models were adjusted for age, baseline NIHSS, hypertension, diabetes, atrial fibrillation, IV-tPA use, time to recanalization, and revascularization status.

Results:

Of the 938 STRATIS patients, 662 with 24-hour NIHSS and 90-day mRS were included. A model trained with the continuous 24-hours NIHSS had higher predictive power (sensitivity 0.89, specificity 0.76, AUC 0.89 ± 0.013 , $P < 0.001$) than the models trained with thresholds ≤ 6 and ≤ 8 .

Conclusions:

When adjusted for covariates, 24-hour NIHSS as a continuous variable was the strongest predictor of dichotomous mRS outcomes in STRATIS patients. Twenty-four hour NIHSS ≤ 6 and ≤ 8 present the second and the third best results, respectively.



Keywords: Ischemic Stroke, Stent retriever

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

3D Analysis of Atherosclerotic Plaque Enhancement and the Parent Vessel

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Introduction:

High resolution vessel wall imaging (HR-VWI) is a promising tool in studying intracerebral atherosclerotic disease. The analysis of the interplay between the patterns of enhancement between the plaque and its parent vessel can generate further insights on the biology of these lesions. We have developed a 3D method of plaque and parent vessel analysis.

Methods:

Images from fifty-five plaques were obtained using 7T HR-VWI. T1 and T1+Gd sequences were performed. 3D reconstructions of the plaque and its parent vessel were generated with 3D Slicer. Using an in-house code, probes were orthogonally extended from the lumen of the vessel into the vessel wall and the plaque. Signal intensity values were then normalized to the corpus callosum. 3D heat maps and histograms were generated from hundreds of data points. A detailed analysis of the morphology of the histograms was performed to determine the uptake of gadolinium (Gd) by the parent vessel and the plaque. Variations in the width of the histogram were measured with the standard deviation.

Results:

Forty-one patients with 55 plaques (41 culprit and 15 non culprit) were included. There was no difference in enhancement in T1-pre between culprit and non-culprit plaques when compared to the parent vessel (width = 0.14 ± 0.05 and 0.14 ± 0.03 , respectively; $p=0.91$). On the T1+Gd culprit plaques were significantly more enhancing compared to the parent vessel (0.26 ± 0.10) than non-culprit plaques (0.20 ± 0.06) ($p=0.02$). The presence of an enhancing plaque creates a bimodal distribution that increases the width of the histogram curve (figure).

Conclusions:

Culprit plaques exhibit different patterns of enhancement relative to the parent vessel compared to non-culprit plaques. Histogram analysis of the parent vessel and its plaques provides a new set of metrics that may be used as a biomarker of disease progression.

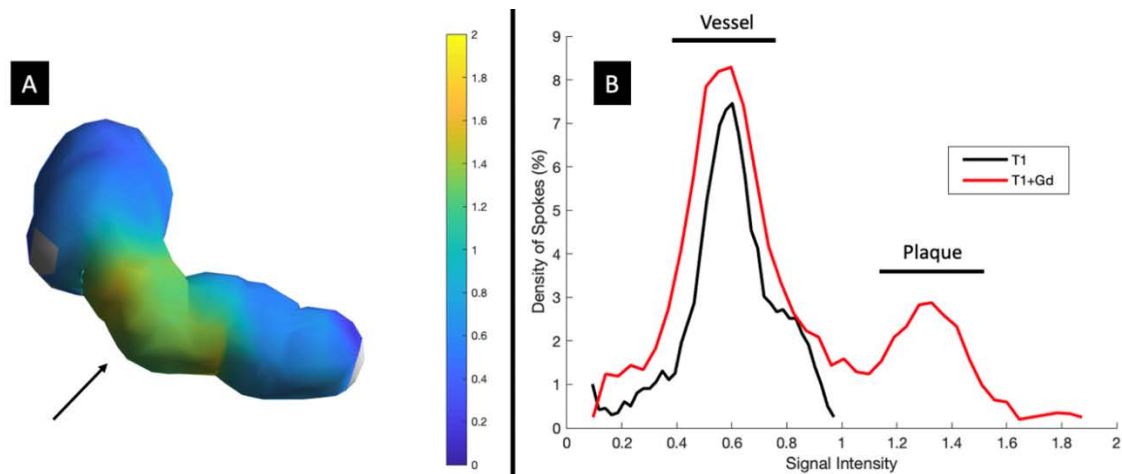


Figure. A. 3D reconstruction of a vessel in the T1+Gd sequence exhibiting an area of enhancement at the location of the plaque (arrow). B. Histogram of the plaque and the parent vessel showing a bimodal distribution on T1+Gd corresponding to the vessel and the enhancing plaque.

Keywords: Vascular Imaging, Cerebrovascular Disease, Intra Caranial Stenosis, Stroke, New Innovation

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Poster

Acute Isolated PCA Occlusion Treated with Mechanical Thrombectomy: A Single-Center Experience and Literature Review

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Introduction:

Acute isolated posterior cerebral artery (aPCA) occlusions account for 5-10% of all ischemic strokes. Due to peculiar patient presentation, the potential benefit of mechanical thrombectomy (MT) for these patients remains controversial. Our objective is to evaluate the safety, feasibility and effectiveness of MT in these patients and compare it to literature.

Methods:

For this retrospective single-center study, charts were reviewed for consecutive patients diagnosed with aPCA stroke who underwent MT from January 2013 thru July 2020. Presenting symptoms, patient demographics, procedural information, and 90-day follow-up details were noted. For the literature review, a systematic search of Pubmed, MEDLINE, and EMBASE databases was conducted for the keywords “posterior cerebral artery” and “thrombectomy” for articles published between January 2010 thru June 2021. Estimated rates for rate of recanalization, favorable outcomes (mRS 0-2), symptomatic intracerebral hemorrhage (sICH), and mortality were extracted.

Results:

Twenty-one patients were included in the study. Mean age was 71.2 years (SD ± 10.2). Median NIHSS score at presentation was 9 (IQR 5-15) with visual symptoms reported in 12 cases (57.1%). Overall, final mTICI 2b-3 was achieved in 17 patients (80.9%) with first-pass mTICI 2b-3 attained in 8 (38.1%). Post-procedure sICH occurred in 1 patients (4.7%). Fifteen patients (71.4%) had an mRS of 0-2 at 90-days and visual symptoms resolved in 83.3%. Mortality occurred in 2 patients (9.5%). For the systematic review, 4 articles plus our cohort were included in the final analysis, totalizing 222 patients. The estimated rate of successful recanalization was 85.25% (95% CI, 73.05%-97.45%), sICH was 3.60% (95% CI, 1.11%-6.09%), and mortality was 10.51% (95% CI, 5.88%-15.15%).

Conclusions:

Our results indicate MT as a potentially safe and efficacious treatment modality for aPCA strokes. Our results, in addition to the systematic review, indicate that patient selection and assessment may be the key in obtaining favorable long-term clinical outcomes.

Keywords: Cerebrovascular Disease, Acute Ischemic Stroke Intervention, Mechanical Thrombectomy,

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

An Alternative Reduced Dose Regimen of Ticagrelor for patients receiving Neuro-endovascular procedures

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Introduction:

There is a growing use of Ticagrelor in patients undergoing neuroendovascular procedures, especially those who demonstrate Clopidogrel resistance. While multiple dosages are studied in the cardiology literature, the optimal dose for patients with neurological pathology has yet to be established. Here we describe a single center experience involving 39 patients who underwent neuroendovascular procedures that then received an adjusted lower dose of Ticagrelor.

Methods:

A retrospective chart review was performed between 2013 and 2017 for patients on dual antiplatelet therapy (DAPT) for either cervical or intracranial vascular pathologies, as well as stenting of the neurovasculature, including carotid arteries. Patients were placed on Ticagrelor if their measured PRU responses to Clopidogrel were outside the expected range in our center using the P2Y12 test. All patients were maintained on a dose of 45mg BID except for one patient who received 22.5 mg BID. Responsiveness to Ticagrelor were measured utilizing the P2Y12 test.

Results:

The mean number of days for follow up post treatment initiation was 532 days. A total of 39 patients were included in the analysis. Of these, 8 patients (21%) received implantation of intracranial stents (5 patients received pipeline embolization devices, 1 patient received stent- assisted coiling, and 2 patients received intra-cranial stents for atherosclerotic disease). Fourteen patients (35%) received carotid angioplasty and stenting. Seventeen patients (44%) did not receive permanent implantation of a stent. All patients on the lower dose Ticagrelor of mg BID achieved responsiveness per the P2Y12 test. Hemorrhagic transformation of ischemic stroke occurred in one patient (2.5%). No other hemorrhagic complications were encountered. No thromboembolic events were recorded aside from one patient (2.5%) with intracranial atherosclerotic disease who had an ischemic event.

Conclusions:

A lower dose of Ticagrelor (45 mg BID) appears to be a safe and effective in this small cohort of patients who are resistant to Clopidogrel per P2Y12 testing and who have increased risk of ischemic or hemorrhagic strokes due to neurovascular pathologies and implants. Further randomized studies are required to confirm these findings.

Keywords: Antiplatelet

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Grant Support: None.

Poster

Basilar Artery Occlusion Thrombectomy Between Evidence Based Medicine and The Real-World practice, Single Centre Experience.

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Introduction:

BAO (basilar artery occlusion) is well known by catastrophic outcomes whether death or disability in approximately 70 %. ¹Thrombectomy as an intervention in large vessel occlusion of anterior proximal circulation was approved after multiple RCTs and meta-analyses.² In spite of two RCTs that appeared lately, there is still uncertainty about the effect of thrombectomy in BAO. ^{9, 10} Our study aims to report the outcome of BAO, as a further clue of MT effectiveness in BAO and variables affecting good outcome and mortality rate.

Methods:

We retrospectively collected the clinical and radiological data of 30 BAO patients treated in our center between 2016 and 2020. There is no limitation as regard age or presenting NIHSS. Twenty-two patients who came to the emergency within 4.5 hours had I.V. thrombolytic therapy (73.3%). A favorable clinical outcome was considered if mRS ≤ 2 . Angioplasty, stenting, or I.A thrombolysis were used as a rescue treatment. Symptomatic intracranial hemorrhage within two days after the initiation of treatment and mortality at 90 days were reported. The radiological outcome was assessed by modified Thrombolysis in Cerebral Infarction (mTICI) score where mTICI $\geq 2b$ or 3 at the end of the intervention was considered a favorable radiological result. Multiple variables were tested for their effect on favorable clinical outcomes and mortality (Table 1).

Results:

Among 30 patients, the mean age was 61.23 ± 16.81 years; 20/30 (66.7%) male. A favorable functional outcome was achieved in (40.7%). Successful revascularization was achieved in 26 patients (86.7 %). Four patients had procedural complications (13.3%). Symptomatic intracranial hemorrhage occurred in three cases (11%) and mortality at 90 days was 11 patients (36.7 %). The presenting NIHSS is the only predictor of mortality and the optimal cut-off value for death was 15 with AUC=0.758 (sensitivity 91 % and specificity 59%) and p-value = 0.02. TOR (time of onset to recanalization) had no effect on the clinical outcome which is controversy with the paradigm of early reperfusion leading to a good outcome

Conclusions:

In spite of two RCSs approved no statistical difference between medical treatment and thrombectomy, thrombectomy is still an effective procedure in real-world practice in selected cases. The presenting NIHSS is the only predictor of mortality in our studies. More studies are warranted to discover other predictors of BAO thrombectomy outcome to improve case selection and avoid futile recanalization.

Table (1): - Variables tested for favorable outcome and mortality

The variable	P-value for favorable outcome	P-value for Mortality
Sex	0.82	0.70
I.V lysis	0.68	0.95
TOR (time from onset to recanalization)	0.87	0.24
Onset to puncture time	0.81	0.33
postoperative mTICI	0.71	0.61
The presenting NIHSS	0.09	0.02*

(*) statistically significant

Keywords: Acute Ischemic Stroke Intervention, Endovascular Therapy, Interventional Neuroradiology, Stroke, Acute Stroke

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

Bilateral ACA Stroke - A Case Report of an Unusual Presentation

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Introduction:

Bilateral ACA strokes are rare, with one stroke registry reporting 2 cases out of 1490 strokes (1). These strokes are even less common in the absence of anatomic variants, such as an azygos ACA. Diagnosis may be difficult given the variability in clinical presentation.

Methods:

This is a case report.

Results:

A 51-year-old right handed man with no cerebrovascular risk factors on no antithrombotic medications presented two hours from last known well with complaints of generalized weakness, inability to speak or move, and feeling numb all-over during intercourse. He reported rapid improvement in symptoms. Emergency room exam was notable for right leg weakness (3/5) and left leg plegia with intact sensation. Hoover's sign was positive in the left leg and the patient was able to bear some weight while standing with a two-person assist. A computed tomography angiogram (CTA) of his head and neck was preliminarily interpreted as normal. No azygos ACA or single internal carotid artery origin for the ACAs were present. His exam improved to an isolated left foot dorsiflexor and plantar flexor weakness. The decision was made not to use thrombolytics based on his symptoms and exam which were improving and not entirely consistent with acute stroke. Brain magnetic resonance imaging demonstrated bilateral parasagittal acute strokes. It was later noted that the non-contrast head CT demonstrated bilateral hyperdense ACAs.

Conclusions:

This case demonstrates the difficulty in diagnosing bilateral ACA infarcts in a previously healthy adult in the setting of whole-body numbness and positive Hoover's sign. In retrospect, his transient inability to speak or move may have been transient akinetic mutism or callosal disconnection syndrome. Additionally, this case emphasizes the importance of evaluating for the hyperdense ACA sign (2) in patients complaining of bilateral leg weakness.

Keywords: Stroke, Acute Stroke, Ischemic Stroke

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Grant Support: None.

Poster

Cangrelor to Prevent Intraluminal Thrombosis in Endovascular Therapy for Acute Stroke: Single Center Case Series

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Introduction:

Intraluminal thrombosis after endovascular therapy (EVT) is a peri-procedural complication that carries a high burden of morbidity and mortality. The use of anti-thrombotic therapies during EVT remains an evolving field. Recent surveys suggest the glycoprotein IIb/IIIa inhibitor, tirofiban, is often used during EVT. However, the increased intracranial hemorrhage risk and the medication's long half-life pose significant challenges to management. Cangrelor, an intravenous and reversible P2Y₁₂ inhibitor, was first approved by FDA in 2015 for use in patients with coronary artery disease undergoing percutaneous intervention. Its rapid onset and offset are beneficial as an anti-thrombotic during EVT. Our case series aim to characterize the safety and efficacy of cangrelor use in our institution and contribute towards its growing body of data.

Methods:

Chart review was conducted for patients that required endovascular therapy for acute stroke and received intravenous cangrelor at our center between January 2019 to December 2020. We included patients that underwent both extracranial and intracranial stent placement, as well as patients who suffered from intraluminal thromboses intra-procedurally. Variables of interest included lesion pathophysiology, peri-procedural complications including intraluminal re-occlusion and intracranial hemorrhage, TICI score post-procedurally, vessel patency and MRS on post-hospitalization followup.

Results:

Nine patients received intravenous cangrelor during endovascular therapy. Mean age was 50 (range 41-67 years old), 3/9 patients were male. Seven patients (77.8%) had ischemic stroke, of whom five exhibited tandem intracranial occlusions and three required intraprocedural stent deployment. 3/7 patients received IV TPA prior to EVT. Interestingly, one patient had a previously placed Precise stent for acute internal carotid thrombus, briefly placed on eptifibatide (180mcg/kg), suffered from stent re-occlusion on POD1 and required repeat thrombectomy with cangrelor intra-procedurally; stent patency was maintained for the rest of her hospital course. One patient received balloon angioplasty of supraclinoid internal carotid artery. The remaining two patients required cangrelor for visualized intraluminal platelet aggregates during the EVT. Two patients presented with aneurysmal subarachnoid hemorrhage, one treated with flow diversion stent and the other requiring stenting for prolapsed aneurysm coiling. Dosing of cangrelor bolus and infusion varied. Six patients were bolused with 15 mcg/kg, while three patients received 7.5 mcg/kg. Infusion rates range from 0.5 to 4 mcg/kg/minute with all nine patients reaching therapeutic range P2Y₁₂ levels on post-procedural testing. Cangrelor infusion was transitioned to oral antiplatelet on post-operative day 4 on average. In all nine patients, vessel and stent patency was maintained intra-procedurally with cangrelor. Subsequent vascular imaging during hospitalization demonstrated no intraluminal thrombosis. One patient experienced

intracranial hemorrhage, however they received intraprocedural eptifibatide (180mcg/kg) and cangrelor infusion (15 mcg/kg bolus, 2 mcg/kg/min) for their extensive clot burden and triple stent placement. Five patients attended three-month post-hospitalization followups. Their median MRS was 2 and all followup vessel imaging demonstrated patent vessels.

Conclusions:

Our case series demonstrate the promising efficacy of cangrelor in patients undergoing emergent endovascular therapy to prevent intraluminal thrombosis. Further studies with larger sample sizes can elucidate the optimal dose of cangrelor, length of treatment before oral transition, and compare its efficacy to eptifibatide.

Keywords: Extracranial Stenosis, Angioplasty, Antiplatelet, Stenting, Intracranial Stenosis Stenting And Angioplasty

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Grant Support: None.

Poster

Cannabis and Cerebrovascular Outcomes: A National Registry Analysis

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Introduction:

Introduction: Recreational and medical cannabis use in the United States has been increasing in recent years in light of state and federal efforts to decriminalize and legalize its use. Its legal status has long precluded extensive research into its adverse effects, especially as it pertains to the realm of vascular and cerebrovascular outcomes. To date, minimal research has been completed on the sequelae of cannabis in inpatient admissions for stroke.

Methods:

A query of the 2012-2015 Nationwide Inpatient Sample searched for patients admitted with stroke ICD-9 diagnoses. These patients were then grouped by the presence of concurrent diagnosis of cannabis use disorder, and compared with respect to various peri- and postoperative complications, all-cause mortality, discharge disposition, length of stay, and hospitalization costs. Propensity score matching was utilized to control for potential baseline confounders.

Results:

A total of 414,340 patients met inclusion/exclusion criteria, 6794 (1.64%) of whom had cannabis use disorder. After controlling for baseline characteristics, these patients had higher rates of inpatient mortality (odds ratio [OR] 1.43; $p=0.01263$), and non-routine discharge, as well as increased lengths of stay (6.5 vs 5.7 days, $p<0.001$) and no significant difference in hospitalization charges (\$67507 vs. \$63328, $p=0.3918$).

Conclusions:

Based on a national trends analysis, chronic cannabis use appears to be associated with increased perioperative morbidity and mortality among patients admitted for stroke diagnoses. Physicians should ensure affected patients be adequately informed of associated risks. Further research should include matching of risk factors not captured in databases.

Keywords: Acute Stroke

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

Capacity and Characteristics of Thrombectomy Centers World-wide Using the MT2020+ Global Thrombectomy Tracking Smartphone App.

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Introduction:

Mechanical thrombectomy (MT) has been established as a first line therapy for large vessel occlusion stroke; however, MT remains underutilized globally with massive disparity in access based on country income level. Mission Thrombectomy 2020+ (MT2020+) is a global alliance and campaign that aims to reduce this disparity and democratize MT access for patients. A novel smartphone application, Global Thrombectomy Tracking App, was designed to characterize thrombectomy centers on a global-level and numerically track MT cases in near real-time.

Methods:

The MT2020 App was launched in November 2019. To gain insight into local systems of care, neurointerventionalists were prompted to participate in an optional 11-question survey over a 19-month period. Questions pertained to population density, organizational structure, academic affiliation, available imaging modalities, tPA usage, and case volumes.

Results:

Of 338 active users from 9 countries, 49-neurointerventionalists participated in the survey. The majority (71.5%) practiced in large metropolis with population >1-million, of which 16.3% were in mega-cities (>10-million). The centers were government funded (46.9%), private (40.8%) or charitable (12.2%). Most were academic hospitals (81.6%) with neurointerventional trainees (55.1%). At most centers (87.7%), IV-tPA was available with annual treatment rate >5% for 55.1%. Most centers (57.1%) utilize additional CT perfusion scans prior to MT. For 69.3% respondents, the annual MT case volume was between 10-100 cases.

Conclusions:

Our survey analysis shows that the global MT tracking APP can generate important thrombectomy capacity and characteristics at regional levels on a global scale, which can be used for targeted funding and resource allocation to accelerate access to MT.

Keywords: Mechanical Thrombectomy

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

Carotid Artery Revascularization Using Walrus Balloon Guide Catheter: Safety and Feasibility from US Multicenter Experience

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Introduction:

The Walrus Balloon Guide Catheter (BGC) is a new generation of BGC, designed to eliminate conventional BGC limitations during mechanical thrombectomy (MT). We report a multi-institutional experience using this BGC for proximal flow-control (PFC) in the setting of carotid artery angioplasty/stenting (CAS) in elective (eCAS) and tandem strokes (tCAS).

Methods:

Prospectively maintained databases at 7 North-American Centers were queried to identify patients with cervical carotid disease undergoing eCAS/tCAS with Walrus BGC.

Results:

110 patients (median age 68, 64.6% males) undergoing 80 eCAS (72.7%) and 30 tCAS (27.3%) procedures were included (median cervical carotid stenosis 90%; 41.8% with contralateral stenosis). Utilizing proximal flow-arrest technique in 87.2% and flow-reversal in 12.8% of procedures, the Walrus was navigated into the common carotid artery (CCA) successfully in all cases despite challenging arch anatomy (28.2%), with preferred femoral access (93.6%) and in conscious sedation (81.8%). Angioplasty and distal embolic protection devices (EPD) were used in 83.7% and 52.7% of procedures, respectively. tCAS led to a mTICI 2b/3 in all cases. Periprocedural ischemic stroke (till 30-days post-operatively) rate was 0.9% and remote complications occurred in 1.8% of the cases. Last follow-up mRS of 0-2 was seen in 95.3% of eCAS cohort, with no differences in complications in the eCAS subgroup between PFC only versus PFC and distal EPD (median follow-up 4.1 months).

Conclusions:

Walrus BGC for proximal flow-control is safe and effective during eCAS and tCAS. Procedural success was achieved in all cases, with favorable safety and functional outcomes on short term follow-up.

Table 4. Comparison of elective carotid stenting with/without distal protection

Variable	Distal Protection 51 (63.8%)	Without Distal Protection 29 (36.2%)	p- Value
Age at time of treatment			
Years; (median; IQR)	68 (59 - 76)	68 (62 - 76)	0.56
Gender			
Female	13 (25.5%)	18 (62.1%)	0.001
Male	38 (74.5%)	11 (37.9%)	
Smoking history			
Never smokers	18 (35.3%)	15 (51.7%)	0.34
Past smokers	11 (21.6%)	4 (13.8%)	
Current smokers	22 (43.1%)	10 (34.5%)	
Cardiac comorbidities history	27 (52.9%)	6 (20.7%)	0.005
Prior treatment history			
None	48 (94.1%)	28 (96.6%)	0.63
Yes (CEA/CAS)	3 (5.9%)	1 (3.5%)	
Access			
Femoral	45 (88.2%)	29 (100%)	0.06
Wrist	6 (11.8%)	0 (0%)	
Presence of carotid challenges	1 (2%)	2 (6.9%)	0.26
Presence of aortic arch challenges	9 (17.7%)	12 (41.4%)	0.02
Atherosclerotic lesions nature	44 (88%)	23 (79.3%)	0.3
CCA diameter (mm median; IQR)	6.6 (6.2-7.1)	6.7 (6.1-7.3)	0.82
ICA diameter (post-lesion) (mm median; IQR)	4.2 (3.7-4.9)	4.2 (3.8-4.6)	0.9
Presence of contralateral stenosis	29 (56.9%)	8 (27.6%)	0.012
Contralateral stenosis % (median; IQR)	50 (45-80)	65 (42.5-99.5)	0.72
Platelet function tests	48 (94.1%)	24 (82.8%)	0.1
P2Y12 at day of procedure (median; IQR)	120 (60-155)	105 (54-186)	0.29
Pre-stent deployment angioplasty	18 (36%)	14 (50%)	0.23
Post-stent deployment angioplasty	25 (50%)	20 (71.4%)	0.07
Outcomes			
Peri-procedural ischemic complications	0 (0%)	0 (0%)	>0.99
Remote ischemic complications	1 (2%)	1 (3.4%)	0.63
Hemorrhagic complications	0 (0%)	0 (0%)	>0.99
Retreatment	3 (6.8%)	1 (4.4%)	0.69

Keywords: Carotid Stenting And Angioplasty

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

Characterization of Critical Sequelae in Ischemic Stroke Using Natural Language Processing

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Introduction:

Automated processing of electronic health data to classify complications of ischemic stroke serves numerous purposes, including improved electronic phenotyping for clinical research. Here, we present a natural language processing (NLP) approach to identify critical findings in acute ischemic stroke from unstructured radiology reports of computed tomography (CT) and magnetic resonance imaging (MRI).

Methods:

Text reports of CT and MRI scans taken from 2292 patients admitted for large (>1/2 middle cerebral artery territory), acute anterior circulation ischemic stroke were gathered from a single-institution retrospective cohort. Reports were reviewed and labelled for the presence of hemorrhagic conversion, intracerebral edema, midline shift, intraventricular hemorrhage and parenchymal hematoma as defined by European Cooperative Acute Stroke Study PH1 and PH2 categories. For binary classifications, we quantified co-occurrence of individual words within reports using two separate NLP methods: Bag-of-Words (BOW) and Term Frequency-Inverse Document Frequency (TF-IDF). We then trained Lasso regression, random forest, and neural network classifiers to predict all complications based on word co-occurrence. Classifier performance was measured by area under receiver operating characteristic curves (AUC) using five separate folds of an internal test dataset. To predict midline shift as a continuous outcome, we developed a semantic rule-based system (RBS) based on regular radiographic report expressions. This system was tested using an external validation dataset of 1472 acute large anterior circulation stroke reports from a separate hospital.

Results:

2292 reports were fully labelled for the presence of all stroke complications. Lasso regression consistently displayed the best discrimination among all models. For BOW and TF-IDF, Lasso yielded respective AUCs of 0.894 and 0.919 (hemorrhagic conversion), 0.935 and 0.950 (intracerebral edema), 0.968 and 0.963 (midline shift), 0.933 and 0.904 (intraventricular hemorrhage), and 0.873 and 0.879 (parenchymal hematoma). All models were well-calibrated to underlying complication rates. The RBS also achieved strong performance in quantifying midline shift, achieving a mean absolute error (MAE) of

0.103 mm, sensitivity of 99.1% and specificity of 97.5% in the original cohort. In the external validation set of 1472 additional stroke reports, this same system achieved a MAE of 0.126 mm, sensitivity of 99.5% and specificity of 97.5% for midline shift. Wilcoxon rank sum testing on bootstrapped samples confirmed no statistically-significant differences in RBS performance between institutions when comparing MAE ($p=0.918$), sensitivity ($p=0.152$), and specificity ($p=0.929$).

Conclusions:

A machine learning pipeline based on Lasso regression successfully identified critical complications of large anterior circulation ischemic stroke from unstructured radiology reports, while our RBS quantified midline shift with a high degree of generalized accuracy between different institutions. We propose that these systems may warrant prospective validation in care settings and data mining for stroke research.

Keywords: Acute Stroke, New Technique, Stroke, Diagnostic Neuroradiology

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

Clinical Factors Associated rTPA Administration in Acute Ischemic Stroke Patients with History of Atrial Fibrillation

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Introduction:

Previous research into the administration of rTPA therapy in acute ischemic stroke patients has largely focused on the general population, however the comorbid clinical factors held by stroke patients are important factors in clinical decision making. One such comorbid condition is Atrial Fibrillation. The purpose of this study is to determine the clinical factors associated with the administration of rTPA in Acute Ischemic Stroke (AIS) patients specifically with a past medical history of Atrial Fibrillation (AFib).

Methods:

The data for this analysis was collected at a regional stroke center from January 2010 to June 2016 in Greenville, SC. It was then analyzed retrospectively using a multivariate logistic regression to identify factors significantly associated with the inclusion or exclusion receiving rTPA therapy in the AIS/AFib patient population. This inclusion or exclusion is presented as an Odds Ratio and all data was analyzed using IBM SPSS.

Results:

A total of 158 patients with Atrial Fibrillation who had Acute Ischemic Strokes were identified. For the 158 patients, the clinical factors associated with receiving rTPA therapy were a Previous TIA event (OR = 12.155, 95% CI, 1.125-131.294, $P < 0.040$), the administration of Antihypertensive medication before admission (OR = 7.157, 95% CI, 1.071-47.837, $P < 0.042$), the administration of Diabetic medication before admission (OR = 13.058, 95% CI, 2.004-85.105, $P < 0.007$), and serum LDL level (OR = 1.023, 95% CI, 1.004-1.042, $P < 0.16$). Factors associated with not receiving rTPA therapy included a past medical history of Depression (OR = 0.012, 95% CI, 0.000-0.401, $P < 0.013$) or Obesity (OR = 0.131, 95% CI, 0.034-0.507, $P < 0.003$), Direct Admission to the Neurology Floor (OR = 0.179, 95% CI, 0.050-0.639, $P < 0.008$), serum Lipid level (OR = 0.544, 95% CI, 0.381-0.984, $P < 0.044$), and Diastolic Blood Pressure (OR = 0.896, 95% CI, 0.848-0.946, $P < 0.001$).

Conclusions:

The results of this study demonstrate that there are significant associations between several clinical risk factors, patient lab values, and hospital admission factors in the administration of rTPA therapy to AIS patients with a past medical history of Atrial Fibrillation. Further research is recommended to determine the extent and reasoning behind of these associations as well as their impact on the clinical course for AIS/AFib patients.

Keywords: Acute Ischemic Stroke Intervention, Ischemic Stroke, TPA

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Grant Support: None.

Poster

Clinical Factors Associated with rtPA Inclusion in Ischemic Stroke Patients with and without Heart Failure

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Introduction:

It is estimated that approximately 10-24% of acute ischemic stroke (AIS) patients have comorbid heart failure (HF). However, it is currently unknown if certain clinical risk factors associated with rtPA thrombolytic therapy differ based on HF diagnosis. The purpose of this study is to determine the clinical factors associated with rtPA inclusion in AIS patients with and without heart failure.

Methods:

Retrospective data for baseline clinical and demographic factors from January 2010 to January 2016 in a regional stroke center were analyzed. Of the 5,469 patients identified with AIS, 590 presented with heart failure while 4,879 did not. Odds ratios and 95% confidence intervals were used to determine which clinical factors were associated with rtPA inclusion.

Results:

Adjusted multivariate analysis demonstrated that within the AIS population, those without HF who received rtPA were more likely to be associated with Hispanic ethnicity (OR = 0.464, 95% CI, 0.247-0.87, P= 0.017), coronary artery stenosis (OR = 0.55, 95% CI, 0.366-0.83, P= 0.004), previous stroke (OR = 0.745, 95% CI, 0.609-0.91, P= 0.004), previous TIA (OR = 1.447, 95% CI, 1.094-1.91, P= 0.010), total cholesterol (OR = 1.487, 95% CI, 1.175-1.88, P= 0.001), lipids (OR = 0.998, 95% CI, 0.996-1, P=0.038), serum creatinine (OR = 0.899, 95% CI, 0.854-0.95, P<0.001), INR (OR = 0.825, 95% CI, 0.73-0.93, P= 0.002), heart rate (OR = 0.13, 95% CI, 0.071-0.24, P<0.001), and direct admission (OR = 2.87, 95% CI, 2.432-3.39, P<0.001). AIS patients with HF who received rtPA were more likely to be associated with increasing age (OR = 0.982, 95% CI, 0.966-1, P= 0.020), coronary artery disease (OR = 0.618, 95% CI, 0.391-0.98, P= 0.040), INR (OR = 0.326, 95% CI, 0.129-0.82, P= 0.018), and ambulatory improvement (OR = 1.69, 95% CI, 1.058-2.7, P= 0.028).

Conclusions:

The results of this study demonstrate that within the AIS population, there are certain clinical risk factors that influence the likelihood of receiving rtPA in patients with and without HF. These findings provide further insight into AIS and HF and suggest the need for further research into the role the identified factors play in influencing clinical outcome.

Keywords: Acute Stroke, Thrombolytics, TPA,

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Grant Support: None.

Poster

Collateral Circulation In Ischemic Stroke Is Not Determined By Anatomical Variants Of The Cerebral Arteries.

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Introduction:

In acute ischemic stroke, collateral circulation determines tissue fate and treatment results. The aim of this study was to evaluate the role of anatomical variations of the Circle of Willis (CoW) in formation of cerebral collateral blood flow in patients with acute M1 occlusion.

Methods:

This study was a retrospective assessment of radiological examinations of patients with stroke due to middle cerebral artery M1 segment occlusion. All patients underwent mechanical thrombectomy from January 2015 until March 2021. The anatomy of the CoW was assessed on initial CT-angiography and DSA. CTA was utilized to grade cranial collateral vasculature status and cortical vein opacification score (COVES). Non-contrast CT scans and ASPECTS scores (using RAPID software) were used to determine the ischemic area.

Results:

A total of 100 patients were included in the analysis (58 females and 42 males, mean age: 71.6 +/- 13.9). We classified the anatomy of the CoW according to its continuity as a full circle. Patients with fully continuous CoW (n=19) had worse COVES scores than those with CoW incomplete at both anterior and posterior portion (n=9) (89% vs 68% with COVES 0-2, p=0.179). No statistically significant results were found when comparing the enhancement of collaterals between these two groups (p=0.390). The COVES scores were similar for patients with complete and incomplete anterior portions of CoW (77% vs 80% with COVES 0-2, p=0.812). Patients with incomplete posterior portions of CoW had lower COVES scores than those with complete (80% vs 67% with COVES 0-2, p=0.206). No statistically significant differences were discovered when comparing different types of the posterior communicating artery (adult, transitional and fetal). Analysis of ischemic areas determined as ASPECTS scores pre- and post-thrombectomy yielded no significant differences between any of the groups.

Conclusions:

Although certain variants of the CoW have been reported to increase the risk of ischemic stroke, our results show that the anatomy of CoW has no large effect on collateral blood flow during acute M1 occlusion. We presume that the greater role is played by pial arterioles than anatomical variants of major cerebral arteries in cerebral collateral circulation formation. Detailed knowledge about the factors that influence collateral blood flow is crucial as it may aid in identification of patients prone to worse outcomes of ischemic stroke. Anatomical variants of CoW do not play a major role in formation of cerebral collaterals.

Keywords: Cerebral Blood Flow, Collateral, Ischemic Stroke, Angiographic Ct

Financial Disclosures: The authors had no disclosures.

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Poster

Comparing Machine Learning Algorithms and Regression Models for Predicting Functional Outcome in the STRATIS Registry

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Introduction:

Machine learning algorithms have emerged as powerful predictive tools in the field of acute ischemic stroke. Here, we examine the predictive performance of a machine algorithm compared to logistic regression for predicting functional outcomes in the prospective Systematic Evaluation of Patients Treated With Neurothrombectomy Devices for Acute Ischemic Stroke (STRATIS) Registry.

Methods:

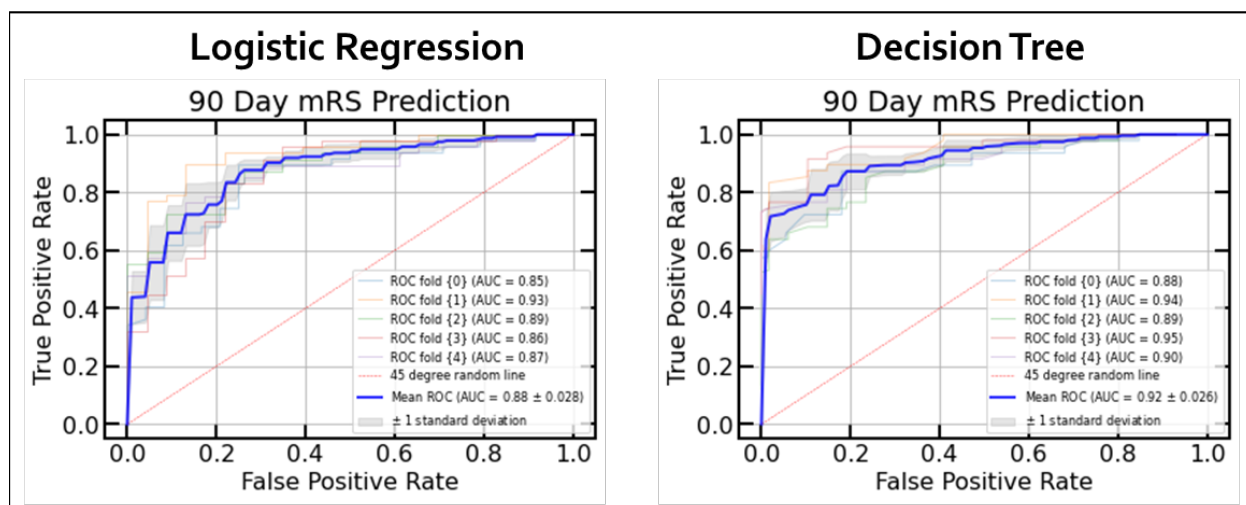
The STRATIS Registry was a prospective, observational study of the use of the Solitaire device in acute ischemic stroke patients. Patients with posterior circulation stroke or missing 90-day mRS were excluded from the analysis. A statistical algorithm (logistic regression) and a machine learning algorithm (decision tree) were implemented on the preprocessed dataset using 10-fold cross-validation method where 80% of the data were fed into the models to be trained and the remaining 20% were utilized in the test phase to evaluate the performance of the models for prediction of 90-day mRS score as dichotomous output.

Results:

Of the 938 STRATIS patients, 702 with 90-day mRS were included. The machine learning model outperformed the logistic regression model with a 0.92 ± 0.026 Area Under Curve (AUC) score compared to a 0.88 ± 0.028 AUC score obtained by implementing logistic regression.

Conclusions:

Our machine learning model delivered improved performance in comparison with the statistical model in predicting 90-day functional outcome. More studies are needed to understand and externally validate the predictive capacity of our machine learning model.



Keywords: Ischemic Stroke

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

Comparison Of Transradial Artery Versus Transfemoral Artery Access Mechanical Thrombectomy At A Comprehensive Stroke Center

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Introduction:

The transradial approach (TRA) is being increasingly adopted by neuro-interventionists and has emerged as an alternative to the traditional transfemoral approach (TFA) for mechanical thrombectomy (MT). We aim to compare various time, technical and outcome parameters in patients who undergo MT via TRF vs. TRA approach.

Methods:

We performed a retrospective chart review of patients who underwent MT at a comprehensive stroke center from 7/2016 to 12/2020. We compared patients who underwent MT via TRA vs. TRF with respect to time from angio suite arrival to puncture, first pass, second pass and recanalization; time from puncture to first pass, second pass and recanalization; time from arrival to the emergency department (ED) to puncture, first pass, second pass and recanalization; the number of passes, rate of switching, achievement of TICl₂ score, functional independence (3-month mRS_{≤2}), 3-month mortality and neurological improvement (improvement in NIHSS by ≥ 4 points) on day 1 and 3. A binary logistic regression analysis was performed, controlling for age, sex, NIHSS, type of anesthesia (general vs. moderate), laterality, and location of clot (internal carotid or middle cerebral artery), ASPECTS ≥ 6 , presenting mean arterial pressure, blood glucose, Hb A1C, LDL, intravenous alteplase.

Results:

217 patients met our inclusion criteria. The mean age was 64.09 $\pm$ 14.4 years. 42 (19.35%) patients underwent MT through the TRA approach. There was a significantly higher rate of conversion from TRA approach to TRF approach (11.90% vs. 2.28%; OR, 105.59; 95% CI, 5.71-1954.67; P 0.002), but no difference in various time, technical and outcome parameters, as shown in the table.

Conclusions:

Our study demonstrates no significant difference between TRA and TRF approaches with respect to various time, technical and outcome parameters, with a notable exception of a significantly higher rate of conversion from TRA to TRF approach.

Variables	TRA Approach N=45	TRF Approach N=172	Multivariate analysis P
Number of Passes [n]	1.8±1.14	1.57±1.06	OR, 0.91; 95% CI,0.66-1.26; P 0.562
Switch to a Different Approach [n (%)]	5 (11.90)	4 (2.28)	OR, 105.59; 95% CI,5.71-1954.67; P 0.002
Time from Angio suite arrival to Puncture (minutes)	31.78±12.54	28.96±13.28	OR, 0.99; 95% CI,0.96-1.03; P 0.524
Time from Angio suite arrival to First Pass (minutes)	99.23±172.3	85.97±119	OR, 1; 95% CI,1-1.01; P 0.292
Time from Angio suite arrival to Second pass (minutes)	90.78±21.16	84.89±29.02	OR, 1.03; 95% CI,0.99-1.06; P 0.191
Time from Angio suite arrival to Recanalization (minutes)	104.67±46.78	107.28±105.74	OR, 1.01; 95% CI,1-1.01; P 0.841
Time from Puncture to First Pass (minutes)	67.45±171.88	52.93±104.48	OR, 1; 95% CI,1-1.01; P 0.238
Time from Puncture to Second pass (minutes)	57.62±19.06	54.68±23.79	OR, 1.02; 95% CI,0.99-1.06; P 0.226
Time from Puncture to Recanalization (minutes)	72.89±41.66	74.37±89.44	OR, 1; 95% CI,1-1.01; P 0.96
Time from ED arrival to Puncture (minutes)	133.09±98.78	180.29±213.86	OR, 1.01; 95% CI,1-1.01; P 0.295
Time from ED arrival to First Pass (minutes)	200.54±195.38	236.96±238	OR, 1; 95% CI,1-1.01; P 0.774
Time from ED arrival to Second pass (minutes)	185.78±47.91	278.29±307.94	OR, 1.01; 95% CI,1-1.02; P 0.316
Time from ED arrival to Recanalization (minutes)	205.98±107.35	258.14±233.77	OR, 1.01; 95% CI,1-1.01; P 0.271
Functional Independence [n (%)]	11 (26.19)	50 (28.57)	OR, 1.21; 95% CI,0.52-2.83; P 0.669
3-Month-Mortality [n (%)]	10 (24.39)	126 (72)	OR, 0.75; 95% CI,0.3-1.89; P 0.54
Neurological Improvement on Day 1 [n (%)]	20 (28.78)	97 (56)	OR, 0.51; 95% CI,0.23-1.1; P 0.085
Neurological Improvement on Day 2 [n (%)]	24 (57.14)	101 (60.12)	OR, 0.59; 95% CI,0.26-1.34; P 0.207
Achievement of TICI score of ≥2b [n (%)]	41 (97.61)	150 (85.71)	OR, 2.21; 95% CI,0.46-10.64; P 0.324
Onset to Recanalization Time (minutes)	461.92±306.13	411.36±262.68	OR, 1; 95% CI,1-1.01; P 0.369

Table: Multivariate Binary Logistic Regression Analysis of patients who underwent Mechanical Thrombectomy via TRA versus TRF approach.

Abbreviation: TRA, Trans Radial Artery; TRF, Trans Femoral Artery; TICI, Thrombolysis in Cerebral Infarction; ED, Emergency Department

Keywords: Mechanical Thrombectomy, Acute Ischemic Stroke Intervention

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

Considering Transcarotid Access for Mechanical Thrombectomy in Acute Ischemic Stroke: A Meta-Analysis and Systematic Review

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Introduction:

Despite the success of mechanical thrombectomy in large vessel acute ischemic stroke, there remain cases where recanalization fails due to difficult anatomic access or peripheral arterial occlusive disease. In these cases, transbrachial or transcarotid access may be considered as alternatives to the transfemoral or increasingly popular transradial route. Of these approaches, the transcarotid route has not gained prominence due to safety concerns despite its prior routine use in angiography. In this study, we conducted a systematic review and meta-analysis of the literature in order to better summate the data on transcarotid access.

Methods:

Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines were used in order to perform a systematic review of articles published from 2010-2020 summarizing pre-intervention characteristics of patients undergoing mechanical thrombectomy via transcarotid puncture. We performed a meta-analysis focused on clinical outcomes, reperfusion times (in minutes), and overall complication rates of transcarotid access for mechanical thrombectomy. Pooled analyses were performed to examine predictors of complications and outcomes.

Results:

Six studies describing 72 patients, out of 80 attempts at carotid access (90% success rate), were included. Age ranged from the 5th to 9th decade (median 7.5). Initial National Institutes of Health Stroke Scale (NIHSS) score ranged from 4 to 28 (median 17). Direct carotid puncture was most often used as a rescue technique (86% of patients) secondary to failed femoral access. Successful recanalization was achieved in 85% of patients. Good 90-day outcome (modified Rankin Scale ≤ 2) was achieved in 27% of patients. Median carotid puncture-to-reperfusion time was 32 minutes (CI = 24–40, $p < 0.001$). Cervical complications occurred at a rate of 23% (CI = 14–35%, $p < 0.001$). Only one complication resulted in a fatal outcome and only one required an intervention (each 1.4%). Use of IV thrombolysis did not significantly predict better mTICI outcome. Complications were not predicted by use of IV thrombolysis or closure method. Carotid puncture as the primary access route was associated with significantly shorter procedure times and carotid puncture as a rescue route was associated with comparable procedure times to the classic femoral access route.

Conclusions:

Our results suggest that, despite current concerns about the use of transcarotid access, this technique can be considered a viable backup route in cases of failed transfemoral or transradial access. Though this method requires further research to better understand the variables that might play into clinical decision-making for its use in acute stroke management, it is a promising area of study that could allow for thrombectomy in patients where it would otherwise be aborted.

Keywords: Acute Ischemic Stroke Intervention, Carotid, Mechanical Thrombectomy, Endovascular Therapy, Interventional Neuroradiology

Financial Disclosures: The authors had no disclosures.

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Poster

De Novo Intracranial Stenosis after Mechanical Thrombectomy with Stent Retrievers

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Introduction:

Increased vascular damage with the use of stent-retrievers (SR) has been shown on histopathological analysis of the vascular tissue immediately after mechanical thrombectomy (MT) in animal models. We hypothesized that intraoperative endovascular damage-intimal injury could result in fibrosis and de novo vascular stenosis (dnVS). The purpose of the study is to identify de novo or worsening intracranial stenosis (wICS) of the treated vessel(s) on patients who underwent MT for the treatment of acute ischemic stroke with SR, on follow-up vascular imaging (FVI).

Methods:

This was a retrospective chart review. Patients who underwent MT with SR at two centers from January 2015-December 2020, who had FVI (CTA, MRA or cerebral angiogram) were included. Patient characteristics, procedural details, timing for FVI and clinical outcomes were collected. Two neuroradiologists reviewed baseline angiograms and FVI to assess for the presence of dnVS or wICS, and graded each stenosis and collateral scores (CS), when stenosis was present. CS were calculated using the multiphase CT angiography collateral score (mCTA). Fischer exact test and Mann-Whitney U test were used to assess for differences in categorical and continuous variables, respectively. Statistical analysis was performed using SPSS 28.0 (IBM Corp.).

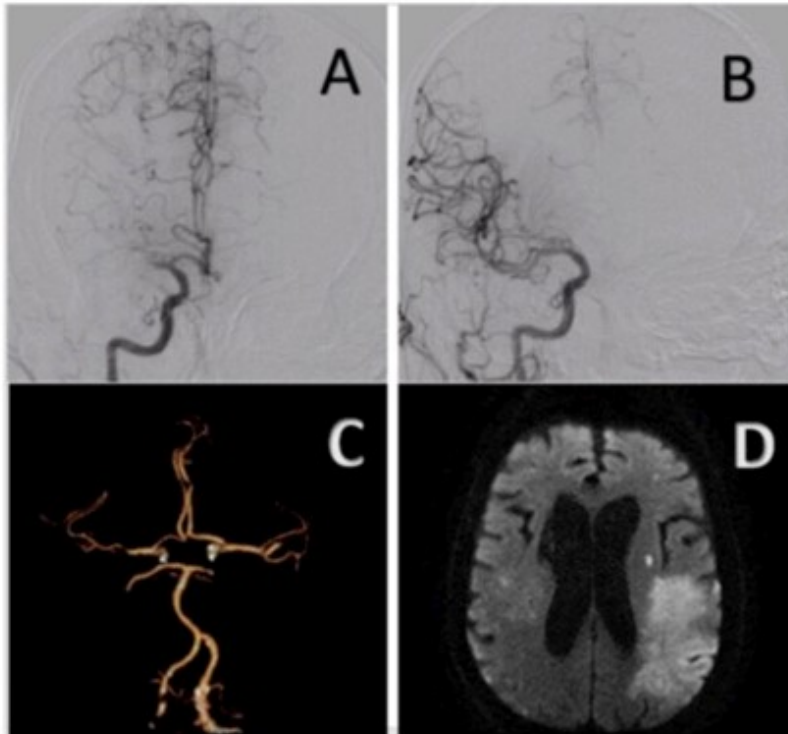
Results:

Forty-six patients within this cohort had FVI with 9 patients developing dnVS or wICS in the follow-up period (19.6%) with a median follow-up of 113 days. Five of these patients demonstrated a complete occlusion of the target vessel on FVI. Of the remaining 4 patients, mean degree of stenosis was 55%. Only 2 of these patients had underlying stenosis on baseline post-treatment angiogram: one with 44% stenosis which progressed to 95% in 2 months. Another with mild stenosis that progressed to complete occlusion in 50 days. Adequate revascularization, defined as TICI score >2b was achieved in 88.8% of patients with dnVS or wICS, and in 89.2% of patients with stable FVI. No significant differences were observed in baseline demographics, NIHSS score at presentation or initial ASPECTS. Median number of passes was identical between patients who developed dnVS or wICS (median 1, IQR [1, 2], p=0.683). Mean CS for dnVS or wICS was 3. No significant differences were observed in discharge or follow-up NIHSS scores, mRS, mortality, or recurrent stroke or TIA between the two cohorts.

Conclusions:

MT with SR can be associated with dnVS or wICS in some patients. The number of passes with SR did not seem to have an impact on this. Patients with dnVS or wICS did not have a higher incidence of recurrent stroke or TIA. This could be due to the development of new collaterals in this population. Our study is limited by a small cohort, however, larger studies might be challenging as standardized radiological follow up of these patients has not been implemented.

Figure 1.



Patient with acute right M1 occlusion on DSA (Fig. A), with no underlying stenosis after successful TICI 3 revascularization with one pass of stent retriever (Fig. B). Follow up CTA 9 months after treatment shows severe stenosis at the distal right M1 segment (Fig. C). Brain MRI during the same time reveals bilateral strokes, mainly on the left hemisphere (Fig. D).

Keywords: Acute Ischemic Stroke Intervention, Stent retriever

Financial Disclosures: Penumbra - Consulting. Cerenovus - Speaker. Siemens - Consulting. Medtronic - Research support, speaker.

Grant Support: None.

Poster

Delays In Care For Patients With Acute Stroke During Hospitalization For Other Reasons

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Introduction:

In-hospital stroke (IHS) is defined as stroke that occurs during hospitalization for non-stroke conditions. We aimed to understand the timing of symptom recognition for patients who experienced IHS and its impact on the care they receive.

Methods:

A prospective, single center registry of adult patients (9/20/19-2/28/21) was queried for acute anterior circulation IHS. Indications for hospitalization, delays from last known well (LKW) to symptom recognition, imaging, and treatment were explored.

Results:

Of 928 consecutively evaluated adults with acute stroke, 85 (9%) developed an anterior circulation IHS, 39 (46%) of whom were female, with a median age of 67 years (IQR 60-76) and median NIHSS of 15 (IQR 4-22). Sixty-eight (80%) had a >1 hour delay from last known well to symptom recognition. Two patients (2%) received IV thrombolysis, although another 38 (45%) would have been eligible if not for a delay in symptom recognition. An ICA, M1, or M2 occlusion was observed in 18 patients (21%), 7 of whom were treated at a median of 174 minutes after LKW (IQR 65-219). Compared to the 11 patients who did not undergo thrombectomy with large vessel occlusion, those who underwent thrombectomy had non-significantly shorter delays from LKW until neuroimaging (median 85 [IQR 65-162] vs. 216 [IQR 133-507], p=0.12).

Conclusions:

While uncommon, patients with IHS experience delays in symptom recognition and treatment, which lead to exclusion from acute care treatment such as thrombolysis and thrombectomy. Earlier detection with more frequent nursing assessments or advanced neuromonitoring devices in at-risk patients may reduce delays in care.

Keywords: Treatment, Acute Ischemic Stroke Intervention

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

Does Intravenous Thrombolysis Promote Delayed Reperfusion After Incomplete Mechanical Thrombectomy?

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Introduction:

The value of intravenous thrombolysis (IVT) in patients eligible for mechanical thrombectomy (MT) remains unclear. We hypothesized that pre-treatment with and/or ongoing IVT may facilitate reperfusion of distal vessel occlusion after incomplete MT. We evaluated this potential association using follow-up perfusion imaging.

Methods:

Retrospective observational analysis of our institution's stroke registry included patients with incomplete reperfusion after MT, admitted between February 1, 2015 and December 8, 2020. Delayed reperfusion (DR) was defined as the absence of a persistent perfusion deficit on contrast-enhanced perfusion imaging ~24h±12h after the intervention. The association between baseline parameters and the occurrence of DR was evaluated using a logistic regression analyses. To account for possible time-dependent associations of IVT with DR, additional stratification sets were made based on different time windows between IVT start time and final angiography runs.

Results:

Among the 378 included patients (median age 73.5, 50.8% female), DR occurred in 226 (59.8%). Atrial fibrillation (aOR 2.53 [95% CI 1.34 - 4.90]), eTICI score (aOR 3.79 [95% CI 2.71 - 5.48] per TICI grade increase), and intervention-to-follow-up time (aOR 1.08 [95% CI 1.04 - 1.13] per hour delay) were associated with DR. Dichotomized IVT strata showed no association with DR (aOR 0.75 [95% CI 0.42 - 1.33]), whereas shorter intervals between IVT start and end of the procedure showed a borderline significant association with DR (OR 2.24 [95% CI 0.98 - 5.43, and OR 2.07 [95% 1.06 – 4.31], for 80 and 100 minutes respectively). Patients with DR had higher rates of functional independence (modified Rankin scale 0-2 at 90 days, DR: 63.3% vs PPD: 38.8%; p<0.01) and longer survival time (at 3 years, DR: 69.2% vs PPD: 45.8%; p=0.001).

Conclusions:

There is weak evidence that IVT may favor DR after incomplete MT if the time interval between IVT administration and end of the procedure is short. In general, perfusion follow-up imaging may constitute a suitable surrogate parameter for evaluating medical rescue strategies after incomplete MT, because a

considerable proportion of patients do not experience DR, and there seems to be a close correlation with clinical outcomes.

Keywords: Acute Ischemic Stroke Intervention, Interventional Neuroradiology, Ct Perfusion, Mr Perfusion, Thrombolytics

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

Does Persistence In Reperfusion Pay Off?

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Introduction:

Reperfusion with mechanical thrombectomy improves outcomes in patients with Large Vessel Occlusion Acute Ischemic Stroke (LVO-AIS). The technical goal of thrombectomy is reperfusion to a modified Thrombolysis in Cerebral Infarction (mTICI) grade $\geq 2b$. Here we investigate if procedures requiring multiple passes to achieve complete reperfusion (MP mTICI 3) result in better outcomes compared to procedures stopped after achieving mTICI 2b-2c on the first pass (FP mTICI 2b-2c).

Methods:

Using data from the COMPLETE registry (a global prospective study of LVO-AIS patients who underwent mechanical thrombectomy using the Penumbra System), we grouped patients into MP mTICI 3 and FP mTICI 2b-2c. Functional independence (mRS 0-2) at 90 days, all-cause mortality at 90 days, device-related serious adverse events (SAE) ≤ 24 hours, procedure-related SAEs ≤ 24 hours, embolization to new or previously uninvolved territories (ENT), symptomatic intracranial hemorrhage (sICH) ≤ 24 hours, vessel perforation, vessel dissection, and length of stay were compared.

Results:

Of the 650 patients in the COMPLETE registry, 215 were included in this subgroup analysis; 111 were categorized as MP mTICI 3, and 104 as FP mTICI 2b-2c. The MP mTICI 3 group has fewer M1 occlusions (48% vs 67%, $p = 0.004$) and more ICA-T occlusions (19% vs. 9%, $p = 0.032$). The groups were otherwise well matched with respect to age, sex, medical history, pre-procedure ASPECTS, NIHSS, IV tPA use, onset-to-puncture time, and occlusion etiology. Outcomes are shown in table 1.

Conclusions:

In this exploratory subgroup analysis, we found that procedures requiring multiple passes to achieve complete revascularization were not associated with improved outcomes compared to procedures stopping after achieving mTICI 2b-2c on the first pass.

Table 1: Outcomes for MP mTICI 3 versus FP mTICI 2b-2c

Outcome, % (n/N) (95% CI)	MP mTICI 3 Group (n = 111)	FP mTICI 2b-2c Group (n = 104)	p-value
Functional independence (mRS 0-2) at 90 days	56.3% (58/103) (46.2%, 66.1%)	57.1% (56/98) (46.7%, 67.1%)	1.0000
All-cause mortality at 90 days	11.7% (13/111) (6.4%, 19.2%)	15.4% (16/104) (9.1%, 23.8%)	0.5496
Device Related SAE ≤ 24 hours	0.9% (1/111) (0.0%, 4.9%)	0.0% (0/104) (0.0%, 3.5%)	1.0000
Procedure Related SAE ≤ 24 hours	4.5% (5/111) (1.5%, 10.2%)	2.9% (3/104) (0.6%, 8.2%)	0.7226
ENT	3.6% (4/111) (1.0%, 9.0%)	0.0% (0/104) (0.0%, 3.5%)	0.1223
sICH ≤ 24 hours	3.6% (4/111) (1.0%, 9.0%)	1.9% (2/104) (0.2%, 6.8%)	0.6841
Vessel Dissection	0.0% (0/111) (0.0%, 3.3%)	0.0% (0/104) (0.0%, 3.5%)	N/A
Vessel Perforation	0.0% (0/111) (0.0%, 3.3%)	0.0% (0/104) (0.0%, 3.5%)	N/A
Length of stay (days), median [IQR]	7.0 [4.0, 12.0]	5.0 [3.0, 10.0]	0.0270

CI, confidence interval; ENT, embolization to new or previously uninvolved territory; IQR, inner quartile range; mRS, modified Rankin Scale; mTICI, modified thrombolysis in cerebral infarction; SAE, serious adverse event; sICH, symptomatic intracranial hemorrhage

Keywords: Ischemic Stroke, Mr Perfusion, Acute Ischemic Stroke Intervention, Hemorrhage

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Grant Support: None.

Poster

Effect of Intravenous Thrombolysis on Early Clot Lysis in Large Vessel Occlusion Strokes Undergoing Thrombectomy

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Introduction:

Intravenous thrombolysis (IVT) and endovascular thrombectomy (EVT) are both standard of care treatments for acute ischemic stroke patients with large vessel occlusion (LVO) who are eligible for one or both treatments. IVT may result in early recanalization in some patients with LVO. The objective of this study is to analyze whether IVT influences pre-thrombectomy clot lysis in LVO acute ischemic strokes.

Methods:

We reviewed prospectively collected data for all patients with LVO ischemic strokes who were transferred to the angiography suite with intention to perform EVT at a single comprehensive stroke center between January 2016 to December 2018. We identified subjects who showed partial or complete clot lysis vs no lysis based on the first angiographic picture of the occluded territory at the time of the initial vessel selection. Descriptive statistics were used to summarize demographic and clinical characteristics. We compared key predictor variables between lysis and no lysis groups including baseline variables, effect of IVT, time from IVT to groin puncture, LVO location, final modified treatment in cerebral ischemia (mTICI) score and discharge Modified Rankin Scale (mRS). t-test or Kruskal-Wallis test for continuous variables and chi square test or Fisher's Exact test for categorical variables.

Results:

Two hundred and fifty-nine patients were included. Among these patients, 10.8% (28/259) showed partial or complete lysis of the clot vs 89.2% (231/259) with no lysis. Among these patients who showed clot lysis, 16/28 (57.1%) received IVT. The use of IVT did not show differences between both groups ($p=0.18$). There were no differences in the baseline characteristics except for gender, which was the only variable significantly associated with clot lysis. Men had 2-fold higher odds of spontaneous lysis compared to females (OR [95%CI]: 2.39 [1.01, 5.65], $p=0.04$). There was significant difference in the final mTICI between both groups ($p < 0.001$).

Conclusions:

Our study showed that IVT in a modern practice was not associated with pre-thrombectomy lysis. Some patients had pre-thrombectomy lysis despite not receiving IVT.

Keywords: Acute Ischemic Stroke Intervention, Mechanical Thrombectomy, Recanalization, TPA,

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

Endovascular Therapy Delay For Acute LVO Is Associated With Worse Functional Outcome And Increased Mortality

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Introduction:

The importance of early mechanical thrombectomy (MT) has shown to improve functional outcomes for patients with acute large vessel occlusion (LVO). As well, prior studies have shown that earlier MT resulted in reduced hospital stay, more home-time, and more desirable living situation in the 90 days after stroke. We hypothesized that delay in MT in patients with LVO would result in worse clinical outcome and increased mortality.

Methods:

We performed a retrospective analysis of consecutive patients who underwent MT for LVO in a large academic comprehensive stroke center between 01/2018 and 05/2021. We compared outcomes including in-hospital mortality and 90-day modified Rankin Scale (mRS) based on time from door-to-puncture and door-to-reperfusion, adjusting for relevant covariates using logistic regression.

Results:

Patients that had shorter door-to-puncture time were found to have higher probability of a lower modified Rankin Scale (mRS 0-2) at discharge ($p=0.03$). Patients with door-to-puncture less than 60 minutes had a probability of 50% of achieving a good outcome. Longer door-to-puncture times were associated with lower probability of achieving mRS 0-2 at discharge. A similar finding was seen in patients that had shorter times to reperfusion ($p=0.05$). Adjusting for age, baseline NIHSS score, and final TICI score, delayed door-to-reperfusion time in minutes was an independent predictor of increased mortality at 90 days of 9% for every 10 minutes delay (OR 1.009, 95% CI 1.003-1.016, $p=0.006$). Every 10 minutes delay in door-to-reperfusion time had 7% higher chance of poor functional outcome at 90 days (OR 1.007, 95% CI 1.004-1.019, $p=0.015$).

Conclusions:

Shorter times to MT and reperfusion impact functional outcome and mortality in LVO stroke patients. This indicates that an adequate hospital protocol and continuous education may lead to faster and more efficient stroke activations leading to a shorter time to MT and eventual reperfusion. Goals of door-to-puncture must be established in order to achieve better outcomes.

Keywords: Acute Stroke, Door To Groin Puncture, Endovascular Therapy, Mechanical Thrombectomy

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

Endovascular Treatment of Acute Extracranial ICA Strokes – A Systematic Review and Pooled Analysis

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Introduction:

Ischemic stroke secondary to acute extracranial internal carotid artery (EC-ICA) occlusion with a concurrent intracranial anterior circulation large vessel occlusion (tandem lesions) account for approximately 20% of all stroke cases. Endovascular management includes acute carotid artery stenting (CAS) with or without balloon angioplasty for pure EC-ICA occlusions and concurrent mechanical thrombectomy (MT) for tandem lesions. In lieu of the scarcity of randomized data and abundance of observational studies, we intend to perform a systematic review and pooled analysis of the data over the past decade to evaluate clinical outcomes, safety and feasibility of endovascular management of acute EC-ICA strokes.

Methods:

Systematic search of the Pubmed, MEDLINE, and EMBASE databases was conducted based on Preferred Reporting Items for Systematic Reviews and Meta Analyses (PRISMA) guidelines. We performed a systematic review of all acute EC-ICA stroke papers (including tandem lesions) published between January 2010 and December 2020. A pooled analysis of the extracted data was performed.

Results:

Data from 1153 patients from 22 studies were pooled and analyzed. Mean age after pooling was 66.9 years, mean NIHSS at admission was 15.9, % IV tPA use before endovascular intervention was seen 56.1% of studies. 82.8% of subjects had a tandem lesion involving both Extracranial and intracranial part of ICA and only 17.2% had a pure and isolated EC-ICA lesion. Angioplasty + stenting (both) was done in 77.6% of cases. Pooling was also done for any and all approaches taken in case of a tandem lesion i.e. antegrade or retrograde. Antegrade approach was taken in 61.7% of cases whereby CAS was performed first followed by MT. Outcome measures were reported as successful recanalization (TICI $\geq$ 2B) in 80.0% of cases, with good outcome (90-day mRS <2) in 49.6% and a mortality rate of 12.9%.

Conclusions:

Our systematic review for endovascular treatment of EC-ICA strokes found a high rate of good outcomes and an impressive rate for recanalization, with low mortality rates. Since these results are from observational, retrospective studies, more rigorous randomized trials are required to establish the best approach.

Keywords: Acute Stroke, Acute Ischemic Stroke Intervention, Carotid Stenting And Angioplasty, Mechanical Thrombectomy,

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

Establishing "Code NI" In Addition To "Code Stroke" is Warranted When Mechanical Thrombectomy Is Needed

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Introduction:

Hospital medical emergencies are prone to inefficiencies related to delayed dissemination of information, communication error, role confusion, and delayed decision making. The use of medical codes is intended to convey emergent and essential information quickly while preventing stress and mismanagement. The more complex, critical, and time sensitive an event is, the greater the need to establish a Code. Major mechanical thrombectomy (MT) trials published in 2015 and 2016 proved emergent MT to be more effective compared to IV tPA in stroke patients with large vessel occlusion (LVO). It has been proven that time to reperfusion with MT is directly proportional to severity of patient outcomes, coining the phrase, "save a minute, save a week". When compared to the use of percutaneous intervention (PCI) in the treatment of STEMI, the number needed to treat for MT is estimated at 5 compared to 16 for PCI. Despite this fact, most hospitals have yet to adopt a code specific to MT. Our Purpose is to emphasize the importance of establishing a dedicated Code NI (Neuro-Intervention) for stroke patients who require MT by sharing our

Methods:

After defining the problems, measuring the need, and analyzing the process, we identified the urgency for improvements in our facility. The administration was persuaded to support us in implementation of improvements after realizing the success of MT trials in patient outcomes, length of stay, hospital rankings, Comprehensive Stroke Center Certification, and insurance company compensation.

Results:

In early 2018, after many presentations and meetings, it was decided to implement "Code NI" for acute stroke patients who met MT criteria. Many teams and individuals including Neurointervention, Neuroradiology, Angio Suite, Anesthesia, ICU, Bed management, and transport were alerted. Following these implementations, from 2018 to 2021, our Door to Puncture Time and Puncture to Recanalization Time has been trending down from 219 to 120; and 261 to 147 minutes respectively.

Conclusions:

Approximately 70% of stroke patients with LVO have the potential of a meaningful recovery if treated efficiently and effectively. Establishing a "Code NI" for this time sensitive medical emergency helps the patients, their families, hospitals, and society.

Keywords: Interventional Neuroradiology

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

Experiences And Strategies Developing An Evidence-based Clinical Guideline for Ischemic Stroke In A Middle-income Setting.

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Introduction:

Developing an evidence-based clinical practice guideline in a middle-income country is challenging. After a discussion with the stakeholders, we identified and prioritized the need for a clinical guideline about ischemic stroke in our country. We defined stakeholders to anyone who has an interest in the recommendations of the guideline, including patients' representatives, practitioners, policy/decision makers, commissioners of guidelines and other end users.

Methods:

We developed an evidence-based guideline using the Grades of Recommendation, Assessment, Development, and Evaluation System (GRADE) approach with a multidisciplinary team including independent methodologists, local and international clinical experts. Systematic step-by-step search strategy was used. Four clinical guidelines were identified, quality of development of these guidelines was evaluated using the Appraisal of Guidelines for Research & Evaluation (AGREE II) tool. In the absence of a systematic review in the guideline to answer the clinical question, we proceeded to search for primary studies. The certainty of evidence was classified according to the GRADE system, as high, moderate, low, and very low. Recommendations were classified according to strength, as strong or conditional, and to direction, as in favor or against. Applicability and acceptability were evaluated by the stakeholders and patient's representatives. External validation by national and international experts in the field was performed.

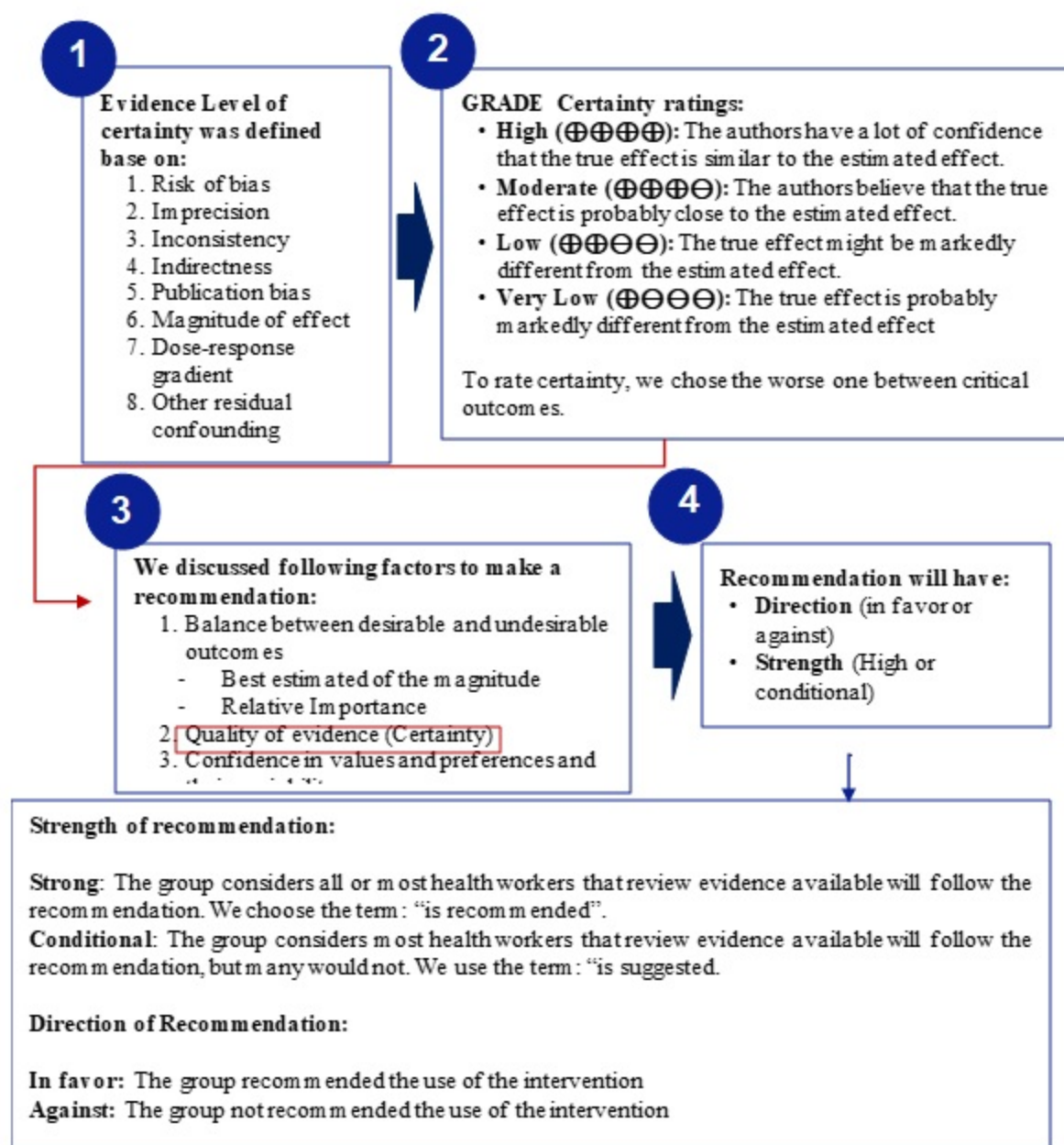
Results:

Eight clinical questions related to diagnosis, management, and early rehabilitation for ischemic stroke were formulated. Evidence from systematic reviews and meta-analysis for every clinical question was discussed, an update was made when needed, and finally, twenty-eight trustworthy recommendations (8 strong and 20 conditional) were developed. Also, thirty-eight good practice points and two flowcharts were developed.

Conclusions:

In a setting with limited resources a high-quality clinical guideline could be developed using good quality data from the systematic reviews found in previous guidelines. The GRADE approach could be very useful to contextualize the available evidence, making the process feasible and efficient.

Figure 1. Evidence Level of Certainty and Strength of recommendation



Keywords: Acute Ischemic Stroke Intervention, Stroke, Treatment

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Grant Support: None.

Poster

Factors Affecting Door To Recanalization Times At A Comprehensive Stroke Center

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Introduction:

Timely recanalization is strongly associated with functional independence in patients who undergo mechanical thrombectomy (MT) for a large vessel occlusion (LVO). The American Heart Association recommends Door to Recanalization/Reperfusion (DTRp) time of ≤ 120 minutes. We aim to identify factors associated with a delayed DTRp at a comprehensive stroke center (CSS).

Methods:

We performed a retrospective chart review of patients who underwent MT for an anterior circulation LVO at a CSS from 7/2014 to 12/2020. We compared various presenting variables and technical parameters between patients who achieved DTRp in ≤ 120 minutes vs. ≥ 120 minutes. A binary logistic regression analysis was performed, controlling for age, sex, NIHSS, presenting mean arterial pressure (MAP), presenting serum calcium level, Hb A1C, LDL, intravenous alteplase, left hemispheric location, location of the clot (internal carotid artery vs. middle cerebral artery), $\geq 50\%$ ipsilateral stenosis, ASPECTS ≥ 6 , general anesthesia, transradial approach, number of passes, arrival to the emergency department on night shift (7 pm to 7 am) and on weekends.

Results:

217 patients met our inclusion criteria. The mean age was 64.09 ± 14.4 years. In our cohort, arrival on weekend (66.84% vs. 4.76%; OR, 0.02; 95% CI, 0.01-0.37; P 0.012), higher serum calcium level (9.02 ± 0.62 mg/dL vs. 8.4 ± 0.9 mg/dL; OR, 6.7; 95% CI, 1.77-25.31; P 0.005), left hemispheric occlusion (52.55% vs. 14.29%; OR, 0.05; 95% CI, 0.01-0.33; P 0.002), general anesthesia (81.67% vs. 61.90%; OR, 0.16; 95% CI, 0.03-0.81; P 0.026), higher presenting MAP (105.33 ± 21.05 vs. 91.93 ± 10.79 ; OR, 1.1; 95% CI, 1.03-1.17; P 0.004) and female sex (47.96% vs. 33.33%; OR, 5.61; 95% CI, 1.09-28.87; P 0.039) were associated with DTRp of ≥ 120 minutes.

Conclusions:

Parameters of arrival on the weekend, higher serum calcium level, higher MAP, left hemispheric occlusion, use of general anesthesia, and female sex were associated with DTRp of ≥ 120 minutes.

Variables	DTRp of ≤120 minutes N=21	DTRp of ≥120 minutes N=196	Multivariate analysis P
Age	63.29±13.69	64.18±14.5	OR, 1; 95% CI,0.95-1.05; P 0.818
Sex [female, n (%)]	7 (33.33)	94 (47.96)	OR, 5.61; 95% CI,1.09-28.87; P 0.039
NIHSS	14.72±4.32	15.03±5.8	OR, 0.95; 95% CI,0.81-1.1; P 0.427
Hemoglobin A1C (%)	5.88±0.89	6.26±1.52	OR, 1.02; 95% CI,0.51-2.07; P 0.96
Presenting Mean Arterial Pressure (mm Hg)	91.93±10.79	105.33±21.05	OR, 1.1; 95% CI,1.03-1.17; P 0.004
Low Density Lipoprotein (mg/dL)	84.1±31.26	90.79±35.83	OR, 0.99; 95% CI,0.97-1.01; P 0.241
Presenting Serum Calcium Level (mg/dL)	8.4±0.9	9.02±0.62	OR, 6.7; 95% CI,1.77-25.31; P 0.005
ASPECTS ≥6 [n (%)]	18 (85.71)	165 (84.61)	OR, 0.62; 95% CI,0.09-4.32; P 0.621
ICA Location [n (%)]	3 (14.29)	48 (24.49)	OR, 0.17; 95% CI,0.02-1.47; P 0.105
Left hemispheric Occlusion [n (%)]	3 (14.29)	103 (52.55)	OR, 0.05; 95% CI,0.01-0.33; P 0.002
Presence of ≥50% Ipsilateral Stenosis [n (%)]	4 (19.04)	61 (31.12)	OR, 0.6; 95% CI,0.12-3.21; P 0.55
Administration of IV-rtPA [n (%)]	11 (55)	95 (50)	OR, 0.3; 95% CI,0.07-1.36; P 0.115
Trans-Radial Approach [n (%)]	5 (23.81)	40 (20.41)	OR, 3.11; 95% CI,0.35-28.24; P 0.314
Number of Passes [n]	1.43±0.6	1.64±1.12	OR, 1.87; 95% CI,0.91-3.84; P 0.089
Use of General Anesthesia[n (%)]	13 (61.90)	156 (81.67)	OR, 0.16; 95% CI,0.03-0.81; P 0.026
Arrival to ED in Night Shift [n (%)]	3 (14.29)	61 (31.94)	OR, 0.5; 95% CI,0.1-2.71; P 0.418
Arrival on Weekend [n (%)]	1 (4.76)	131 (66.84)	OR, 0.02; 95% CI,0.01-0.37; P 0.012

Table: Multivariate Binary Logistic Regression Analysis of patients with DTRp of ≤120 minutes and ≥120 minutes.

Abbreviation: DTRp, Door to Recanalization/Reperfusion; ED, Emergency Department, IV-rtPA, Intravenous Alteplase; NIHSS, National Institutes of Health Stroke Scale.

Keywords: Endovascular Therapy, Treatment

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

Factors associated with the Delayed Door to Puncture Time for the Basilar Artery Occlusion patient

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Introduction:

Performing mechanical thrombectomy (MT) in patients with basilar artery occlusion (BAO) is currently not evidence-based. In the real-world practice, it is also often encountered that the delayed initiation of the MT happens for this particular patient groups due to lack of cortical signs and other medical confounding factors.

Methods:

We retrospectively analyzed the angiographical and clinical outcomes of consecutive BAO patient who underwent MT in single institution. Onset to treatment (OTT), Door to Puncture (DTP) time were compared with those in anterior circulation large vessel occlusion (ACLVO) group who underwent MT in the same time period. For those showed significantly longer DTP time, the factors associated with the delayed initiation of the MT were analyzed.

Results:

A total of 271 patients underwent mechanical thrombectomy at UCI Medical Center between Jan 2016 and June 2021. Of these, 32 patients diagnosed as BAO by CTA and underwent MT were included in the study. Successful recanalization was achieved in 28 cases (87.5%), and symptomatic ICH occurred in 3 cases (9.4%). Nine patients (28.1%) showed good clinical outcomes (mRS 0-3) at 3 months. The median Onset to Puncture Time (OTT) was 340 min. The median DTP time (145 min) was significantly longer as compared to the ACLVO patients (99 min) (p value = 0.04). Of the 6 patients who showed significant delay in the initiation of intervention (DTP>300 min), 5 patients (83.3%) did not have the initial “stroke-code activation” at the time of ED arrival. The cause of the delay was due to lack of cortical sign (3), bilateral spontaneous sustained clonus, which misinterpreted as seizure (1), AMS with non-focal neurological signs interpreted as encephalopathy (2).

Conclusions:

DTP of the patients who underwent MT for BAO was significantly longer than that in ACLAO. Lack of cortical signs which are markers of ACLVO were associated with delayed activation of stroke code. Establishment of BAO screening in the ED assessment and prompt activation of Stroke code may contribute to the improvement of MT treatment for the BAO patients.

Keywords: Acute Ischemic Stroke Intervention, Door To Groin Puncture, Basilar, Care

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

Failure of Tenecteplase in Maintaining Collateral Circulation in Large Vessel Occlusion Strokes.

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Introduction:

Acute administration of alteplase with collateral patency has been systematically evaluated in acute ischemic stroke (AIS) patients. Large studies evaluating alteplase demonstrate a significant association of successful recanalization (TICI score) and good clinical outcome (mRS) with ASITN/SIR collateral grade greater than 2. However there is paucity of data looking at the association between IV tenecteplase (TNK) and acute collateralization. Our objective was to investigate early TNK use association for the degree of collateralization in subjects with AIS secondary to large vessel occlusion (LVO).

Methods:

Collateralization was assessed on digital subtraction angiography using the American Society of Intervention and Therapeutic Neuroradiology/Society of Interventional Radiology (ASITN/SIR) scale. Grades were defined by the following: 0 no collaterals to ischemic region; 1 slow collaterals peripherally; 2 rapid collaterals peripherally; 3 slow collaterals within ischemic region; 4 complete retrograde perfusion to ischemic region. Subjects with LVO undergoing mechanical thrombectomy status post TNK as part of the pilot early clinical use of TNK within 4.5 hours of last known well were assigned a grade. Mean ASITN/SIR collateral grade was determined. Spearman's rho was used to measure association of collateral grade with thrombolysis in cerebral infarction (TICI) score. Patients with TNK-associated recanalization at time of cerebral angiogram were excluded from study. Social Science Statistics was used for data analysis.

Results:

From October 2020 to April 2021, 16 subjects (6 females; age, 63.25 95% CI [54.9207, 71.5793]) received TNK and underwent mechanical thrombectomy. From those subjects, 25 % (n=4) had IV TNK-associated recanalization with normalization of collateral blood flow and were excluded. Of the rest (n=12, 75%) had a mean ASITN/SIR collateral grade of 1.08 (95% CI [0.5762, 1.5838]). Association between collateral grade and final TICI score was not statistically significant (rs = -0.33576, p = 0.28598) suggesting inability of TNK to result in/maintain a robust collateral flow.

Conclusions:

Poor correlation of collateral grade and final TICI score may have implications of faster progression in patients with ischemic stroke receiving TNK in the setting of LVO if immediate recanalization is not achieved. Larger prospective studies are needed to evaluate the effect of TNK on collateralization when compared to Alteplase.

Keywords: Acute Stroke, Collateral, Endovascular, Thrombolytics, TICI

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

Feasibility of Successful Mechanical Thrombectomy of Large Vessel Occlusion Stroke due to Calcified Emboli: Technical Note

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Introduction:

Clot composition has been identified as a predictor of successful recanalization in mechanical thrombectomy (MT). Emboli with high calcium content may affect the extraction ability of thrombectomy devices. We aimed to evaluate the recanalization rates of calcified emboli in patients with large vessel occlusion (LVO) who underwent MT.

Methods:

A prospectively maintained MT database from January 2019 to June 2021 was reviewed. We included patients with LVO in whom a calcified embolus was identified. The primary outcome was successful reperfusion (eTICI2B50-3) at the end of the procedure. Secondary outcome included rates of dramatic clinical improvement at discharge defined as an improvement of NIHSS score ≥ 10 points or to 0-2. Safety measures included procedural complications and rates of symptomatic intracranial hemorrhage (SICH).

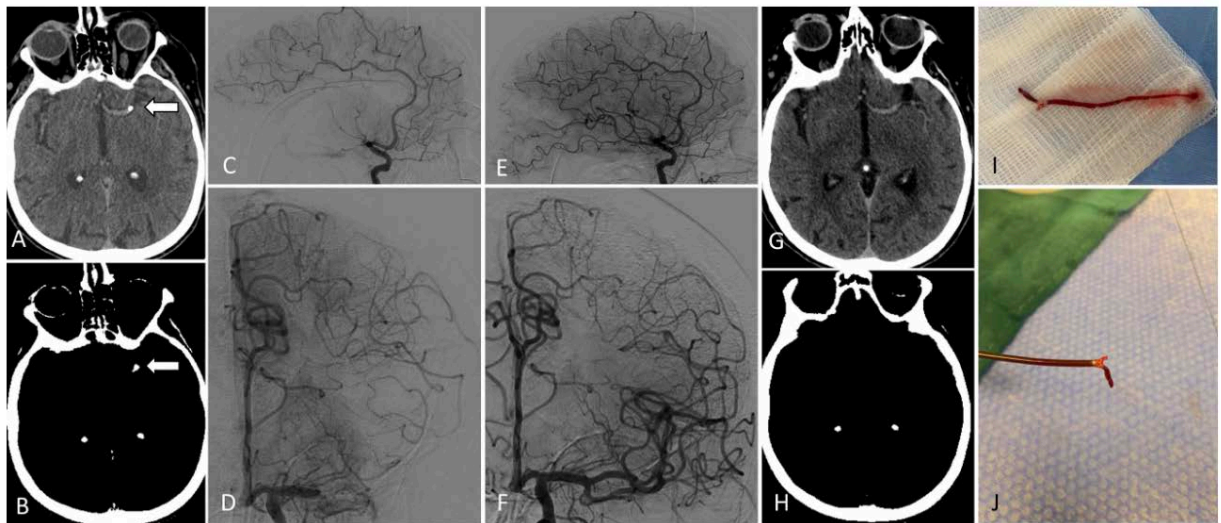
Results:

Seven patients (age, ~57-89 years; sex, 5 females; baseline NIHSS, ~6-27) were identified. Six patients had anterior circulation occlusion (four MCA-M1, one MCA-M2, and one case with ICA occlusion) whereas, one patient had basilar artery occlusion. The thrombus attenuation ranged from 122.5 to 457 Hounsfield unit, and only two patients had preprocedural IV-tPA administration. All procedures were performed under monitored anesthesia care with procedural duration ranged from 22 to 240 minutes and 1 to 7 MT passes. Successful recanalization was achieved with aspiration thrombectomy alone (two cases) or combined with stent-retriever (three cases) whereas two cases underwent rescue intracranial stenting. There were no reported intraprocedural complications or SICH. Dramatic clinical improvement was achieved in 3/7 (43%) cases. One patient expired at discharge from non-stroke-related causes.

Conclusions:

Even though calcified thrombi are associated with longer procedure time and a higher number of passes, our case series demonstrates a favorable safety profile for aggressive treatment of this condition including rescue stenting when necessary. Specifically, there were no cases of SICH or procedure-related mortality. Successful recanalization can be achieved in the majority of these patients with rates of dramatic improvement in nearly half of cases.

Figure Legend shows (A&B) axial cuts in NCCT with calcified emboli ($HU=284.25\pm7.6$) in left MCA-M1 (arrow). Lateral and anterior-posterior views for the baseline angiography showing complete occlusion of the distal MCA-M1 segment (C&D). Final angiography, lateral and anterior-posterior views show successful recanalization (eTICI2C) (E&F). Axial cuts in post-procedural NCCT (G&H) demonstrate the absence of calcified embolus (I&J).



Keywords: Acute Stroke, Mechanical Thrombectomy, Recanalization

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

First-in-Human Experience Using the Millipede 088 Aspiration Catheter in Stroke Thrombectomy

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Introduction:

Studies have suggested that closely matching the catheter size to the vessel size may improve the effectiveness of clot aspiration in stroke thrombectomy. A new category of “super-bore” aspiration catheters with 8Fr OD and 0.088in ID has recently been developed to further improve reperfusion success. In this work we report on early clinical experience using a CE Marked device called Millipede 088 developed by Perfuze (Galway, Ireland).

Methods:

The clinical, procedural, and radiological data were reviewed for consecutive cases in which Millipede 088 was used. Millipede 088 was navigated to the target vessel over a 6F intermediate catheter with or without a microcatheter and microwire, at the discretion of the physician. Performance was evaluated in terms of successful intracranial navigation and reperfusion measured using the mTICI scale.

Results:

Ten patients (age 55-89 years, 50% male) with intracranial large vessel occlusions (LVOs) were treated - 4 ICA and 6 M1 LVOs. In two cases, the patients had concomitant tandem lesions requiring additional treatment. Millipede 088 was delivered intracranially in all cases, and to the target vessel in 8 cases. In two cases in which Millipede 088 was not advanced to the target vessel, it was placed intracranially for distal flow control, and an intermediate catheter was used for clot aspiration. In one case, following mTICI 2b reperfusion after aspiration, a stentriever was deployed via Millipede 088 to retrieve a distal M2 clot. Excellent reperfusion (mTICI 2c-3) at the end of the procedure, was achieved in all (100%) of patients. First-pass mTICI 2c-3 was achieved in 5 patients (50%). No sICH or other complications were reported.

Conclusions:

In this first in man experience, aspiration thrombectomy using the Millipede 088 proved to be technically feasible and safe. Excellent reperfusion was achieved in all patients. The Millipede 088 represents a promising option for stroke thrombectomy.



Keywords: Acute Ischemic Stroke Intervention, Endovascular Therapy, New Innovation, Mechanical Thrombectomy, TICI

Financial Disclosures: Stockholder

Grant Support: None.

Poster

First-Line Direct Contact Aspiration Versus Stent-Retriever Technique: Real-World Comparative Outcomes for Successful Mechanical Thrombectomy

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Introduction:

Mechanical thrombectomy for large-vessel acute ischemic stroke has been adopted as the standard of care treatment across the world, with dramatic improvements in long-term functional outcomes for an otherwise debilitating disease process. Timely and complete recanalization are paramount in achieving good outcomes. Though several revascularization techniques have been described, direct contact aspiration and clot removal via stent-retriever remain the foundation of endovascular stroke therapy. Utilizing the NeuroVascular Quality Initiative – Quality Outcomes Database (NVQI-QOD), we present our data on real-world, first-line practice for treatment of large vessel occlusions (LVOs), and compare angiographic and clinical outcomes between direct contact aspiration and stent-retriever mechanical thrombectomy techniques.

Methods:

Retrospective analysis of the NVQI-QOD was performed. We included patients with LVOs that underwent mechanical thrombectomy who were older than 18 and whose baseline NIHSS ≥ 6 . We compared procedural times, rate of revascularization, and outcomes, including in-hospital mortality and discharge NIHSS.

Results:

We identified a total of 2381 patients who met the inclusion criteria, of which 998 (41.9%) underwent treatment with direct contact aspiration alone and 1383 (58.1%) underwent treatment utilizing a stent-retriever (with or without local aspiration). There were no significant differences in the baseline median NIHSS scores (16 vs 17, $p = 0.25$) or baseline median ASPECTS scores (9 vs 9, $p = 0.7$). No significant difference was seen in time metrics, including last known well to puncture (282 min vs. 280 min, $p = 0.22$) or recanalization (323 min vs. 322 min, $p = 0.39$), ED to puncture (75 min vs. 71 min, $p = 0.25$) or recanalization (158 min vs. 160 min, $p = 0.55$), or median procedure times between the two groups (23 vs 23 min, $p = 0.64$). The median number of passes required for recanalization was lower in the direct aspiration group (1 vs 2, $p = 0.01$). Though there was no difference in successful recanalization (TICI 2B-3) between the two groups (86.1% vs 88%, $p = 0.71$), there was a lower rate of complete recanalization (TICI 2C-3) in the direct aspiration group (46% vs 51.7%, $p = 0.007$). There was also a lower rate of adjunct treatments (defined as the use of GP IIb/IIIa inhibitors, P2Y12 inhibitors, and/or salvage angioplasty and/or stenting) required in the direct contact aspiration group (36.1% vs 44.4%, $p < 0.001$). There were no differences noted in discharge NIHSS scores (5 vs 4, $p = 0.21$) or in-hospital mortality (22.2% vs 22.5%, $p = 0.92$).

Conclusions:

In the NVQI-QOD, stent-retriever techniques were associated with higher rates of complete recanalization when compared to direct contact aspiration alone, although acceptable (TICI 2B-3) recanalization rates were similar. There were no statistically significant differences in procedure times or clinical outcomes at discharge.

Keywords: Acute Ischemic Stroke Intervention, Mechanical Thrombectomy, Stent retriever

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

Function of Proteins Predictive of Infarct Volume in Mechanical Thrombectomy Subjects

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Introduction:

Emergent Large Vessel Occlusion (ELVO) strokes are devastating ischemic vascular events which can cause severe and permanent impairment. The purpose of this study is to investigate protein-protein interactions at the time of mechanical thrombectomy (MT) which correlate to infarct volume. Uncovering functions of protein-protein interactions involved in infarct volume will allow for biomarker discovery and potential therapeutic targets.

Methods:

The Blood And Clot Thrombectomy Registry And Collaboration (BACTRAC) is a continually enrolling tissue bank (clinicaltrials.gov NCT03153683) from stroke patients undergoing MT. N=61 human carotid plasma samples were analyzed for inflammatory and cardiometabolic protein expression by Olink Proteomics. To determine which proteins had the most significant changes based on infarct volume, a series of 184 paired t-tests were performed. Within each panel, proteins were then ranked based on the associated p-values. Benjamini and Hochberg's linear step-up procedure was used to control the false discovery rate at 0.05. Pearson correlation revealed proteins which were most significantly related to infarct volume. STRING analysis was used to identify protein-protein network and biologic functions.

Results:

Systemic proteins most predictive of infarct volume included adenosine deaminase (ADA), monocyte chemotactic protein 1 (MCP1), eukaryotic translation initiation factor binding protein (EBP1), Nidogen-1 (NID1), CD40, and leukemia inhibitory factor receptor (LIFR). All correlations between each protein and infarct volume were positive in directionality and were statistically significant with p-values less than 0.05. STRING output demonstrated relevant biological functions including 'positive regulation of signal transduction,' 'cytokine mediated signaling,' 'positive regulation of NFkB transcription factor activity,' and 'tumor necrosis factor signaling pathways.'

Conclusions:

This study identified proteins predictive of infarct volume at time of MT in ELVO patients. LIF is a cytokine in the IL-6 family that has been shown to play a role in inflammation and ischemia. ADA deaminates adenosine, which inactivates its neuroprotective property in acute cerebral ischemia. Higher levels of circulating MCP1 have been shown to be associated with increased risk of stroke. These proteomic signaling networks and functions inform the biochemical picture involved in the pathogenesis and outcome of cerebral ischemia. Importantly, these proteins serve as biomarker candidates and possible therapeutic targets.

Keywords: Ischemic Stroke, Endovascular

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

Fluoxetine for recovery after stroke: A pooled analysis of 7165 patients

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Introduction:

Stroke is one of the predominant causes of permanent disability, mortality, significant cognitive, physical, and psychosocial morbidity in the world. We conducted this systematic review and meta-analysis to assess the safety and efficacy of fluoxetine for recovery stroke patients through different time points of follow up.

Methods:

We searched in PubMed, Cochrane Library, Scopus, and Web of Science databases/ search engines until June 2021. Mean difference (MD) with 95% confidence interval (CI) was applied for continuous data, while risk ratio (RR) with 95% CI was used for dichotomous data.

Results:

Seventeen randomized clinical trials were identified which assessed the safety and efficacy of fluoxetine compared to placebo for stroke patients. Fluoxetine enhances the National Institutes of Health Stroke Scale (NIHSS) score [MD = -0.67, 95 % CI (-1.19 to -0.15), P = 0.01] and the Fugl-Meyer Motor Scale (FMMS) score [MD= 17.36, 95 % CI (12.12 to 22.61), P < 0.00001] at three months follow up. However, the NIHSS score showed no significant difference between the two groups at two weeks [MD= -0.32 , 95% CI (-0.72 to 0.07), p=0.11] or at six months [MD= -0.17 ,95% CI (-0.47 to 0.14), p=0.29]. Fluoxetine and placebo-treated patients had the same overall impact on FMMS scores at one month [MD=7.77, 95 % CI (-10.57 to 26.11), P = 0.41]. The fluoxetine arm had a higher risk of broken bone (RR = 2.30, 95% CI [1.59, 3.32], p < 0.001) and hyponatremia (RR = 2.12, 95% CI [1.19, 3.76], p= 0.01) with lower risk of new depression (RR = 0.72, 95% CI [0.61, 0.84], p< 0.001) in comparison to the placebo arm.

Conclusions:

The efficacy of fluoxetine is likely to take time to emerge, and is expected to be transient. The use of fluoxetine increased the incidence of hyponatremia and bone fractures while decreasing the risk of new-onset depression.

Keywords: Acute Stroke

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

Hemorrhagic Conversion In Patients Undergoing MT With Concurrent IA tPA With Or Without IV tPA/Anticoagulation

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Introduction:

Introduction There is a growing body of literature on concurrent use of MT and IA tPA use in acute large vessel occlusion ischemic stroke, but few address the risk of IA tPA use in patients also receiving IV tPA or baseline anticoagulation^{1,2,3}. This cohort study aims to assess the rate of improved functional outcome and complications in patients receiving MT plus IA tPA with or without IV-tPA or baseline anticoagulation.

Methods:

In this single institution, retrospective cohort study, medical records of 114 patients undergoing MT who received concurrent IA-tPA were identified and reviewed. Parameters such as age, sex, admission/discharge mRS scale and NIHSS score, INR, history of anticoagulation use, concomitant IV-tPA and complications such as any hemorrhage and in hospital death were reviewed. Patients were divided into two groups and two subgroups. First group included patients treated with IA-tPA who also received IV-tPA, had an INR above 1.7 or were on anticoagulation therapy. The second group was composed of patients who only received concurrent IA-tPA. The primary outcomes were hemorrhage, all cause mortality, and good functional outcome (modified Rankin scale equal to or less than 2). The results were calculated and t-test for two samples analysis was conducted with one-tail p-value (<0.05).

Results:

74 patients were included in the first group receiving IA-tPA with either IV-tPA, or elevated INR or anticoagulated while 40 patients were in the only concurrent IA-tPA group. 72% versus 60% of the groups respectively have an mRS less or equal to 2 on discharge, p-value 0.07. 41% of the first group had some type of bleeding on repeat imaging compared to 25% in the IA-tPA only group, p-value 0.03. In a subgroup analysis, IV-tPA alone without prior anticoagulation treatment or an elevated INR, when given in conjunction with IA-tPA, was an independent risk factor that increased rate of bleeding, 42% versus 25% with a p-value of 0.04 with an attributable risk of 32%. There was no difference in in-hospital death rate between the groups.

Conclusions:

This study shows that in patients receiving MT with concurrent IA tPA with elevated INR>1.7, treatment with anticoagulation at baseline, or concomitant IV-tPA use increases the risk of hemorrhagic conversion. Therefore, there is a need for careful selection of patients receiving concurrent IA-tPA. Further investigation is warranted to elucidate which patient groups might maximally benefit from IA-tPA.

Keywords: Endovascular, TPA, Hemorrhagic Transformation, Mechanical Thrombectomy, Acute Ischemic Stroke Intervention

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

High School Student Stroke Awareness in Rio De Janeiro

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Introduction:

The ultimate purpose of this study was to assess the extent of stroke awareness within high school students in several countries in Latin America. Stroke awareness and prevention is the best way to minimize the risks of a stroke. Strokes resulted in 195,661 deaths in 2016 in high-income regions within North America. In Brazil alone, there were 107,258 deaths by stroke in 2016 that could have been caused by improper treatment and lack of awareness.

Methods:

The focus of the study quickly shifted to within Brazil, due to its concerning status. Quantitative data provided by secondary and primary research through an anonymous survey shows a critical need for more awareness in high school students. A Google Form survey was conducted in 2020 with various multiple choice, checkbox, and multiple-choice grid questions on 124 high school students in Brazil was passed out through several students in the area. Of these students, 83% were from a private high school with excellent academics, student life, and club activities, in the city of Rio de Janeiro. The impact of Covid-19 has resulted in fewer responses from schools and officials as many were not taking any messages, making it difficult to attain survey responses.

Results:

Regardless, 26.61% of all survey participants were unaware of what a stroke is, and a majority thought it had to do with the heart. Less than half of the participants knew what FAST stood for, a well-known acronym for identifying symptoms of a stroke. Even if a student identified a stroke, 25% did not know that the first step is calling an emergency hotline, crucial knowledge that could lead to a decrease in the high rate of stroke deaths. When asked where their knowledge of strokes came from, further concerns arose with more than half learning from social media, 12.39% not knowing anything, and 6.45% even citing Grey's Anatomy, a popular television series. Only 37.1% of participants got any of their knowledge on stroke from the news and less than half learned from a credible source, such as their school.

Conclusions:

Lack of education about stroke among a significant number of students in Rio de Janeiro may lead to an increase in the number of stroke deaths that could have been prevented had communities been educated. The research marks the beginning of an ongoing assessment that will expand to all of Latin America. The assessment will reveal the extent of stroke awareness among the youth in the entire region and may provide a blueprint for educating them, ultimately improving the treatment rates for stroke in the region.

Keywords: Stroke, Ischemic Stroke

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

Histological Composition of Large Vessel Occlusion Stroke-Causing Thrombi to Identify Etiologies: Systematic Review and Meta-Analysis

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Introduction:

More than a third of large vessel occlusion ischemic strokes do not have clear etiology. Mechanical thrombectomy provides a method to retrieve stroke-causing thrombi and potentially identifying the etiology. A systematic meta-analysis is performed to determine if there is a histological difference in red blood cell (RBC) composition of thrombi after the etiology of the stroke is known.

Methods:

We performed a systematic search through PUBMED and EMBASE. Studies meeting inclusion criteria were identified in which the large vessel occlusion stroke-causing thrombi histology and etiology of the stroke were determined as either large artery atherosclerotic (LAA), cardioembolic (CE) or cryptogenic. Studies that had the data available or extractable data were selected. Random-effect models were used to compare the histological difference between each etiology.

Results:

From inception to August 2021, 4 studies (n=1022) were used to compare CE vs LAA, 5 studies (n=1247) were used to compare CE vs cryptogenic and 4 studies (n=654) were used to compare LAA vs cryptogenic. There was no significant difference in the red blood cells vs white blood cells/fibrin/platelets component between the stroke origins of CE vs LAA (mean difference (MD) -1.87; 95% confidence interval [CI]: -16.51, 12.78), CE vs cryptogenic (MD 1.18; 95% CI: -1.49, 3.86) and LAA vs cryptogenic (MD 7.20; 95% CI: -3.93, 18.34).

Conclusions:

There was no significant gross histological difference between CE, LAA and cryptogenic stroke etiologies and of the large vessel occlusion stroke-causing thrombi retrieved by mechanical thrombectomy. Further studies into biochemical or genetic markers may be needed to identify stroke etiology.

Keywords: Mechanical Thrombectomy, Acute Stroke, Ischemic Stroke, Atherosclerosis, Embolization

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

Histology Profiles of Thrombi In Men and Women Undergoing Thrombectomy

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Introduction:

Understanding clot composition and associated genomic, epigenomic, and proteomic signatures could provide insight into thrombus biology and etiology, and aid in prognosis in stroke. We report preliminary analysis of histology evaluations in subjects enrolled in the INSIGHT Registry, a multicentered 'multi-omic' analysis of thrombi associated with acute hemorrhagic and ischemic stroke this multi-omic clot collection registry. Our aim was to determine potential histology differences between men and women with emergent large vessel occlusive thrombi.

Methods:

Subjects age ≥ 18 years, treated frontline with the Penumbra System® for thrombectomy are included in this analysis. Patient demographics, medical history, radiographic, and procedural information are collected in conjunction with extracted clot and concurrent extracranial arterial blood. Enrollment, data collection and monitoring are ongoing for the INSIGHT registry. While the protocol include analysis for proteomics and transcriptomics, for this analysis we used automated histology. An MSB Trichrome stain was used to evaluate the tissue. Composition was determined by automated pixel analysis, with the values representing ratios of the overall clot.

Results:

Samples from 60 subjects were enrolled from 10 sites between 02/2021 and 07/2021. Analysis of the thrombi determined the relative proportions of fibrin, red blood cells (RBCs), and platelets (PLT). The median RBC-fibrin ratio did not differ between females (1.27, IQR 0.57-2.62) n=34 and males (0.95, IQR 0.41-1.51) n=26. However, the ratio was more widely distributed in females as seen in the wider IQR.

Conclusions:

These preliminary results demonstrate a lack of uniform differences in thrombus composition in males versus females with emergent large vessel occlusion. There may be more heterogeneity among females, which requires further study.

Keywords: Thrombosis, Interventional Neuroradiology, Cerebrovascular Disease, Basic/Translational Vascular Science

Financial Disclosures: PI of INSIGHT Study

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Poster

Hyperacute Stenting and Angioplasty for Isolated Non-tandem Cervical ICA Strokes within the First 48 hours

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Introduction:

Acute stroke that involves complete and isolated occlusion of extracranial cervical ICA segment with no intracranial clot burden account for a minority of stroke cases. Since endarterectomy is not recommended in the hyperacute phase (first 48 hours), management of these strokes includes administration of IV-tPA as part of standard medical therapy. This makes endovascular intervention with acute carotid artery stenting (CAS) with or without balloon angioplasty a viable treatment option during the hyperacute phase of the disease. We aim to present our two-decade long experience of endovascular management of complete and isolated cervical ICA occlusive strokes in the hyperacute phase, and attempt to evaluate the clinical efficacy and safety of this treatment modality.

Methods:

A prospectively maintained database was retrospectively searched for patients who presented from Jan 2000 – Dec 2020 with acute cervical ICA stroke confirmed on angiography. Only patients who had 100% occlusion of cervical ICA segment and who underwent acute CAS within the first 48 hours of symptom onset were included. Patients who had an intracranial or tandem lesion or those with <100% EC-ICA stenosis were excluded. Information on demographics, co-morbidities, procedural details, and complications was recorded. Rate of adequate revascularization and follow up were also recorded.

Results:

A total of 46 patients with acute cervical ICA occlusive stroke were included in the study. Mean age was 68.9 years, and 32 (69.6%) were male. Median NIH Stroke Scale at admission was 8 (IQR 7) with a perfusion deficit seen in 78.3% of cases. IV-tPA was administered in 41.3% of cases with median time from symptom onset to puncture 14.4 hours. Stenting was performed in all patients with pre- and/or post-angioplasty done in 78.3% of cases. Successful recanalization was achieved in 82.6% cases. One patient (2.2%) suffered a symptomatic intracerebral hemorrhage (sICH) post-procedure. Outcome measures were reported as stable or improved NIHSS at discharge in 86.9% of cases, with good outcome (functional independence at 90-day-mRS <2) at 78.3% and a mortality rate of 6.5%.

Conclusions:

Emergent stenting and angioplasty for acute cervical ICA occlusive strokes within the first 48 hours (hyperacute phase) can be performed successfully with good clinical outcomes and an impressive rate of recanalization.

Keywords: Acute Ischemic Stroke Intervention, Carotid Stenting And Angioplasty, Balloon Angioplasty

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

Impact Of COVID-19 On Acute Ischemic Stroke Treatment In Latin America

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Introduction:

Acute ischemic stroke is one of the leading causes of death and disability in the lower and middle income countries (LMIC). The emergence of COVID-19 has negatively impacted medical care, specifically AIS treatment, in many parts of the world. In this study, we investigated AIS treatment barriers in high COVID-19 incidence regions in Latin America.

Methods:

In our study, we organized the 21 Latin American regions based on the number of COVID-19 cases from the highest to the lowest. In August 2020, Brazil had the highest number of COVID-19 cases which was 2,736,298 while Belize had the lowest number of COVID-19 cases which was 57. Taking the top 5 countries with the highest COVID-19 cases (Brazil, Peru, Chile, Colombia, and Argentina), we compiled a list of neurologists, neurosurgeons, and neurointerventionalists involved in stroke care. We then sent 100 of these clinicians a survey to understand the effects of the pandemic on stroke treatment in their hospitals. Following the survey, we requested the doctors to set up an interview to delve deeper into the barriers to access to AIS treatment. Out of the 100 clinicians contacted, 16 filled out the survey and 14 doctors set up an interview with us.

Results:

Using the survey results and the interview data, the top-5 barriers mentioned were transportation, disease awareness, rehabilitation, shortages in staff, and fear among the public about contracting COVID-19 at the hospital. About 62% of the doctors indicated that people are scared of coming to the hospital due to the high COVID-19 cases. Furthermore, 60% of the doctors mentioned that there has been a lack of staff at hospitals which causes a reduction in the number of treatment procedures performed, especially mechanical thrombectomies. Moreover, 50% of the doctors said that the main barrier was transportation delay, which results in time lost before treatment. About 50% of the doctors also mentioned that most of the population does not know what AIS is or its symptoms, resulting in fewer patients seeking appropriate care. Finally, 50% of the doctors said that there has been no sufficient rehabilitation. Many rehab units/hospitals have been converted into COVID-19 hospitals due to the large number of COVID-19 patients. Therefore, after a patient has received stroke treatment, they have not been able to recover back to their original healthy status. These barriers have overall decreased AIS treatments in hospitals and have negatively impacted patients who have experienced AIS.

Conclusions:

Overall, the emergence of COVID-19 has negatively impacted AIS treatment in regions in Latin America with the highest COVID-19 cases. Hospitals faced several barriers during the pandemic making it difficult for staff to adjust to those specific circumstances. Based on recommendations that doctors have provided us, we are currently working with doctors in Peru to launch an app that tackles the transportation, educational, and rehabilitation barriers. This app will allow patients to connect with

doctors online and perform rehabilitation exercises at the comfort of their home while also being able to learn more about stroke.

Keywords: Acute Stroke, Mechanical Thrombectomy, Acute Ischemic Stroke Intervention, Stroke, Treatment

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

Impact of Diabetes on Pass-Number in Intracranial Thrombectomy for Large Vessel Occlusion Acute Ischemic Stroke

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Introduction:

Admission hyperglycemia is associated with poor functional outcomes, greater hemorrhagic risk and mortality after endovascular therapy (EVT) for large vessel occlusion (LVO) acute ischemic stroke (AIS). Diabetes is also linked with intracranial atherosclerosis. In this study, we examine whether underlying diabetes is associated with increased pass number requirements, as a possible etiology for worsened clinical outcomes in these patients.

Methods:

From our prospectively maintained multi-institutional registry across 4 comprehensive stroke centers, we identified patients with LVO AIS undergoing EVT, for whom admission glucose, HbA1c as well as complete procedural details and 90 day outcome measures (mRS) had been captured. Diabetes was defined using HbA1c cutoff of $\geq 6.5\%$ consistent with American Diabetes Association definitions. Admission hyperglycemia was defined as serum glucose on admission of >140 mg/dL. The primary outcome was number of EVT passes required for TICI $\geq 2b$ in diabetic vs. non-diabetic patients.

Results:

Among 512 patients that met inclusion criteria, median age was 68 [IQR 58-78], 254 (49.6%) were female, and median NIHSS was 16 [IQR 11-20]. Median HbA1c was 5.8% (range 2.5-14%), and 136 (26.6%) were diabetic. Mean admission glucose was greater in diabetic patients (122 ± 30.7 vs. 199 ± 79.8 mg/dL, non-diabetic vs. diabetic, $p < 0.01$). Admission hyperglycemia and HbA1c ≥ 6.5 were associated with lower rates of 90 day mRS 0-2 (24.0% vs 42.7%, hyperglycemia vs. no hyperglycemia, $p < 0.01$; 28.7% vs. 39.1%, diabetes vs. no diabetes, $p = 0.03$). However, diabetics and patients presenting with hyperglycemia did not appear to require a higher number of passes to achieve TICI 2b or greater (1.83 vs 1.88, $p = 0.69$, 1.82 vs 1.88, $p = 0.56$, respectively) and had comparable first pass recanalization rates (56 vs 53%, $p = 0.50$, 56 vs 54, $p = 0.72$).

Conclusions:

Presentation hyperglycemia and diabetes were both associated with worsened clinical outcomes, but not with increased pass numbers or procedural time in EVT. These findings suggest alternative means by which clinical outcomes are worsened in this population.

Keywords: Mechanical Thrombectomy, Ischemic Stroke, TICI

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

Impact of Systemic Inflammatory Response Syndrome on Acute Ischemic Stroke Patients Treated with Mechanical Thrombectomy

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Introduction:

Systemic inflammatory response syndrome (SIRS) has been associated with poor outcomes after acute ischemic stroke (AIS). The primary goal of this study was to determine whether SIRS status on admission correlated with functional outcomes in AIS treated with mechanical thrombectomy (MT).

Methods:

Consecutive patients from September 2015 to April 2019 were retrospectively reviewed for SIRS on admission. SIRS was defined as the presence of ≥ 2 of the following: temperature $<36^{\circ}\text{C}$ or $>38^{\circ}\text{C}$, heart rate >90 , respiratory rate >20 , and white blood cell count $<4000/\text{mm}^3$ or $>12\,000/\text{mm}^3$.

Results:

Of 202 patients, 188 met inclusion criteria. 49 patients (26%) had evidence of SIRS. Neither basic patient demographics nor standard stroke risk factors predicted the development of SIRS. However, presentation with SIRS was correlated with higher rates of death (odds ratio [OR], 2.6; 95% confidence interval [CI], 1.2-5.5) as well as lower rates of favorable functional outcomes at discharge (OR, 0.09; 95% CI, 0.02-0.40) and 3-month follow up (OR 0.12; 95% CI 0.03-0.43). These results remained significant even after adjustment for age, sex, baseline NIHSS, recanalization status, and prior co-morbidities.

Conclusions:

In our sample population, SIRS was associated with worse outcomes and higher rates of mortality in AIS patients treated with MT. Recognition of key risk factors can provide better prognostication and possible future therapeutic targets.

Keywords: Acute Stroke, Inflammation, Mechanical Thrombectomy

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

In a hub-and-spoke network, spoke-administered thrombolysis reduces mechanical thrombectomy procedure time and number of passes.

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Introduction:

The utility of intravenous thrombolysis (IVT) prior to mechanical thrombectomy (MT) in large vessel occlusion (LVO) stroke is controversial. Some data suggest IVT could increase MT difficulty. Within our hub-and-spoke telestroke network, we examined how spoke-administered IVT affects hub MT procedure time and number of passes.

Methods:

Patients presenting to 25 spoke hospitals who were transferred to the hub and underwent MT from 2018 to 2020 were identified from a prospectively maintained database. Procedure time, fluoroscopy time, and number of passes were obtained from operative reports. Statistics were performed using permutation resampling and linear regression in R.

Results:

Of 113 patients, 50 received IVT. Baseline characteristics and NIHSS were similar between groups, however the last known well-to-groin puncture time was shorter among IVT patients (4.4 ± 1.8 hrs vs. 10.5 ± 5.7 hrs, $p < 0.001$). In patients that received IVT, mean MT procedure time was decreased by 19 minutes (50 ± 29 mins vs. 69 ± 47 , $p = 0.01$) and mean fluoroscopy time was decreased by 12 minutes (21 ± 16 mins vs. 33 ± 31 mins, $p = 0.02$). Linear regression modeling showed IVT was associated with improved procedure time and fluoroscopy time even when controlling for last known well ($p = 0.02$ and $p = 0.02$, respectively). For patients that achieved TICI2b-3 reperfusion, there was a trend for reduced groin puncture-to-reperfusion time by 13 minutes in IVT patients (30 ± 22 mins vs. 43 ± 49 mins, $p = 0.07$). IVT-treated patients required less MT passes (median 1 pass [IQR 1.0, 1.80] vs. 2 passes [1.0, 2.3], $p < 0.001$), and the proportion of IVT patients requiring 2 or few passes was significantly higher (91.6% vs 59.3%, $p = 0.01$). Moreover, IVT was associated with decreased number of passes even when controlling for last known well ($p = 0.01$). For patients that received IVT, there was a trend for improved TICI2b-3 reperfusion at the end of MT (93.9% vs. 83.8%, $p = 0.06$). IVT did not result in increased intracranial hemorrhage (IVT=10% vs. 18%, $p = 0.17$).

Conclusions:

Within our network, hub MT following spoke-administered IVT was faster and required fewer passes, even when controlling for last known well. Furthermore, IVT did not result in worsened reperfusion following MT. This retrospective analysis suggests IVT does not impair MT, but instead may enhance it.

Keywords: Mechanical Thrombectomy, Acute Ischemic Stroke Intervention, Thrombolytics, Stroke, Endovascular Therapy

Financial Disclosures: The authors had no disclosures.

Grant Support: The National Institutes of Health, National Institute of Neurological Disorders and Stroke supported this work (R25 NS065743).

Poster

In Vitro Investigation of Endothelial Injury During Mechanical Thrombectomy for Ischemic Stroke

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Introduction:

Ischemic stroke (IS) makes up a significant proportion of all strokes, of which large vessel occlusions (LVO) are the most debilitating type. The current clinical standard-of-care for IS includes mechanical thrombectomy with stent retrievers. One of the impediments to the success of SR intervention is endothelial injury (EI), which can occur in approximately 30% of cases and impedes vessel reperfusion. Since successful reperfusion of the occluded vessel is instrumental in survival and patient recovery, it is imperative to reduce device injury-based complications such as vasospasm, and to improve patient outcomes.

Methods:

In this work, our hypothesis is that EI can be reduced by investigating the mechanisms of stent retriever-induced injury in vitro using live cell 3D cerebrovascular models. Using true-scale cerebrovascular phantoms with lumen diameter approximately 4 mm created using 3D printing and PDMS casting, Human Umbilical Vein Endothelial Cells (HUVECs) were seeded on the luminal surface. The in vitro models were coated with fibronectin (density 4 µgrams/cm²) to encourage cell adhesion, and were divided into control and treated samples (n=3 each). Mechanical thrombectomy was performed using two different clinically used SR (Trevo XP PROVUE 3x20 mm and Trevo XP PROVUE 6x30 mm) to investigate the extent of stent retriever size on EI on the same diameter lumen. Following thrombectomy, the cerebrovascular models were fixed and stained with immunofluorescent dyes (DAPI, Phalloidin and VE cadherin antibody) and imaged using transmitted light, confocal microscopy and scanning electron microscopy. For quantitative assessment, real time PCR was performed on both control and treated samples.

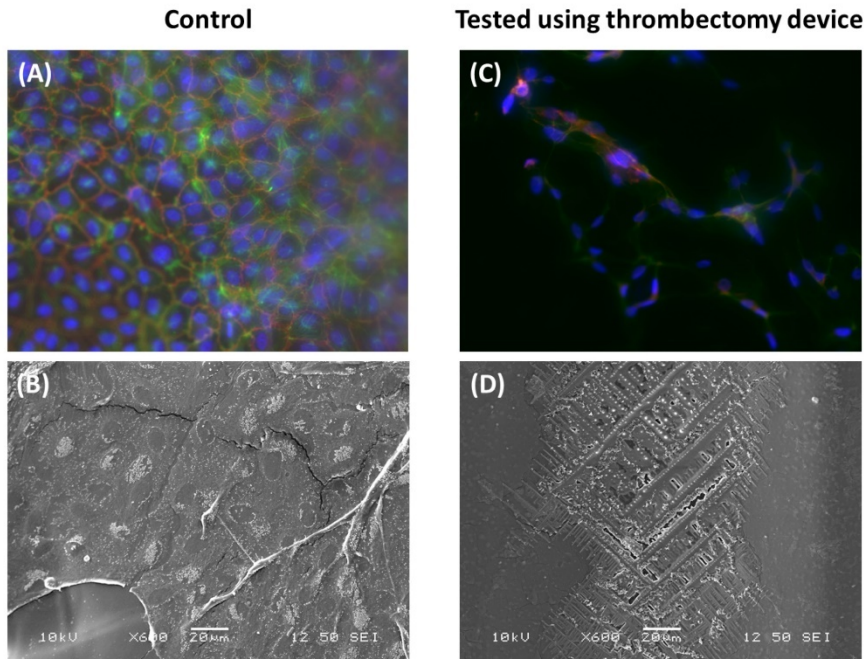
Results:

All models were initially confluent and functional, as assessed by immunofluorescent staining (Figure 1 A and B). All treated samples demonstrated EI and endothelial damage, as evidenced by loss of endothelial cell coverage, denuding of the models, stripping / clumping of endothelial cells into non-physiological three dimensional structures and physical scratching of the in vitro model (Figure 1 C and D). Sizing of stent retriever had a strong influence on the effects on the endothelium, with larger sizes causing more damage.

Conclusions:

A significant knowledge gap exists in understanding the factors responsible for disruption of the endothelium during mechanical thrombectomy. Using a 3D in vitro platform of cerebrovasculature, we demonstrated that endothelial damage occurs during thrombectomy using stent retrievers. A parameteric investigation is currently ongoing that characterizes the influence of vessel lumen diameter,

stent retriever size, number of passes and patient specific vasculature. This work can provide guidelines for optimal stent retriever devices to be used where possible, ultimately reducing EI and improving outcomes of ischemic stroke treatment.



(A) Immunofluorescence imaging for control sample demonstrating functional and confluent layer of endothelial cells, (B) SEM image of control sample showing continuous endothelial cell coverage, (C) Immunofluorescence imaging for treated sample with stent retriever showing denuding and stripping of endothelial cells from vascular phantom surface, (D) SEM imaging of treated sample showing absence of endothelial cells and scratch marks indicating damage to the surface of the vascular phantom

Keywords: Mechanical Thrombectomy, Stent retriever, Basic Sciences, Ischemic Stroke

Financial Disclosures: Consultant: Cerenovus, Medtronic

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Poster

Incidence of Access Site Complications in Patients Receiving Tenecteplase as Bridging Therapy to Endovascular Treatment

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Introduction:

Mechanical thrombectomy (EVT) is the standard of endovascular care for acute ischemic stroke secondary to large vessel occlusion. Alteplase in conjunction with EVT has a strong safety profile with low incidence of complications including groin hematoma. Our objective was to evaluate the incidence of groin hematoma in EVT following bridging therapy tenecteplase (TNK) as this is not well-described in the literature.

Methods:

Retrospective review of prospectively collected data for patients with acute ischemic stroke who underwent mechanical thrombectomy at a University Hospital. Incidence of access site complication including groin hematoma, retroperitoneal hematoma, blood loss and femoral artery pseudoaneurysm with or without the need for surgical intervention were reviewed. Rates of use of other antithrombotic agents were also noted. Social Science Statistics was used for data analysis.

Results:

From October of 2020 to April of 2021, of 348 ischemic stroke patients, 16 had LVO identified on CT and received TNK prior to mechanical thrombectomy (Females = 6; age, 63.25 95% CI [54.9207, 71.5793]); Mean weight =78kg, 95% CI [67.68, 88.32]). Five subjects (31.25%) received intra-arterial non-thrombolytics. None received intra-arterial thrombolytics. Three patients (18.75%) received therapeutic heparin during the procedure. Four patients (25%) were started on non-thrombolytic infusion during the periprocedural period. One subject (6.25%) was started on stroke nomogram heparin infusion less than 24 hours post-intervention. One subject (6.25%) developed groin hematoma that did not require intervention. This subject received intra-arterial non-thrombolytics during procedure and IV non-thrombolytics during the peri-procedural period.

Conclusions:

Our single center experience with TNK outside of the clinical trial setting with concomitant use of other antithrombotics suggests safety of bridging strategy. Larger prospective 'real-life' studies are required to validate our findings.

Keywords: Angiogram

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

Intracranial Atherosclerotic Disease with Acute Ischemic Stroke Managed with Drug-Eluting Stents - A Case Series

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Introduction:

Intracranial atherosclerotic disease (ICAD) is a common cause of Acute ischemic stroke (AIS). Intracranial stenting in such setting has high rates of restenosis. Drug-eluting Stents (DES) have significantly reduced restenosis rates in coronary artery disease. We present our experience with use of DES in patients of Acute ischemic stroke with intracranial atherosclerotic disease.

Methods:

Retrospective case series of five patients who presented with acute ischemic stroke. All patients underwent mechanical thrombectomy following which ICAD was noted. Angioplasty followed by stenting was done in view of reocclusion or significant residual stenosis. Half nominal pressure used to deploy the stent. All patients were pretreated with heparin. Intraop loaded with dual anti platelets prior to stent deployment. Dual anti platelets continued for 1 year.

Results:

Of five patients, 4 had ICA stenosis and one patient had MCA stenosis. All patients underwent stenting using Zotarolimus eluting stent (Resolute Onyx- Medtronic). Four patients had TICI 3 reperfusion and one had TICI 2b reperfusion owing to distal emboli. Two patients followed up for more than 1 year and other three for 6 months. None of the patients had any clinical evidence of restenosis. Follow up angiogram at 1 year does not show any evidence of restenosis in the two patients. Also the cost of stent comes down by 5 times (approximately 2500USD for intracranial stent versus 450 USD for DES)

Conclusions:

Drug eluting stents are safe and cost effective in the treatment of ICAD presenting with acute ischemic stroke

Keywords: Acute Ischemic Stroke Intervention, Intracranial Stenosis Stenting And Angioplasty, Stenting

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

Is Age Critical in Determining Stroke Severity Within the Telestroke Network?

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Introduction:

Age is the single most important risk factor for stroke and an estimated 75% of all strokes occur in people >65 years of age. In addition, adults >75 years' experience more hospitalization stays and higher mortality rates with an estimated 50% in the occurrence of all strokes. Several comorbidities have been linked to an increased risk and severity of acute ischemic stroke (AIS). How these factors differentially contribute to the severity of stroke in patients ages >65 and <75 as well as those ≥75 is not known. In this study, we aim to investigate how age, coupled with various clinical risk factors, affects AIS severity within these two age categories.

Methods:

This retrospective data analysis study was conducted using the data collected from the PRISMA Health Stroke Registry between 2010 and 2016. Baseline clinical and demographic data for patients ages >65 and <75 as well as those ≥75 was analyzed using univariate analysis. Receiver operating characteristic (ROC) curve analysis and multivariate regression models were used to examine the association of specific baseline risk factors or comorbidities associated with worsening or improving neurologic functions. The primary functions were risk factors associated with improving or worsening neurologic outcome in each age category.

Results:

Adjusted multivariate analysis showed that AIS population of patients >65 and <75 experiencing heart failure (OR = 4.398, 95% CI, 3.912 – 494.613, P = 0.002) and elevated HDL levels (OR = 1.066, 95% CI, 1.009 – 1.126, P = 0.024) trended towards worsening neurologic functions while patients experiencing obesity (OR = 0.177, 95% CI, 0.041 – 0.760, P = 0.020) exhibited improving neurologic functions. For the patients ≥75 years of age, direct admission (OR = 0.270, 95% CI, 0.085 – 0.856, P = 0.026) was associated with improvement of patients treated in the telestroke.

Conclusions:

Age is a strong risk factor for AIS, and aged stroke patients have higher morbidity and worsening functional recovery than younger patients. In this study, we observed differences in stroke risk factor profiles for >65 and <75 and ≥75 age categories. Heart failure and elevated HDL levels were significantly associated with worsening neurologic functions among AIS for patients aged >65 and <75. Obese patients and individuals ≥75 years who were directly admitted were most likely to exhibit improving neurologic functions. Most importantly, findings from this study reveal specific risk factors that can be managed to improve the care in older stroke patients treated in the telestroke network.

Keywords: Acute Stroke, NIHSS, Door To Needle

Financial Disclosures: The authors had no disclosures.

Grant Support: NIH National Institute of Aging R25 Grant

Poster

Is Neutrophilia a Risk Factor for Fast Stroke Progression in Large Vessel Occlusion?

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Introduction:

Rapid stroke progressors with large vessel occlusion (LVO) have a worse prognosis than their time-matched cohorts receiving IV thrombolytics and/or mechanical thrombectomy. Our objective was to evaluate the association of neutrophilia with rapid stroke progression.

Methods:

Initial white blood cell (WBC) and absolute neutrophil counts (ANC) were collected for subjects presenting with acute ischemic stroke secondary to LVO who received IV thrombolytics and/or mechanical thrombectomy within 4.5 and 6 hours, respectively. Rapid stroke progression was determined by Alberta Stroke Program Early CT Score (ASPECTS) on initial CT head. Baseline and discharge NIHSS, age, and follow up mRS were also compared to presenting WBC and ANC. Spearman's rho was used for correlation. Social Science Statistics was used for data analysis.

Results:

From October 2020 to April 2021, the association between neutrophilia and stroke progression was evaluated in 19 subjects receiving tenecteplase (n=16; 6 females; age, 63.25 95% CI [54.9207, 71.5793]) and alteplase (n=4; 2 females; mean age 59, 95% CI [38.13, 79.87]) for LVO causing disabling neurological deficits. Mechanical thrombectomy was attempted in all subjects. The association between higher ANC and lower ASPECTS score reached statistical significance (rs=-0.49255, p=0.04457). There was no significant association of white blood cell (WBC) and ASPECTS score. WBC and ANC were not associated with baseline or discharge NIHSS, age, or follow up mRS.

Conclusions:

Rapid stroke progression as measured by presenting ASPECTS score may be associated with neutrophilia. Larger prospective clinical trials are needed to validate our results.

Keywords: Acute Stroke, Aspects, Imaging

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

Keep it simple: MAC (Manual Aspiration with Contrast) Technique for the Endovascular Management Stroke.

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Introduction:

Background: The availability of advanced large-bore diameter aspiration catheters has improved recanalization rates and time. We report a prospectively collected clinical experience with a simple technique: MAC (Manual Aspiration Contrast Enhancement) as the primary method for vessel recanalization. Gently contrast injection while the aspiration catheter is advanced to the thrombus and subsequently creating a closed-loop system with the contrast column within the catheter can result in better visualization during the aspiration, thus improving the FPE avoiding clot fragmentation, multiple passes and blind movements of catheter by a single operator.

Methods:

Methods: 47 prospectively patients with ELVO and 3 cases of middle vessel occlusion (MVO) at four institutions were included in the study. The MAC technique was utilized in all patients. Procedural and clinical data were analyzed.

Results:

Results: MAC technique using SOFIA 6 Plus Catheter was successful in achieving first pass effect (FPE) and Thrombolysis in Cerebral Infarction (TICI) 2b- 3 revascularizations in 77% of cases. The average time from groin puncture to at least TICI 2b recanalization was 16 min. National Institutes of Health Stroke Scale (NIHSS) score average at onset of 16, and improved to a median NIHSS score at discharge of 5.5. One ICA rupture and two symptomatic intracerebral hemorrhages were recorded peri operatively.

Conclusions:

Discussion: MAC technique is a simple, fast, safe, and effective method that has reduced the requirements to multiple passes and also avoiding the use of expensive materials to reach the occlusion site. MAC is a replicable approach without additional training requirements.

Keywords: Acute Stroke, Endovascular Therapy, Mechanical Thrombectomy

Financial Disclosures: consultan for Medtronic and microvention

Grant Support: None.

Poster

Left Atrial Dilatation, Atrial Fibrillation and Stroke; A 5 Year Follow Up Study

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Introduction:

Our prior study showed that Atrial Fibrillation (AFib) and not Left Atrial Dilatation (LAD) was associated with ischemic stroke (IS) in a cross-sectional analysis. We sought to validate these findings in a prospective 5-year follow up study.

Methods:

Patients with transthoracic Echocardiography (TTE) completed from March to September 2016 were selected. New diagnoses of Afib and IS over the interval period of 5 years (2016-2021) were obtained. Regression models were used to analyze LAD, Afib and other covariates as they relate to IS, as well as the association of baseline LAD to subsequent Afib.

Results:

There were 7988 subjects analyzed. Of those; 578 had IS before 2016 and an additional 249 patients had no follow-up information, who were excluded from the analysis. Of the remaining 7161, mean age was 65.1, 54% females, 52% Caucasian, 43% African American, 9% developed new AFib and 3% had a new IS during follow-up. The median follow-up was 47 months (IQR 14-60). Also, 54% patients had a normal LA, 13% were mildly dilated, 13% were moderately and 20% were severely dilated, of which 6%, 11%, 13% and 15% were found to have new AFib, respectively ($p < 0.001$). Mild and Severe LAD was more likely to experience IS when compared to normal LAD and moderate LAD showed a trend (Model-1). Prior diagnosis of LAD or Afib was associated with a new IS on univariate analysis (Model-2). However, on multivariate analysis, only Afib remained associated (Models-3/4). Additionally, anticoagulant use was associated with a reduced risk of IS. (Model-4)

Conclusions:

LAD increased the probability of AFib discovery during follow-up and was associated with both Afib and IS. However, Afib, not LAD, was independently associated with IS. Medical treatment of Afib was associated with a reduction in future IS, reaffirming the need to identify and treat Afib. Our study suggests the presence of LAD on TTE is a useful marker for identification of high risk individuals for Afib and prospective investigations to identify Afib would provide primary IS prevention.

Table: Associations with IS (Cox proportional hazards)					
Model	Parameter	HR	95%CI		p-value
1	Mild LAD vs Normal (N)	1.57	1.06	2.32	0.0245
	Moderate LAD vs N	1.43	0.95	2.16	0.0857
	Severe LAD vs N	1.86	1.33	2.59	0.0003
2	Afib prior	2.09	1.59	2.74	<.0001
3	Mild LAE vs N	1.39	0.93	2.07	0.1054
	Moderate LAE vs N	1.22	0.80	1.86	0.3543
	Severe LAE vs N	1.39	0.97	2.00	0.0754
	Afib prior	1.86	1.38	2.51	<.0001
4	Mild LAE vs N	1.31	0.86	1.99	0.2085
	Moderate LAE vs N	0.98	0.62	1.57	0.9415
	Severe LAE vs N	1.08	0.72	1.63	0.7154
	Afib prior	2.28	1.54	3.38	<.0001
	Female	0.88	0.65	1.18	0.3927
	AA	1.68	1.23	2.30	0.0010
	Age (increase of 10)	1.26	1.13	1.42	<.0001
	EF (increase of 10)	0.93	0.83	1.06	0.2759
	Smoking	2.02	1.37	2.97	0.0004
	HTN	1.25	0.77	2.05	0.3683
	DM	1.35	1.00	1.82	0.0483
	CHF	1.36	0.97	1.91	0.0760
	PVD	0.87	0.62	1.20	0.3912
	Medications	0.61	0.40	0.91	0.0161

Keywords: Clinical Investigations, Acute Stroke, Medical Management

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

Machine Learning to Predict Stroke Outcomes after Mechanical Thrombectomy

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Introduction:

Prognostication is an integral part of clinical decision-making in stroke care. Machine learning (ML) methods have gained increasing popularity in the medical field due to their flexibility and high performance. Using a large comprehensive stroke center registry, we sought to apply various ML techniques for 90-day stroke outcome predictions after thrombectomy.

Methods:

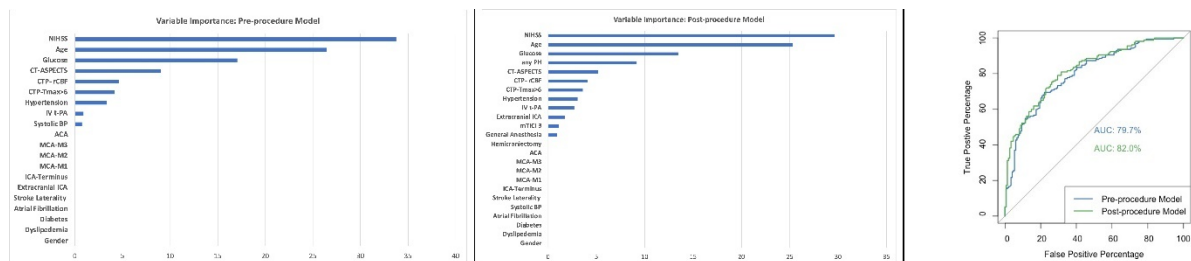
We used individual patient data from our prospectively collected thrombectomy database between 09/2010 and 03/2020. Patients with anterior circulation strokes (Internal Carotid Artery, Middle Cerebral Artery M1, M2, or M3 segments and Anterior Cerebral Artery) and complete records were included. Our primary outcome was 90-day functional independence (defined as modified Rankin Scale score 0–2). Pre- and post-procedure models were developed. Four known ML algorithms (support vector machine, random forest, gradient boosting, and artificial neural network) were implemented using a 70/30 training-test data split and 10-fold cross-validation on the training data for model calibration. Discriminative performance was evaluated using the area under the receiver operator characteristics curve (AUC) metric.

Results:

Among 1248 patients with anterior circulation large vessel occlusion stroke undergoing thrombectomy during the study period, 1020 had complete records and were included in the analysis. In the training data (n=714), 49.3% of the patients achieved independence at 90-days. Fifteen baseline clinical, laboratory and neuroimaging features were used to develop the pre-procedural models, with four additional parameters included in the post-procedure models. For the preprocedural models, the highest AUC was 0.797 (95%CI [0.75- 0.85]) for the gradient boosting model. Similarly, the same ML technique performed best on post-procedural data and had an improved discriminative performance compared to the pre-procedure model with an AUC of 0.82 (95%CI [0.77- 0.87]).

Conclusions:

Our pre-and post-procedural models reliably estimated outcomes in stroke patients undergoing thrombectomy. They represent a step forward in creating simple and efficient prognostication tools to aid treatment decision-making. A web-based platform and related mobile app are underway.



Keywords: Acute Stroke, Mechanical Thrombectomy

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

Mechanical Thrombectomy of the Fetal Posterior Cerebral Artery

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Introduction:

Fetal posterior cerebral artery (FPCA) occlusion is a rare but potentially disabling cause of stroke. While endovascular treatment is established for acute large vessel occlusion (LVO) stroke, FPCA occlusions were excluded from acute ischemic stroke trials. We aim to report the feasibility, safety and outcome of mechanical thrombectomy (MT) in acute FPCA occlusions.

Methods:

We performed a multi-center retrospective review of consecutive patients who underwent MT of acute FPCA occlusion. Primary FPCA occlusion was defined as an occlusion that was identified on the pre-procedure CT angiogram or baseline angiogram whereas a secondary FPCA occlusion was defined as an occlusion that occurred secondary to embolization to a new territory after recanalization of a different LVO. Demographics, clinical presentation, imaging findings, endovascular treatment and outcome were reviewed.

Results:

There were twenty-five patients with acute FPCA occlusion who underwent MT, distributed across 14 centers. Median NIHSS on presentation was 16. There were 76% (19/25) of patients who presented with primary FPCA occlusion and 24% (6/25) of patients who had a secondary FPCA occlusion. The

configuration of the FPCA was full in 64% patients and partial or “fetal-type” in 36% of patients. FPCA occlusion was missed on initial CTA in 21% of patients with primary FPCA occlusion (4/19). The site of occlusion was posterior communicating artery in 52%, P2 segment in 40% and P3 in 8% of patients. TICl 2b/3 reperfusion was achieved in 96% of FPCA patients. There were no intra-procedural complications. At 90 days, 48% (12/25) were functionally independent as defined by mRS≤2.

Conclusions:

Endovascular treatment of acute FPCA occlusion is safe and technically feasible. A high index of suspicion is important to detect occlusion of the fetal posterior cerebral artery in patients presenting with anterior circulation stroke syndrome and patent anterior circulation.

Keywords: Acute Stroke, Acute Ischemic Stroke Intervention, Mechanical Thrombectomy, Endovascular Therapy

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

National Trends in Readmission after Mechanical Thrombectomy in Acute Ischemic Stroke

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Introduction:

Mechanical thrombectomy (MT) has become the standard of care in patients with large vessel occlusion after trials have demonstrated (MT) improved outcomes in acute ischemic stroke (AIS) as compared to medical therapy. Despite leading to high reperfusion rates, MT patients are at high risk for recurrent ischemic events and complications of stroke. We performed an analysis to evaluate temporal trends in readmission of post-MT among stroke patients over a three-year period.

Methods:

From the Healthcare Cost and Utilization Project Nationwide Readmission Database, we obtained in-hospital adult patient data with a principal diagnosis of AIS in the US from 2016 to 2018. AIS, MT, thrombolysis treatment and other diagnosis were identified based on International Classification of Diseases, 10th Revision, Clinical Modification codes. We compared the trend of 30-day readmission in AIS patients who received MT, thrombolysis only and neither treatment with linear regression. Using Clinical Classifications Software Refined tool, we categorized the readmission principal diagnoses of patients underwent MT into groups. All analyses were performed in Stata/SE 15.1 software.

Results:

Of the 1,271,958 patients admitted from throughout the US with AIS within the study period, 1,130,737 (88.90%) did not receive thrombolysis nor MT, 100,737 (7.92%) received thrombolysis only, and 40,849 (3.21%) underwent MT with or without thrombolysis. The endovascular treatment rate doubled from 2016 (2.40%) to 2018 (4.11%, $p < 0.0001$). From 2016 to 2018, the readmission rate has significantly decreased from 15.00% to 12.04% (absolute risk reduction (ARR) 2.96%, $p = 0.0001$) in patients who underwent MT, decreased from 10.46% to 9.51% (ARR 0.95%, $p = 0.0097$) in patients who received thrombolysis only, and decreased from 11.96% to 11.56% (ARR 0.40%, $p = 0.0130$) in patients received neither therapy. Among all the patients who underwent MT during the three-year period, sepsis (1.88%), cerebral infarction (1.59%), sequelae of cerebral infarction (0.82%), cardiac dysrhythmias (0.67%) and heart failure (0.49%) were the most common principal readmission diagnoses. From 2016 to 2018, there were significant decreases in rate of readmissions with septic infection ($p = 0.0001$), sequelae of cerebral infarction ($p < 0.0001$), and heart failure ($p = 0.0123$), but no significant change in cerebral infarction ($p = 0.4853$) and cardiac dysrhythmias ($p = 0.1834$).

Conclusions:

Over three years, the rate of readmissions in AIS patients receiving MT significantly declined, particularly in rate of readmissions in sepsis, sequelae of cerebral infarction, and heart failure. Improved reperfusion rate and better outcomes may explain the reduction in post-MT complication rate, which needs further studies.

Keywords: Ischemic Stroke, Mechanical Thrombectomy

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Grant Support: None.

Poster

Novel Ischemic Stroke Treatment Protocol for Salvageable Penumbra in Acute Small Vessel Disease

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Introduction:

In small vessel disease (SVD)-related acute ischemic stroke (AIS), no specific acute treatment exists. We propose an acute treatment protocol for patients with fluctuating exam secondary to salvageable micropenumbra in high risk SVD-related AIS.

Methods:

Inclusion criteria included acute SVD-related stroke with NIHSS fluctuation ≥ 2 previously described as a sensitive indicator of neurological deterioration in SVD ischemic stroke. Patients with large vessel atheroma secondarily causing stroke were excluded. Treatment protocol consisted of albumin IV, eptifibatide IV, magnesium sulfate IV, cilostazol PO, normoglycemia, normothermia, aggressive fluid resuscitation, and targeted blood pressure parameters in a neurocritical care setting. Protocol was prospectively initiated in August 2020 at onset of exam fluctuation and continued until plateau NIHSS was reached. Retrospective data for subjects from January 2017 to July 2020 was collected for historical controls. Primary outcomes measures included safety and early efficacy end points. Efficacy was measured by change from maximum NIHSS to plateau NIHSS (NIHSS-diff). Wilcoxon rank-sum test was used to evaluate significant difference of NIHSS-diff in both groups. Social Science Statistics was used for data analysis.

Results:

From January 2017 - May 2021, out of 7,146 AIS patients, 30 met selection criteria. From August 2020 to May 2021, consecutive subjects received treatment protocol (n=15, baseline NIHSS 4.93, 95% CI [3.3572, 6.5028]). They were compared with historical controls (n=15, baseline NIHSS 5.87, 95% CI [2.9407, 8.7993]). There was no significant difference in baseline characteristics (p=1; U=112 at p<0.05; z-score 0). In the SVD group, no subjects had adverse events leading to early termination. Early efficacy as suggested by NIHSS-diff between groups was statistically significant (p=0.00228; U=38.5; z-score 3.04864; 80% power at p<0.05).

Conclusions:

To our knowledge, this is the first systematic demonstration of safety and early efficacy of multimodal intervention for acute SVD-related ischemic stroke. Larger randomized trials using concurrent controls are required to corroborate our findings.

Keywords: Treatment, Penumbra, Cerebrovascular Disease, Basic/Translational Vascular Science, Antiplatelet

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

Number-needed-to-review: a novel metric to assess triage efficiency of large vessel occlusion detection systems

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Introduction:

Endovascular thrombectomy is the gold standard treatment for acute ischemic strokes with large vessel occlusions (LVO). Manual image analysis is often time consuming and requires clinicians to be skilled in reading perfusion scans, as well as vessel images. RapidAI software has an automated processor to detect LVO of the middle cerebral artery and is analyzed in this study. A novel metric, number-needed-to-review (NNR), is introduced to assess the clinical efficiency of this software.

Methods:

This is a retrospective review of patients with a suspected ischemic stroke and an image processed by RapidAI software from 11/1/2020 to 4/30/2021 at a regional hospital system. Only M1 LVOs were included. Sensitivities, specificities, positive predictive value (PPV), and negative predictive value (NPV) were calculated for the following: Rapid LVO detection, gaze deviation (GD), hyperdense sign (HDS), Tmax >6 seconds, and NIHSS at presentation. The NNR was calculated for an M1 occlusion.

Results:

559 patients were included in this study. M1 occlusion was detected in 42 (7.5%) cases. Rapid LVO detection software was found to have a sensitivity of 71%, specificity of 94%, PPV of 49%, and NPV of 92% for a M1 occlusion. When both GD and HDS were combined with Rapid LVO, the specificity and PPV increased to 100% for a M1 occlusion. A negative LVO software combined with either a low (<15 mL on Tmax >6s) or high (<50 mL on Tmax >6s) Tmax threshold were found to have a specificity and PPV of 100% for no M1 occlusion. The combination of GD, HDS, Rapid LVO+ (for M1 occlusion) and Rapid LVO- with a low Tmax threshold (for no M1 occlusion) yielded 24 images NNR per 100 cases. When the combination of GD, HDS, Rapid LVO+ was combined with Rapid LVO- and a high Tmax threshold, the NNR per 100 cases was 16. With the addition of NIHSS<7 for the remaining cases in the high Tmax group, the NNR per 100 cases decreased to 9.

Conclusions:

The addition of GD and HDS to the Rapid LVO increases the specificity and PPV for a M1 occlusion. When combined with a negative Rapid LVO detection and either a low or high Tmax >6s threshold, the NNR is significantly decreased. As few as 9 images per 100 would be needed to be manually reviewed by a clinician during stroke triage.

Keywords: Mechanical Thrombectomy

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

Plasminogen Activator Inhibitor-1 5G/5G Polymorphism – Do We Know all about it?

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Introduction:

The etiology of ischemic stroke is heterogeneous, and it has been proposed that different stroke subtypes might have different genetic architecture 1,2. The plasminogen activator inhibitor-1 (PAI-1) has been of particular interest due to its role in thrombotic diseases. Several polymorphisms have been found for this gene, with some having protective effect while others increase the risk of ischemic and hemorrhagic strokes 3,4. The protective role appears to be due to the role of PAI-1 in fibrinolytic cascade and that PAI-1 also inhibit plasmin-dependent metalloproteinases activation. We hereby, present a case of ischemic stroke in young adult and its association with our gene of interest.

Methods:

Case: We present a case of 43-year-old woman with past medical history significant for Acetylcholine Receptor (AChR) antibody positive Myasthenia Gravis diagnosed in 1993 status post thymectomy (1994), currently on prednisone and intravenous immunoglobulin every two weeks (failed cyclosporine and mycophenolate mofetil). She had two events in 2018 where she reported episodic right sided numbness and weakness that lasted for few hours. Stroke workup was done, and she was found to have focal moderate to severe stenosis of the left middle cerebral artery (MCA) on CT angiography (figure 1) with very subtle left hypoperfusion in the MCA on the brain single-photon emission computerized tomography scan. She underwent catheter angiogram (figure 1) showing severe stenosis involving the mid and distal M1 segment of the left MCA and nondominant proximal A1 segment left anterior cerebral artery (ACA). There were robust leptomeningeal collaterals from the left anterior and left posterior cerebral arteries. She also reported history of two miscarriages in the first trimester. Hypercoagulable workup was done and all of those were negative including: SLE profile, Lupus anticoagulant, ANA comprehensive panel, Cryoglobulin, Anticardiolipin antibody, Antithrombin III, Antithrombin antigen, protein C, protein S, Factor VIII activity, Factor V Leiden. She also had rheumatoid arthritis factor, Homocysteine, sedimentation rate, and C-reactive protein done which were unremarkable. Genetic workup showed that she is PAI-1 5G/5G homozygous. She has been stable since 2018 without new focal neurological events and is on Aspirin monotherapy and Statin.

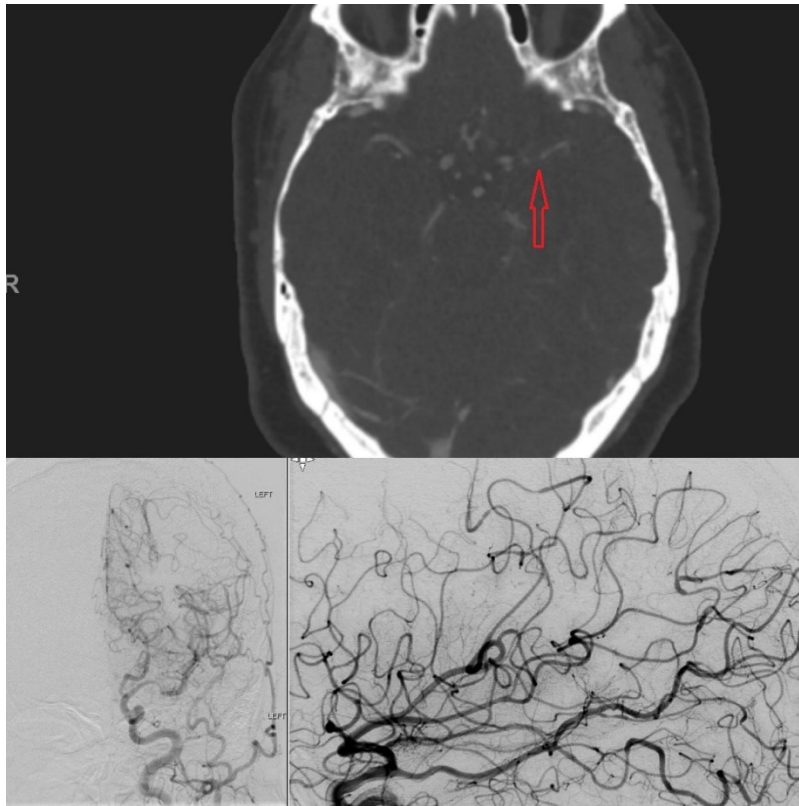
Results:

The genetics for stroke disease are very complicated and yet to be discovered fully. The association between PAI-1 5G/5G and intracranial stenosis has not been reported previously. New genetic associations will need to be increasingly considered as we assess our cerebrovascular diseases and stroke patients

Conclusions:

- With the current knowledge, ischemic stroke have polygenic basis but no single common “stroke gene” has been identified yet.

- Here we present a case suggesting that PAI-1 5G/5G genotype is may be associated with an independent risk of intracranial atherosclerosis.



Keywords: Acute Stroke, Imaging, Pathophysiology, Treatment

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

Predictors of Functional Outcome in Ischemic Stroke Patients with High Pass Number During Endovascular Therapy

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Introduction:

The number of thrombectomy passes during endovascular therapy (EVT) for large vessel occlusion (LVO) in acute ischemic stroke (AIS) has been associated with probability of favorable functional outcome, with worse outcomes correlating with greater pass number. While first-pass recanalization is a strong predictor of functional outcomes, the optimal or maximum recommended number of passes at which patients continue to benefit from EVT remains controversial. Moreover, among patients requiring more attempts, it is unclear if a certain subset of patients continue to benefit despite multiple passes. In this study, we determine predictors of functional outcome among patients requiring a high pass number to achieve successful vessel recanalization.

Methods:

From our prospectively maintained multi-institutional registry across 4 comprehensive stroke centers, we identified patients with LVO AIS who underwent EVT requiring ≥ 3 passes to achieve successful reperfusion, defined as $\geq$ TICI 2b. Patient demographics, co-morbidities, and severity of stroke based on NIHSS and ASPECTS were included within the analysis. Favorable outcome was defined as 90-day post-stroke modified Rankin Scale (mRS) 0-2. The primary outcomes were predictors of favorable outcome, which was assessed by multivariable logistic regression adjusted for age, baseline mRS, NIHSS, admission systolic and diastolic blood pressure, administration of tPA, number of passes during thrombectomy, history of hypertension, hyperlipidemia, atrial fibrillation, coronary artery disease, congestive heart failure, carotid stenosis, and diabetes.

Results:

Among 116 patients, median age was 70 (IQR 59-80), 48% were female, median NIHSS was 16.5 (IQR 13-22), and median number of passes was 3 (IQR 3-4, range 3-8). Patients with favorable outcome were younger (mean age 63 ± 18.1 vs 70 ± 14.5 , favorable vs. non-favorable, $p = 0.041$), and had lower NIHSS on presentation (mean 13.9 ± 6.0 vs 18.3 ± 7.4 , favorable vs. non-favorable $p = 0.003$). Patients with favorable outcome also had lower initial systolic blood pressure (149.6 ± 32.8 vs 163.0 ± 30.0 mmHg, favorable vs. non-favorable, $p = 0.047$). In multivariable logistic regression adjusted for demographics and clinical characteristics, lower NIHSS was significantly associated with likelihood of good outcome (OR 0.88, 95% CI 0.81-0.97, $p = 0.009$).

Conclusions:

Patients presenting with lower NIHSS are more likely to benefit from continued EVT attempts. These findings suggest that this population benefits from continued attempts at revascularization.

Keywords: Ischemic Stroke, Acute Stroke, Endovascular Therapy, Mechanical Thrombectomy

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

Predictors of Symptomatic Hemorrhagic Transformation After Mechanical Thrombectomy in Acute Ischemic Stroke

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Introduction:

Mechanical thrombectomy (MT) has become the current standard of care for large vessel occlusion stroke but is associated with an increased risk of intracranial hemorrhage (ICH). Although several studies have investigated the risk factors, there is still limited, not well-established data. This study aims to evaluate the risk factors of HT after MT.

Methods:

We retrospectively reviewed all MT patients who were treated at a single comprehensive stroke center from 12/2016 to 7/2019. Variables included initial NIHSS, blood glucose, initial systolic blood pressure, age, gender, IV tPA, time from door to recanalization, and TICl score. Outcome measures were HT on post-procedure or 24-hour post-tPA head CT/MRI as well as modified Rankin scale (mRS) upon discharge.

Results:

Among 74 patients (68.8 ± 14 years, men 47.3%), 9 (12.2%) experienced hemorrhagic transformation after thrombectomy. Average admitting NIHSS was significantly higher in the HT group (22 vs 16.8, $p=0.041$). TICl 3 after MT was protective for HT (OR 0.078, 95% CI 0.009-0.663). IV tPA (OR 3.86, 95% CI 1.448-10.326) was associated with good neurological outcome at discharge (mRS ≤ 2), but HT was not (OR 0.114, 95% CI 0.013-0.964). Patients with mRS ≤ 2 upon discharge were younger (65.2 ± 12 vs 71.9 ± 15 , $p=0.04$) and had lower initial BG (124 ± 45.8 vs 157 ± 69.6 , $P=0.02$).

Conclusions:

TICl 3 score, decreased NIHSS, and lower BG were associated with less HT and better outcomes in our MT cohort. Admitting NIHSS ≥ 20 may be a reasonable threshold to predict HT after MT. Our findings are consistent with the TICl-ASPECTS-glucose (TAG) score to predict sICH; however, we used initial NIHSS as a surrogate for ASPECTS. Further studies may utilize additional quantitative measures such as CTP data to predict HT.

Keywords: Thrombolytics, Hemorrhagic Transformation, Acute Stroke, TICl, NIHSS

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

Radial versus femoral artery access for mechanical thrombectomy following IV tPA administration

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Introduction:

The transradial artery (TRA) approach for neuroendovascular procedures has been demonstrated as a safe and effective alternative to the transfemoral artery (TFA) approach. The present study compares the efficiency and periprocedural outcomes of the TRA and TFA approach for acute stroke interventions in patients receiving intravenous alteplase.

Methods:

The study was designed as a retrospective analysis of patients who underwent acute mechanical thrombectomy at a large cerebrovascular center between January 2014 and March 2021. Intervention cohorts (TRA and TFA) were compared on baseline characteristics, periprocedural efficiency/efficacy, and in-hospital outcomes.

Results:

A total of 314 patients underwent acute mechanical thrombectomy following IV tPA via TRA (6.7%, 21/314) or TFA (93.3%, 293/314) approach. The overall complication rate appeared higher in TFA (6.8%, 20/314) compared to TRA (4.8%, 1/21) patients. Access site complications were present in 4.1% (12/293) of TFA patients and 0.0% (0/21) of TRA patients. The average length of stay (days $\pm$ standard deviation) was significantly greater in TFA (8.8 ± 8.5) vs. TRA (4.8 ± 2.9) patients ($P=0.02$). Linear regression analysis found femoral access ($p=0.046$), Medicaid ($p=0.004$) insurance, and discharge NIHSS >10 ($p=0.045$) as predictors of increased length of stay. However, when time to initial physical/occupation session was added to the model, access site was no longer significant.

Conclusions:

The TRA (vs. TFA) approach for acute stroke interventions following IV tPA administration may potentially reduce periprocedural complications and hospital length of stay. The reduction in length of stay with TRA access appears to be associated with earlier initiation of therapies.

Keywords: Mechanical Thrombectomy

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

Real-World Bridging with Intra-arterial therapy is safe after Tenecteplase in patients with Acute Ischemic Stroke

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Introduction:

The safety profile of IV tenecteplase (TNK) as a bridging therapy to Intra-arterial therapy (IAT) is not well-established in patients receiving acute ischemic stroke therapy. Our objective was to evaluate the incidence of hemorrhagic transformation in subjects who received TNK followed by IAT outside of clinical trial setting.

Methods:

Electronic medical records of subjects with stroke secondary to LVO who received TNK and IAT within 4.5 hours of last known normal were reviewed. CT head within 24 hours post-TNK was evaluated for hemorrhagic transformation (HT). Severity was determined by ECASS III criteria Symptomatic intracranial hemorrhage was defined as an increase in NIHSS greater than or equal to 4. Clinical outcomes were assessed with NIHSS at admission, discharge and mRS scores at one month. Z score population proportions were used for subgroup analysis. Social Science Statistics was used for data analysis.

Results:

From October 2020 to April 2021, 20 subjects received IV tenecteplase. Four subjects did not have LVO or undergo IAT and were excluded from study. Four subjects (25%) developed hemorrhagic transformation. Of this subset, 2 subjects (12.5%) had asymptomatic HI-1, 1 subject had symptomatic HI-2, and 1 subject had asymptomatic PH-1. One subject developed intracranial hemorrhage (ICH score 5) outside of stroke region (intraventricular, subarachnoid, infratentorial parenchymal) without evidence of hemorrhagic transformation of ischemic stroke. In subgroup analysis between subjects with HT and without HT, there was no statistically significant difference in intra-arterial non-thrombolytics ($z=0.1393$, $p=0.44433$); there was a trend towards significance in number of passes ($z=1.2534$, $p=.10565$) and periprocedural IV heparin use for intracranial stenting and/or angioplasty ($z=0.9342$, $p=0.17619$). There was a statistically significant increase of HT when periprocedural IV integrilin ($z=1.6727$, $p=0.04746$) was used.

Conclusions:

Our small subset of early real-world experience demonstrates a higher rate of symptomatic transformation in bridging with TNK when compared with alteplase. Larger prospective studies are needed to validate our findings.

Keywords: Angioplasty

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

Repeated Mechanical Thrombectomy for Recurrent Large Vessel Occlusion: A Meta-Analysis of Individual Participant Data

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Introduction:

Mechanical thrombectomy (MT) has become the standard treatment of acute ischemic stroke (AIS) caused by large vessel occlusion (LVO), with different techniques used to achieve revascularization of the occluded vessel. However, early re-occlusion of the target vessels could still take place in a considerable proportion of patients who already underwent MT for LVO. Therefore, we conducted this systematic review and individual participant data (IPD) meta-analysis to provide more comprehensive evidence regarding the efficacy of repeat thrombectomy for recurrent LVO in early after successful first-time MT.

Methods:

A computerized search on MEDLINE via PubMed, SCOPUS, Web of Science, EMBASE, and Cochrane library using the relevant keywords was performed. The retrieved references were screened, and the relevant data were extracted. STATA and SPSS were used to perform this IPD meta-analysis.

Results:

Twenty studies were included, of which ten studies were observational studies (n=21,251 patients) and 10 cases reports (n=10 patients). Out of the included patients, 266 patients (62.78% females) were identified with recurrent LVO. The overall prevalence of recurrent LVO was 1.6%, 95% CI (1.0% to 2.8%), p<0.001. The mean age of the included patients was 65.67±16.23 years. Cardiac embolism was the most common cause of stroke in both times (52%). The median number of days between the first and second LVO was 15 days (IQR: 4-191). Regarding the National Institute of Health Stroke Scale (NIHSS), the first and second MT reduced it significantly (MD= -8.91, 95% CI: -10.02 to -7.82) and (MD= -5.97, 95% CI: -7.53 to -4.43), respectively, with a significant difference between both procedures (p=0.001). The mean ASPECT after the first MT was 8.65±1.45, and after the second MT was 8.01±1.88. A significant weak correlation was observed between the ASPECT of first MT and NIHSS before it (r=-0.270, p=0.001). Based on the thrombolysis in cerebral infarction (TICI) grading system, the first MT resulted in 57.3% complete perfusion, 42.1% partially filling, and 0.7% no/minimal filling, while the second MT resulted in 48% complete perfusion, 30% partially filling, and 6.67% no/minimal filling, with a significant difference between both MTs (p=0.042). Regarding the modified Rankin scale (mRS) at 90 days after the first MT, "0" was the most frequent outcome (26.9%), followed by "2" (13.0%), "1" (12.4%), and "4" (7.3%). On the other hand, the 90-day mRS after the second MT was categorized as the following: "6" in 13.5%, "3" in 13.5%, "2" in 11.9%, "1" in 11.9%, and "4" in 9.3%.

Conclusions:

In properly selected patients with recurrent LVO, repeated MT appears to be feasible and safe. A prior MT procedure should not discourage aggressive treatment as these patients may achieve similar rates of good clinical outcomes as those who undergo single MT.

Keywords: Mechanical Thrombectomy, Acute Ischemic Stroke Intervention, TICI, NIHSS, MRS

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

Risk Factors Associated with Various Subtypes of Ischemic Stroke: A Prospective Study

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Introduction:

Stroke is the main cause of adult disability and the second most leading cause of death worldwide. The number of deaths due to stroke is 5.54 million worldwide. Stroke is also a major cause of long-term disability. Globally, 70% of strokes and 87% of both stroke-related deaths and disability-adjusted life years occur in low and middle-income countries. The incidence of stroke varies among various countries. Over the last four decades, the stroke incidence in low and middle-income countries has become more than doubled. . However, there are limited data and very few studies on various subtypes of ischemic stroke and their risks factors in our country. So, we purposively designed this study. The aim of this study was to investigate the risks factors associated with the various subtypes of ischemic stroke according to TOAST criteria.

Methods:

This was a prospective observational cross sectional study conducted during June-2019 to May-2020. A total of 220 ischemic stroke patients aged above 30 years confirmed by CT Scan/MRI of brain were included in this study. A complete history was taken regarding hypertension, diabetes, dyslipidemia, ischemic heart disease, current smoking history of previous stroke, positive familial history, coronary artery diseases, alcohol consumption and demographic characteristics were noted in the questionnaire. Hypertension was defined as systolic blood pressure (SBP) > 140 mmHg, diastolic blood pressure > 90 mmHg or both on two separate occasions, or the use of anti-hypertensive medication at any time before the onset of stroke. Diabetes was defined if fasting plasma glucose levels are 126 mg/dl or higher after an overnight fast on more than one occasion or as random blood glucose level 200 mg/dl or higher on more than one occasion. Ischemic stroke was classified according to TOAST criteria. Data were collected with a pre structured questionnaire from the patients' investigations reports and face to face interview with the researcher (an expert neurologist).

Results:

Among the 220 stroke patients, Large-artery atherosclerosis (LAA), Cardio-embolism (CE), Small-vessel occlusion (SVO, Stroke of other determined etiology (SODE) and Stroke of undetermined etiology (SUDE) were being observed 84(38.18%), 14(6.36%), 63(28.64%), 12(5.45%) and 47(18.18%). The highest prevalence of subtypes 70(31.82%) was found in the age group (51-60). The prevalence of subtypes was found 150(68.18%) in male and 70(31.82%) in female. 86(39.09%) prevalence of subtypes was found who were from rural areas whereas 134(60.91%) was observed in urban areas. The significant risk factors associated with the prevalence of various subtypes of ischemic stroke were observed Hypertension, Diabetes Mellitus, Smoking history, Dyslipidemia, Heart disease, H/O Previous Stroke , Positive Familial History, Coronary Artery Disease and Alcohol Consumption (p <0.05).

Conclusions:

The higher prevalence of Large-artery atherosclerosis (LAA) was found in this study. It suggests the influence of uncontrolled hypertension, diabetes mellitus, smoking habit and dyslipidemia. So, importance should be given on various subtypes of ischemic stroke and collective preventive measures and strategies are to be taken to control the associated risk factors especially hypertension, diabetes mellitus, smoking habit and dyslipidemia to decrease the stroke mortality rate.

Keywords: Extracranial Stenosis, Intra Caranial Stenosis, Acute Stroke, Ischemic Stroke, MRA

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

Risk of Distal Embolization in Large Vessel Occlusion Strokes Treated with Tenecteplase

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Introduction:

The use of IV thrombolytics and concomitant intra-arterial therapy (IAT) in large artery occlusion (LVO) has become standard of care in acute ischemic strokes. Distal embolization may limit the efficacy of revascularization with IAT. Distal embolization may occur spontaneously or secondary to IV thrombolytics. Our objective was to compare rates of distal embolization in subjects who received IV alteplase (tPA) or IV tenecteplase (TNK) followed by EVT.

Methods:

Electronic medical records of subjects with acute ischemic stroke secondary to MCA occlusion who received TNK or tPA and underwent IAT therapy were reviewed. Digital subtraction images were reviewed to evaluate for distal embolization prior to revascularization. To confirm distal embolization, pre-procedure CT angiogram or CT head hyperdense sign were reviewed. Z score for 2 population proportions was used to compare rates of distal embolization in tPA and TNK subjects. Social Science Statistics was used for data analysis.

Results:

From June 2020 to May 2021, 29 subjects received IV thrombolytics (tPA n= 12; TNK n=17) followed by IAT. Five subjects were excluded from the TNK group with tandem and/or ICA occlusion. Twelve patients in each group with MCA occlusions (M1 or proximal M2 occlusions were compared). Difference in distal embolization rates had a trend towards statistical significance ($z=-1.2649$; $p=0.10383$).

Conclusions:

The exclusion of tandem and/or ICA occlusions due to small sample size was a significant limitation of the study that affects generalizability to the strokes secondary to LVO. The trend towards statistical significance in higher distal embolization rates in subjects receiving TNK warrants larger, prospective studies to validate results.

Keywords: Angiogram

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

Safety and Effectiveness of MT for Primary Isolated Distal Vessel Occlusions: a Retrospective Comparative Study

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Introduction:

Distal vessel occlusions represent about 25-40% of acute ischemic stroke (AIS), either as primary occlusion or secondary occlusion complicating mechanical thrombectomy (MT) for large vessel occlusion. Our aim was to evaluate safety and effectiveness of MT associated with the best medical treatment (BMT) in the management of AIS patients with distal vessel occlusion in comparison with the BMT alone.

Methods:

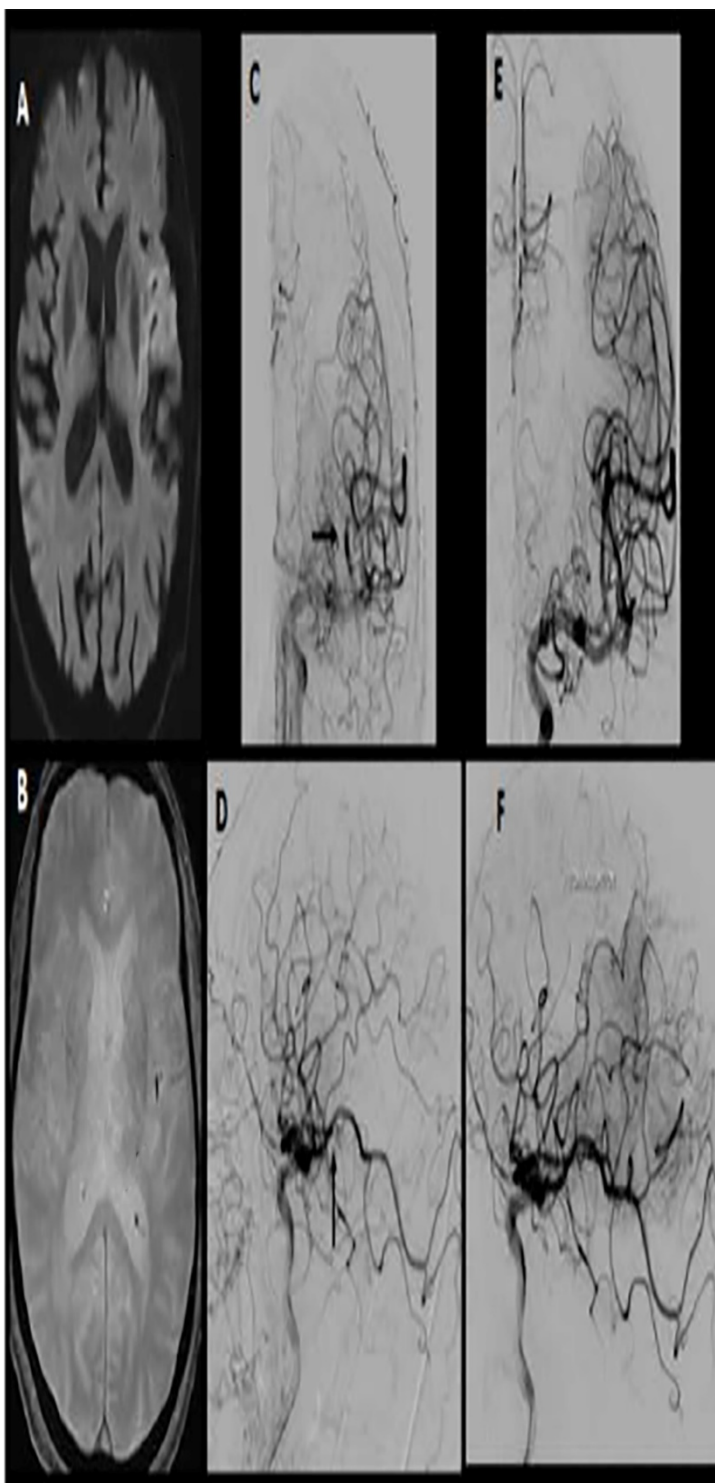
Retrospective analysis was conducted on AIS patients treated by MT+BMT for primary distal vessel occlusion between 2015 and 2020, and were compared with a historic cohort managed by BMT alone between 2006 and 2015 selected based on the same inclusion criteria. A secondary analysis was conducted using propensity score matching (PSM) including the following: NIHSS, age and treatment with intravenous thrombolysis (IVT) as covariates.

Results:

Of 650 patients screened, 44 patients with distal vessel occlusions treated by MT+BMT were selected and compared with 36 patients who received BMT alone. After PSM, 28 patients in each group were matched without significant difference. Good clinical outcome defined as mRS≤2 was achieved by 53.6% of the MT+BMT group and 57% of the BMT group (OR, 0.87; 95%CI, 0.3–2.4; P=1.00). The mortality rate was comparable in both groups (7% vs 10.7% in MT+BMT and BMT patients, respectively; OR=0.64; 95%CI, 0.1-4; P=1.00). Symptomatic intracranial haemorrhage (ICH) was seen in only one patient treated by MT+BMT (3.6%).

Conclusions:

Mechanical thrombectomy seems to be comparable with the best medical treatment regarding the effectiveness and safety in the management of patients with distal vessel occlusions.



Keywords: Mechanical Thrombectomy

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

Stenting Versus Medical Treatment for Chronic Internal Carotid Artery Occlusions: A Systematic Review and Meta-analysis

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Introduction:

Chronic internal carotid occlusion is responsible for 10-15% ischemic strokes or transit ischemic attacks (TIA). Subsequent ipsilateral ischemic stroke rate is 5.9% per year. However, this risk can increase up to 23% in two years in a subgroup of patients with poor collaterals regardless of medical therapy with antiplatelet or anticoagulant agents. Prevention of subsequent stroke in patients with carotid artery occlusion remains a difficult challenge. Carotid artery stenting (CAS) has recently been considered in its management. However, there is ambiguity on its safety. We aim to evaluate the safety and feasibility of CAS and compared it with medical management.

Methods:

We performed a systematic review and meta-analysis to compare long-term outcome (stroke recurrence) of current carotid occlusion treatments (CAS vs medical therapy). Two independent reviewers performed the screening, data extraction, and quality assessment. A random effects model was used for analysis.

Results:

A total of 5720 studies were screened. Of these, 11 studies were included in our systematic review and meta-analysis of proportions. The CAS group has lower proportions of recurrent strokes (5% vs 30%,) after 30 days than medical therapy alone. Additionally, the proportion of periprocedural intracranial hemorrhage was 4.4% (95% CI 2.5 to 6.8) in the CAS group.

Conclusions:

CAS of the chronically occluded cervical ICA seems to be a safe procedure with lower rates of recurrent stroke in clinical follow up. Future randomized studies are warranted to guide the optimal management of this complex disease.

Keywords: Carotid Stenting And Angioplasty, Carotid, Medical Management,

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

Stroke center accessibility study in the U.S. using geospatial analysis and machine learning.

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Introduction:

Background: Several accrediting bodies certify the level of stroke care hospitals provide. The Joint Commission on Hospital Accreditation (JC) is the largest accrediting body in the United States. There is no open source Geographic Information Systems (GIS) dataset showing the distribution of JC accredited centers by ZIP code. Objective: to create a stroke center accessibility and stroke center desert system using geospatial analysis and machine learning which provides real-time assessment of stroke center availability, distribution and access to care.

Methods:

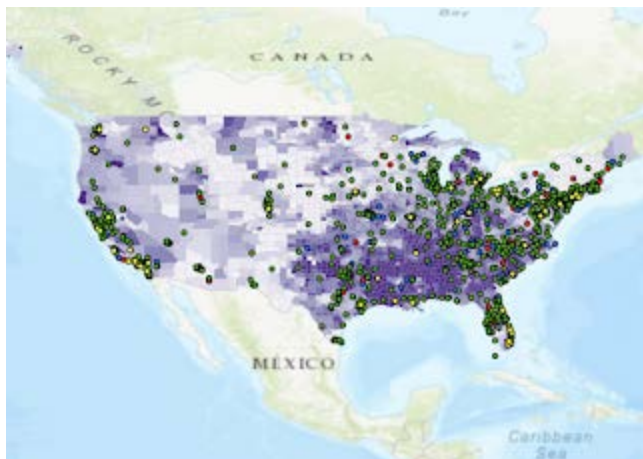
Geospatial data layers of JC accredited stroke centers were compiled using data sources including U.S. Census Bureau and CDC. Map layers corresponding to the levels of JC accredited stroke hospitals geolocated using ZIP code were created as follows: 1) Acute Stroke Ready 2) Primary 3) Thrombectomy Capable 4) Comprehensive Stroke Center. A GIS dataset displaying stroke mortality by region was obtained from the ArcGIS Living Atlas. Stroke center deserts are analyzed using a 4.5 hour drive map along with population and diversity. Machine learning models were implemented to estimate stroke mortality as a function of distance to care centers and capability levels of the stroke centers.

Results:

Stroke centers are highly concentrated within large urban centers. There are geographic regions that have poor access to stroke centers. Such regions include the Gulf Coast States of Louisiana, Mississippi, and Alabama that have large areas with poor stroke center access while having some of the highest stroke mortality in the country. (Figure 1 - Stroke Center Distribution in the United States) Dot Symbols: Blue = Acute Stroke Ready; Green = Primary; Yellow = Thrombectomy Capable; Red = Comprehensive Raster Data: Stroke Mortality by ZIP Code; White to Purple Scale with Purple = Highest Mortality

Conclusions:

There are regional variations in stroke center availability. There are certain regions with high stroke mortality with very little stroke center access. Geospatial AI tools can be utilized to improve stroke systems of care.



Keywords: Acute Stroke

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

The Carotid Web and Ischemic Stroke - A Case Report

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Introduction:

Case report: 63 year old African American woman with history of hypertension presented with acute onset of expressive aphasia. Her neurologic exam and NIHSS was significant for moderate aphasia with paraphasic errors and impairment of repetition. She was outside the treatment window for IV thrombolytic therapy. CT angiography of the head and neck in the ED showed moderate 60-70% stenosis of the left internal carotid artery secondary to a carotid web. She was admitted to the stroke service and started on DAPT with ASA and clopidogrel. MRI brain was obtained, which confirmed a small acute infarct in the posterior margin of the left sylvian fissure.

Methods:

Intervention and Follow-up: Vascular surgery and interventional neurology were consulted to discuss the treatment options for the patient's carotid web. Give the unique nature of the patient's web with its triple lumen appearance, carotid endarterectomy (CEA) was favored over stenting, and the patient underwent left CEA. There were no immediate complications, and she was continued on DAPT for 21 days, then ASA monotherapy. One month follow-up carotid dopplers of the left ICA showed patent flow without significant stenosis. On follow-up evaluations at 3 and 12 months, the patient's speech deficits had improved significantly and she reported no new stroke-like symptoms.

Results:

Literature Review: Carotid webs (CaW) may be a potentially underrecognized cause of ischemic strokes. CaW are thin, fibrous tissue that extends from the wall of the carotid artery into the lumen in a shelf-like projection. It is believed to be a variant of fibromuscular dysplasia. It is hypothesized that blood stasis on the downstream surface of the web may result in thrombus formation and thromboembolic stroke. The optimal treatment for CaW remains unclear, however there is some evidence to suggest that antiplatelet therapy alone may be insufficient to prevent recurrent stroke, with rates of recurrent stroke of 30-50% from a systematic literature review. Furthermore, there have been no reports of CaW positive remodeling over time, so patients likely remain at elevated risk for ischemic stroke without intervention.

Conclusions:

Discussion: Case series as well as systematic literature review have shown high rates of stroke recurrence in CaW patients treated with medical therapy alone. Data is still limited, however, CEA and carotid artery stenting (CAS) appear to be safe and effective revascularization procedures for CaW, with potentially significant reduction in recurrent stroke risk. CEA was preferred in our patient case due to the triple-lumen appearance of the carotid web (Figure). CaW is a relatively underappreciated cause of ischemic strokes and the optimal management is not well-established, however medical therapy alone appears to be sub-optimal with high rates of stroke recurrence. Our patient case shows that carotid revascularization can be safe may be effective in preventing stroke recurrence.

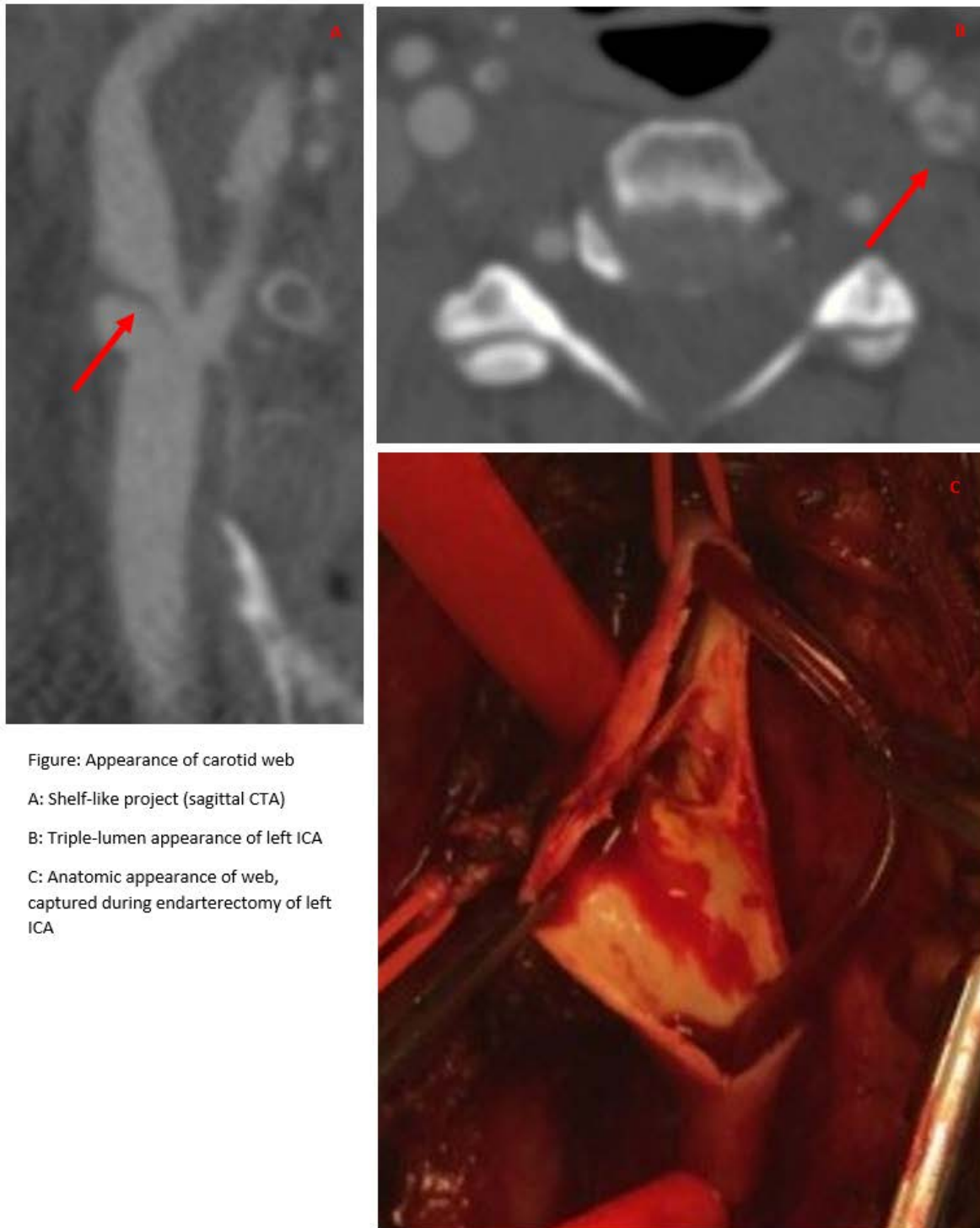


Figure: Appearance of carotid web

A: Shelf-like project (sagittal CTA)

B: Triple-lumen appearance of left ICA

C: Anatomic appearance of web, captured during endarterectomy of left ICA

Keywords: Vascular Imaging, Extracranial Stenosis, Carotid, CEA

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

The Effect of COVID-19 on Stroke Treatment in Africa

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Introduction:

One of the most common neurological sicknesses in healthcare today is acute ischemic stroke. Stroke is associated with symptoms such as neurological damage, and can only be effectively treated with a few methods. One such treatment is mechanical thrombectomy, and in this study, research was done on how the COVID-19 pandemic affected stroke treatments (specifically MT) in Africa.

Methods:

Initially, data of 58 countries in Africa was compiled and put in a spreadsheet. Soon after, the countries that would be most desirable for the study were found. These “target countries” had the highest populations (as of 2020), number of COVID-19 cases (as of October 2020) and number of incident stroke cases (in 2016) in Africa. This group consisted of countries such as Nigeria, Ethiopia, Egypt, and South Africa. Afterwards, neurologists, neurosurgeons, professors of neurology, and neurointerventionalists from the “target countries” were contacted via email. This email invited these individuals to hold an interview or fill out a survey regarding the impact COVID-19 on stroke treatment in their hospital. After sending approximately 50 emails, 3 survey responses were received and 3 interviews were held.

Results:

Following the interviews and after reading survey responses, impairments to mechanical thrombectomy appeared to be the frontrunner of the barriers mentioned. Other important barriers mentioned were: time barriers, rehabilitation barriers, as well as fear of seeking treatment in places of high COVID-19 concentration. The practice of MT is well-established in North America and Europe; however, it is still rather undeveloped in Africa. All doctors interviewed and surveyed indicated that the pandemic practically brought operations to a halt (only one doctor recorded two successful procedures during the pandemic). In Egypt specifically, there has been a lack of equipment and PPE. This is mainly because hospitals are dedicating staff and equipment to COVID-infected patients. The secondary barriers also contributed to problems in hospitals. Due to more screenings and less staff during the pandemic, time for patients to receive treatment has increased. Rehabilitation for stroke patients has been impacted by a lack of prescriptions from pharmacies. Finally, in certain parts of Africa people are too afraid to visit hospitals due to the risk of possibly being infected with COVID-19. The barriers imposed by the pandemic have made stroke treatment significantly more difficult.

Conclusions:

In conclusion, the COVID-19 pandemic has negatively affected stroke treatment in certain areas of Africa. Doctors have faced several key barriers that has limited the effectiveness of stroke treatment during the time period. Based on doctor recommendations, improving in the practice of mechanical thrombectomy is the most effective solution to ensuring stroke treatment is proficient. This could be done through awareness, education, and better equipment.

Keywords: Mechanical Thrombectomy

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

The Role of the Venous System in Infarct Burden in Patients with Acute Ischemic Stroke

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Introduction:

Acute ischemic stroke (AIS) is a leading cause of disability internationally. Most therapies focus on intra-arterial treatment to improve post-stroke deficits and neurologic status. However, if a relationship between venous anatomy and post-stroke deficits or infarct size can be shown, then venous augmentation strategies represent a possibility for future interventions as an adjunct to intra-arterial treatment.

Methods:

We retrospectively reviewed all ischemic infarcts at our institution that underwent thrombectomy from January 2018 – October 2020. From these, we selected cases that were demonstrated as M1 occlusions on intra-procedural angiogram and those who had a CT Head obtained within six hours of the patient's last known normal (LKN). Patients without a CT Head or CT Angiogram of their head were excluded. Using axial and sagittal reconstructed views of 0.9mm slices, cross-sectional area measurements were taken of the superior sagittal sinus 1cm above the Torcula, in three locations of the ipsilateral and contralateral transverse sinus, in three locations of the ipsilateral and contralateral sigmoid sinus, and of the ipsilateral and contralateral internal jugular vein (IJV) at the external surface of the skull. For the transverse and sigmoid sinuses, the three measurements were averaged together. These measurements were then compared against patient's Alberta Stroke Program Early CT Score (ASPECTS).

Results:

77 patients were identified in the study period. Average ASPECTS was 8.9, ranging from 5-10. There were three patients included with ASPECTS < 6. Average ipsilateral transverse sinus area was 34.4mm² ± 3.34, average ipsilateral sigmoid sinus area was 32.8mm² ± 2.74, average ipsilateral IJV area was 46.9 mm² ± 5.00. Correlation tests to identify relationships between venous sinus area and ASPECTS was unremarkable (ipsilateral transverse sinus p=0.574, ipsilateral sigmoid sinus p=0.548, ipsilateral IJV p=0.798). When assessed as a ratio of ipsilateral venous sinus area to contralateral sinus area to assess correlation with ASPECTS, results were unremarkable (transverse sinus p=0.891, sigmoid sinus p=0.292, IJV p=0.499).

Conclusions:

Venous sinus size was not found to be predictive or associated with predominantly favorable ASPECTS for strokes found within six hours. We believe this may be due to our cohort lacking significant numbers of patients with low ASPECTS, yielding a false negative result. We are currently expanding this project to include a comparable number of patients with ASPECTS < 6 to determine the role of venous collateral system in infarct progression.

Keywords: Acute Stroke, Cerebral Blood Flow, Ischemic Stroke, Diagnostic Neuroradiology

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

Thrombectomy Treatment Strategies for Refractory Occlusions

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Introduction:

We sought to compare endovascular strategies in patients with intracranial occlusions refractory to stentriever thrombectomy.

Methods:

With approval, we retrospectively reviewed all acute stroke endovascular interventions from our center from July 2013 to September 2016. Of 294 interventions, we reviewed 151 patients with an intracranial internal carotid artery occlusion or middle cerebral artery M1 occlusion. Of these, 107 were treated initially with a stentriever, and had a completed procedure with < 2 device passes. Forty-three had > 2 passes and were grouped as continued intervention with the same device (Group 1), switch to a different stentriever design (Group 2), switch to aspiration (Group 3), or alternating therapy with continued mechanical and aspiration thrombectomy (3 patients). Our endpoint was procedural time from ground puncture to end of intervention. We used a t test to compare mean procedural times of Groups 2 and 3 against Group 1 to assess for meaningful differences in treatment duration.

Results:

We identified 15 patients in Group 1 with a mean procedural time of 95 minutes (sd 21 minutes); 13 patients in Group 2 with a mean procedural time 89 minutes (sd 1 minute); and 12 patients in Group 3 with a mean procedural time of 81 minutes (sd 9 minutes). We observed a trend toward shorter procedure times when switching to a different stentriever design after two failed attempts with an original device (t score 1.0, 95% CI -18-6, p=0.31). A statistically lower difference procedural time was noted with a transition to aspiration (t score 2.2, 95% CI -27-0.6, p=0.04).

Conclusions:

When dealing with refractory occlusions to mechanical embolectomy, switching therapy to direct aspiration may benefit over continued use of the same or different stentriever design. The possibility of shorter procedural times suggests the value of a prospective design to study this clinical question.

Keywords: Mechanical Thrombectomy

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

Transient Blood Flow Reversal In The Vertebral Artery As An Embolic Protection Method During Angioplasty/Stenting

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Introduction:

Approximately 20% of all acute ischemic strokes occur in the vertebrobasilar (VB) circulation. Similar to carotid stenosis, symptomatic vertebral artery (VA) stenosis is associated with a high risk of stroke recurrence. The use of embolic protection devices for recanalization in the setting of carotid stenosis in order to improve clinical outcomes is well established. Recent randomised trials have failed to demonstrate improvement of clinical outcomes in VB stroke patients treated with stenting. To our knowledge, these studies did not require the use of embolic protection devices or techniques. This may be due to several factors. Firstly, since the caliber of the stenotic segment of VA is not large enough to safely allow the protection device delivery system to pass through, initial angioplasty without protection is needed. Secondly, the most common segment of VA to become stenotic is its origin, and usually after stenting of this segment, the edge of the stent is protruding into the SCA. When the angle of the VA relative to the SCA is acute, passing the filter capture catheter through this protruded stent is very difficult and dangerous.

Methods:

We are introducing a VA reversal blood flow technique for prevention of emboli through the VB system in the setting of symptomatic extracranial VA stenosis. In this technique, we used a balloon tip guide catheter in order to transiently occlude the proximal segment of the SCA, causing flow arrest. We then evaluated the presence of blood flow reversal in the VA. Theoretically, this induction of blood flow reversal in the VA can be considered protective because it washes the embolic particles into the distal SCA.

Results:

Of the 11 cases of VA origin symptomatic stenosis, 4 had desirable VA blood flow reversal after balloon occlusion trial. These patients had successful angioplasty-stenting of the VA origin using balloon mounted stent without major complications such as ischemic stroke in the posterior circulation territory.

Conclusions:

This study demonstrates the feasibility of proximal SCA balloon occlusion to cause transient flow reversal in the VA during angioplasty +/- stenting of the proximal VA. Future studies are required to determine the effectiveness of this approach in the setting of extracranial VA stenosis due to atherosclerosis, especially at its proximal segment.

Keywords: Balloon Guide Catheter, Atherosclerosis

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

Two World Wars, Two Pandemics and Then Stroke: Thrombectomy, Angioplasty and Stenting in a 110-Year-Old Patient

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Introduction:

Endovascular thrombectomy (EVT) is the standard of care in patients with acute stroke due to large vessel occlusion. In an aging population it is important to know EVT outcomes in old age, despite patients over 80 years are mostly excluded from major trial. While the oldest reported patients undergoing EVT was 102 years old, we report a 110 years old patient as the oldest patient undergoing EVT for stroke reported in the literature, and discuss the technical details and outcome.

Methods:

n/a

Results:

A 110-year-old patient presented with right side weakness and slurred speech and found to have left middle cerebral artery occlusion. She received tenecteplase and transferred to angio-suite 1 hour and 35 minutes after onset of symptoms. Left middle cerebral artery underwent two passes with stentriever, balloon angioplasty and stent deployment resulting in thrombolysis in cerebral infarction (TICI) 3 reperfusion. Brain MRI showed infarction in the left basal ganglia and left temporal cortex. After thrombectomy she was able to hold right arm and leg against gravity and follow commands. However, patient developed aspiration pneumonia and passed away after family chose to focus care on her comfort and refused tracheostomy and gastric tube.

Conclusions:

Despite poor clinical outcome, this case presents technical success in good recanalization, resulting in small infarct core and immediate neurological improvement in the oldest reported acute stroke patient undergoing thrombectomy.

Keywords: Acute Ischemic Stroke Intervention, Endovascular Therapy

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

Underlying ICAD is associated with worse outcome in acute large vessel occlusion undergoing endovascular therapy

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Introduction:

Acute large vessel occlusion (LVO) can be secondary to thromboembolism or underlying intracranial atherosclerotic disease (ICAD). Data on the management of LVO due to underlying ICAD are scarce. We hypothesized that patients with ICAD would have worse clinical outcomes following mechanical thrombectomy (MT) than those without ICAD.

Methods:

We performed a retrospective analysis of consecutive patients who underwent MT for LVO in a large academic comprehensive stroke center between 01/2018 and 05/2021. Presence of underlying ICAD at the site of LVO was determined by the treating interventionalist. We compared outcomes including in-hospital mortality and 90-day modified Rankin Scale (mRS) between those with and without underlying ICAD, adjusting for relevant covariates using logistic regression.

Results:

Among 195 patients (mean age 67.4±15.1 years, 56.9% female, 81% black, median NIHSS score 15), underlying ICAD was present in 39 (20.0%). Stent-retrievers were used in 196 patients with only 3 having rescue stent placement. There were no significant differences in baseline factors amongst the two groups except diabetes was more common (69.2% vs. 49.7%, p=0.028) and intravenous thrombolysis provided less often (17.9% vs. 36.5%, p=0.027) in those with ICAD. TICI 2B or higher was achieved in 82.1% of ICAD compared with 94.3% of non-ICAD patients (p=0.012). Mortality was more common (50.0% vs. 30.8%, p=0.025) and good functional outcome (mRS 0-2) at 90 days was less common (10.8% vs. 30.0%, p=0.002) in the ICAD group. Adjusting for age, diabetes, intravenous thrombolysis, baseline NIHSS score, and final TICI score, underlying ICAD was an independent predictor of mRS 0-2 at 90 days (OR 4.5, 95% CI 1.4-14.2, p=0.010).

Conclusions:

Underlying ICAD is associated with 4.5-fold increase in poor functional outcome in patients with LVO undergoing traditional MT. Further research is needed to understand factors associated with poor outcomes investigate alternative interventional approaches and medical management in this high-risk population.

Keywords: Mechanical Thrombectomy, Ischemic Stroke, Acute Ischemic Stroke Intervention, Endovascular Therapy, Atherosclerosis

Financial Disclosures: The authors had no disclosures.

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Poster

Vertebral Origin Stenting Appears Safe and is Associated with Improved Functional Outcome at 3 Months

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Introduction:

Stenosis of the vertebral artery origin (VAOS), while under-diagnosed, is common and may cause up to 25% of posterior circulation infarctions. Stenting is widely employed as a secondary prevention strategy, but clinical studies of safety and efficacy are limited compared to carotid interventions.

Methods:

This is a retrospective observational cohort study of subjects who underwent vertebral origin stenting at two large academic centers. The demographic profile of the subjects, medical comorbidities, and radiological parameters were all collected. Primary safety outcome was defined as 30-day post-procedure complications. Secondary safety outcomes included periprocedural complications and change in the pre-procedure Modified Rankin score (mRS) at 3 months of follow-up.

Results:

There were 80 subjects who underwent vertebral artery stenting in this cohort. Mean age was 66.6 ±10.2 years, 72.5% (n=58) were male, 70% (n=56) were Caucasian. 53.8% (n=43) were treated for the right VA, 72.5% (n=58) received second-generation drug-eluting stents (DES). Hypertension 67.5% (n=54) and hyperlipidemia 65% (n=52) were the most prevalent vascular risk factors. 76.3% (n=61) of subjects were symptomatic at presentation. There were 8 adverse events identified at 30 days (10%): 3 strokes in the same vascular territory (2 minor and without permanent disability), 1 stroke in a different vascular territory, 2 subjects with worsening of symptoms attributable to the posterior circulation, 1 GI bleed, and 1 femoral thrombosis. 3 of these subjects were found to have ipsilateral tandem stenosis and 1 patient died due to distal occlusion and large cerebellar infarction. There were 4 (5%) adverse events identified in the immediate periprocedural period: 1 vertebral dissection, 1 in-stent thrombosis, 1 SCA embolism, and 1 stent migration. mRS of these patients remained the same at 30 days and 3 months of follow-up. Overall, the Modified Rankin score was significantly lower at 3 months versus the pre-procedure (Z=-2.45, p=0.01).

Conclusions:

This large cohort of subjects undergoing vertebral origin stenting demonstrates a low incidence of procedural complications and adverse outcomes at 30 days. mRS was significantly lower at 3 months. While disability seemed to decrease in this population, longer prospective efficacy endpoints are needed to better evaluate this therapy.

Keywords: Vertebral, Stenting, Cerebrovascular Disease, Endovascular Therapy, Extracranial Stenosis

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

EVD Weaning Criteria Decreases VPS/ETV Placement And Hospital Stay In Subarachnoid Hemorrhage Patients

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Introduction:

The Neurocritical Care Society encourages an external ventricular drain (EVD) wean “as quickly as is clinically feasible” but guidelines on achieving it are limited (1). This study aims to improve quality of care by sharing a protocol to initiate EVD weaning. These criteria were developed over 7 years and showed a reduction in ventriculoperitoneal shunt/endoscopic third ventriculostomy (VPS/ETV) placement and length of stay (LOS) at our institute compared to national averages.

Methods:

151 subarachnoid hemorrhage (SAH) patients from January 2016 to January 2019 were analyzed. 60 aneurysmal SAH (aSAH) and 18 non-aneurysmal nontraumatic SAH (naSAH) patients required EVD placement. A gradual EVD weaning protocol was initiated if patients met the following criteria: the reason for EVD placement has resolved or is resolving, quantity of CSF output must be <250mL over 24 hours, quality of CSF must be nonbloody, ICP must be within normal limits, and the patient must be neurologically stable. It was acceptable to wean when the patient had mild cerebral vasospasm, but not moderate to severe cerebral vasospasm. EVD weaning was performed by increasing drain height by 5 millimeters of mercury every 24 hours if criteria were met. Charts were reviewed for LOS and rate of VPS/ETV. Gender, age, race, wean failure incidence, infection rates, and SIADH/CSW rates were obtained.

Results:

Average LOS for aSAH patients with EVD at our institute was 20.35 days. Incidence of VPS/ETV was 11%. Chi-square analysis was performed, and aSAH patients were found to have higher rates of VPS/ETV placement ($p < 0.001$) and EVD wean failures ($p < 0.001$) than naSAH patients.

Conclusions:

Our criteria to initiate EVD weaning provided a reduction in VPS/ETV placement among aSAH patients compared to national averages and provides a standardized approach to EVD management. aSAH patients at our institute had a lower incidence of VPS/ETV placement of 11% compared to 21% nationally (2). aSAH patients at our institute also had a lower LOS at 20.35 days compared to 21.5 days nationally (3).

Keywords: SAH, Aneurysm, Clinical Investigations, Medical Management

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

A survey of current status and roles of interventional neurologists in Japan

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Introduction:

In Japan, there are more board-certified neurosurgeons than board-certified neurologists, and a significant part of stroke practice is provided by neurosurgeons. In neuroendovascular therapy practice, the trend of neurosurgeons to be in majority is more pronounced. The most of neuroendovascular therapy specialists (n = 1,586) certified by the Japanese Society for Neuroendovascular Therapy (JSNET) consists of neurosurgeons, and the proportion of neurologists/internists is only 8% (n = 128) as of April 2021. The aim of this study is to investigate the current status and roles of interventional neurologists, the minority providing neuroendovascular therapy, in Japanese clinical setting.

Methods:

Between 16th and 28th February 2021, the Japan Society of Vascular and Interventional Neurology (JSVIN) conducted a survey for society-member neurologists and internists using questionnaires on Google Forms. The questionnaires consisted of 11 items regarding years after graduation, facility location, department, work style (full-time or concurrent interventionalist), diseases for which respondents were engaged, disease/procedure preferences which respondents would treat by themselves, respondents' roles in their own neuroendovascular therapy team, and others.

Results:

Replies were obtained from 112 (67.1%) out of all JSVIN-member neurologists and internists (n = 167). The respondents included 71 JSNET-certified specialists and they consisted of 56.3% of all the JSNET-certified neurologists/internists. The departments to where the respondents belonged were Neurology in 66%, Cerebrovascular medicine in 25%, Neuroendovascular therapy in 4%, and Neurosurgery in 3%. The median years after graduation was 15 years (interquartile range, 10 – 21 years) and the proportion of respondents who have graduated 10 years or less was 30%. Respondents' facilities were distributed around 27 prefectures of all 47 Japanese prefectures and a significant proportion of those was located in urban area; 20% in Osaka and 13% in Tokyo. The number of full-time interventionalist was only 1. Sixty-three (56%) were concurrently engaged in general neurology practice, and 33 (30%) in stroke neurology practice. The proportions of diseases for which the respondents were engaged were ischemic cerebrovascular diseases (acute large vessel occlusion strokes, carotid stenoses, and others) in 100%, hemorrhagic cerebrovascular diseases (cerebral aneurysms, arteriovenous shunts, and others) in 44%, and other diseases (tumors, spinal vascular disorders, and others) in 28%. The proportions of disease/procedure preferences which respondents would treat by themselves were acute stroke thrombectomy in 90%, carotid/intracranial stenoses in 87%, ruptured cerebral aneurysms in 38%, unruptured cerebral aneurysms in 31%, cerebral arteriovenous shunts in 33%, brain tumors in 29%,

spinal vascular disorders in 13%, and pediatric diseases in 3%. Respondents' roles in their own neuroendovascular therapy team were diagnostic performances based on neurologist's skills in 89%, comorbidity assessment and management based on internist's skills in 88%, precise neurological evaluation in 77%, neurosonological evaluation in 75%, and establishments of in-hospital workflow/multi-disciplinary collaboration in 71%.

Conclusions:

Most of interventional neurologists in Japan were engaged in neuroendovascular therapy mainly for ischemic cerebrovascular diseases in parallel with general neurology and/or stroke neurology practices. Interventional neurologists' skill set developed in neurology/internist trainings and practices might contribute to the quality improvement of neuroendovascular therapy in Japan.

Keywords: Neurointerventional Training

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Grant Support: None.

Poster

Area Deprivation Index and Transfer Likelihood Offer Insight into Improving Stroke Care Access Equity

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Introduction:

Time is brain for stroke care. Socioeconomic disparities may have an impact on timely access to stroke care. A well known factor that affects access to thrombectomy is the necessity for transfer from a non-thrombectomy capable center to a thrombectomy capable center (TSC). The Area Deprivation Index (ADI) is a validated, neighborhood-level composite measure (scored 1-100) which uses income, education, employment, housing quality, and other factors to identify geographic areas with increased need. We analyzed the association between ADI and requirement of transfer prior to thrombectomy to further understand how establishment of TSCs in areas with higher ADI and severity score bypass protocols can increase access to stroke care across all ranges of socioeconomic need.

Methods:

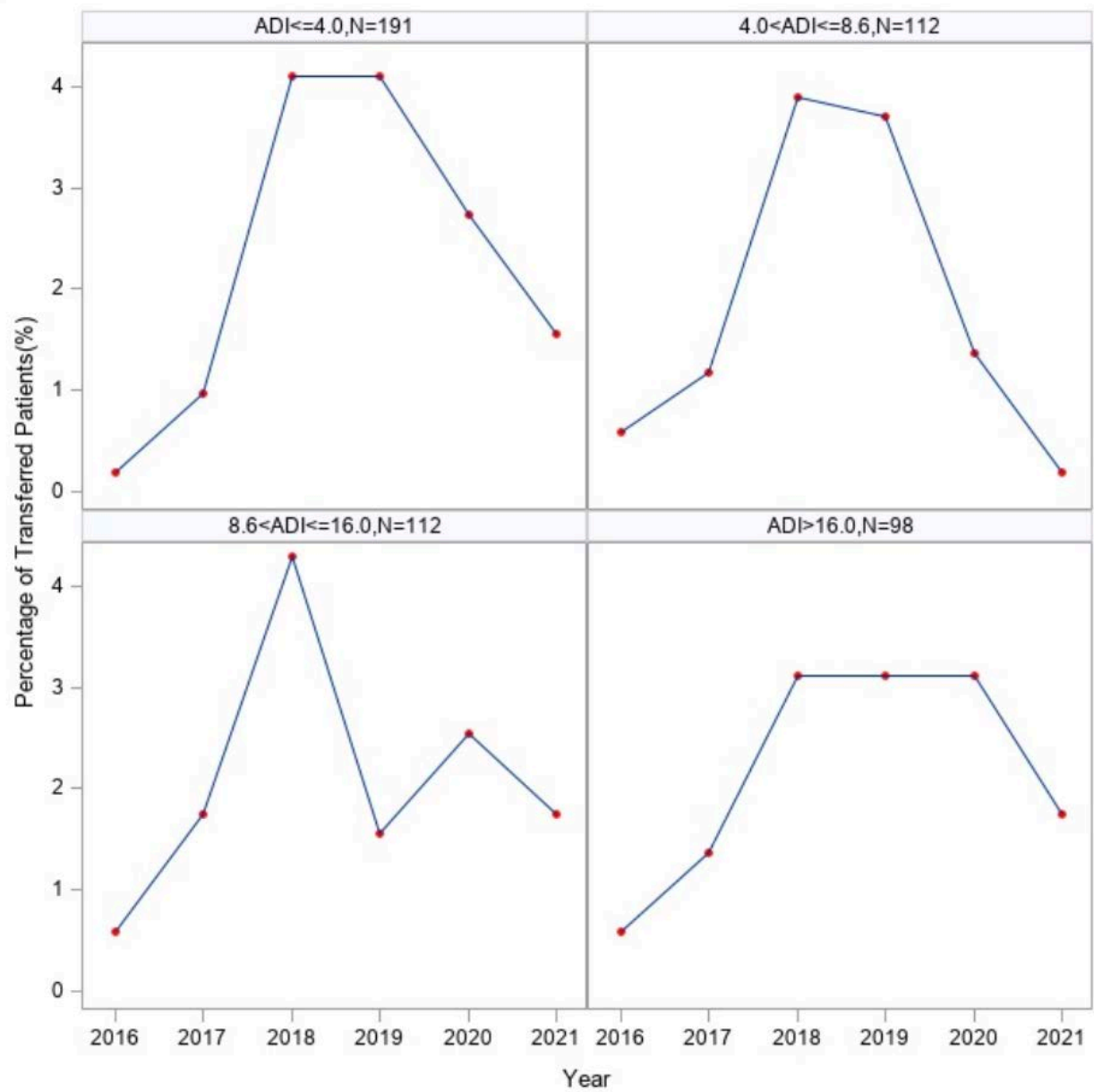
We obtained transfer status and the duration of the transfer time for all thrombectomy patients treated between 2016 and 2021 in a large, urban multi-hospital health system and matched them with their respective census-tract level ADI scores from Neighborhood Atlas, with a higher ADI score signifying lower socioeconomic status. Preliminary analysis utilized logistic regression to compare the ADI between transfer and non-transfer cases. Further exploration observed temporal changes to the percentage of patients requiring transfer across 4 ADI ranges.

Results:

Among 513 cases for which we had a pick up address for between 2016-2021, the average ADI of pick-up locations was 10.3 (range: 1 - 70.5). ADI was significantly predictive of transfer status ($p=0.0004$), with a 1 unit increase in ADI increasing the odds of being transferred by 1.035. Patients requiring transfer took an average of 2.7 hours longer to thrombectomy compared to non-transfer patients. However, within the transfer population, a higher ADI did not correlate with increased transfer time. Across all ADI ranges, the likelihood of transfer began to decrease in 2018. This is likely due to the establishment of a new TSC in 2018 as well as the implementation of an EMS triage protocol transporting patients with a higher severity of stroke directly to TSCs. Notably, patients in the highest ADI range did not experience decreased likelihood of transfer until 2020, correlating with establishment of another TSC.

Conclusions:

Across urban census tracts, patients with a higher ADI had an increased likelihood of transfer, and hence delay in access to thrombectomy. Equity to access to thrombectomy improved over time. Expanding thrombectomy access as well as establishing EMS triage protocols appear to correlate with improvement in access to stroke thrombectomy care for patients with higher ADI.



Keywords: Acute Ischemic Stroke Intervention, Epidemiology

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Poster

Characteristics and Utilization of Acute Reperfusion Therapy after Transfer of In-Hospital LVO Strokes

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Introduction:

Acute reperfusion therapy for acute ischemic stroke is a crucial tool in the tertiary care setting for patients presenting with large vessel occlusion (LVO). While strokes that present from the community have favorable outcomes compared to in-hospital strokes, it is unclear if this is because of greater access to endovascular therapy. We aim to characterize the utilization of endovascular reperfusion therapy for in-house LVO and compare outcomes of in-house LVOs to those presenting from the community.

Methods:

From the period of December 2013 to December 2019, all stroke patients with an LVO who presented to a primary stroke center ("spoke" hospital) who were transferred to a comprehensive stroke center ("hub") were analyzed. Univariate and multivariate analyses were performed to compare baseline characteristics and clinical outcomes.

Results:

A total of 181 in-house strokes were transferred from a peripheral center to our comprehensive stroke center. About 16% (29) received IV-tPA at the OSH and 2 additional patients received IV-tPA at the CSC [17%; n=31]. 163 patients harbored an intracranial acute vessel occlusion. Anterior LVO (ICA, M1, M2) and basilar artery occlusion was observed in 64% (n=116) patients and 6% (n=11) patients, respectively [Total LVO- 70%; n=127]. 20% (n=27) of LVO received IV-tPA and 72% (n=91) of LVO underwent thrombectomy. Reasons for not receiving included symptoms improved (25%), repeat imaging made reperfusion inadvisable (72.2%) and poor baseline (2.8%). Rates of mRS 0-2 in patients with ICA/M1/M2 receiving EVT were 13% (13/100) and the mortality rate was 45% (46/103). Rates of mRS 0-2 were significantly lower [13% vs 38%, p<0.01] and mortality was significantly higher [45% vs 18%, p<0.01] amongst anterior LVO in-house transfer patients receiving EVT compared to all anterior LVO patients receiving EVT in the given time period.

Conclusions:

A relatively large proportion of in-house LVO stroke patients underwent thrombectomy (70%). Most common cause of not receiving thrombectomy was imaging findings showing completed or large infarct. Compared to their community stroke counterparts, in-house LVO strokes had lower efficacy outcomes and higher mortality. Further study is required to understand these findings.

Keywords: Revascularization, Endovascular Therapy, Treatment, Mechanical Thrombectomy, Stroke

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

Effect of Covid-19 on Stroke Treatment in Australia and New Zealand

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Introduction:

In general, compared to the rest of the world, the impact of Covid-19 in the Australia and New Zealand regions has been minimal and this may be attributed to their early adoption of social distancing, stable governments, national wealth and geographic isolation. However, this research was designed to validate this perception amongst the stakeholders.

Methods:

This research included: primary and secondary research. First, secondary research about Covid-19 and stroke treatment and Australia and New Zealand in particular was conducted and compiled in a Google spreadsheet. Research sources include Stroke Foundation, Brain Foundation, and World Meters. Data collected included the number of stroke and Covid-19 cases in Australia and New Zealand as well as a list of stakeholders with their contact information. The stakeholders included neurosurgeons, hospitals, neurologists, interventionists, and vascular surgeons. A survey tool and an interview questions were prepared next. The survey request was emailed to stakeholders, requesting the stakeholders for an interview and survey response. Over the following weeks, survey results came in and interviews were conducted. Since only a small subset of stakeholders responded to the survey (6 survey responses and 4 interviews), this study must be considered to be primarily qualitative in nature. The interviews were conducted online using Zoom. After the interviews, I replayed the interviews and took notes of important details.

Results:

The survey showed that 83% of the doctors worked in a hospital that had a separate stroke unit and that they perform mechanical thrombectomies most often as a treatment for stroke. Most of the doctors suggested that the stroke numbers have not changed significantly since Covid-19. Yet, 50% of the doctors said that there had been delays in admitting stroke patients. One third believed Covid-19 may have made an impact on mortality of stroke patients. One of the interviewees revealed that the main barriers to access to stroke care are the time it takes to treat the patient, fewer locations that treat strokes or perform mechanical thrombectomy, and patients' reluctance to go to the hospital during the pandemic. Another confirmed that she did think there had been delays due to Covid-19.

Conclusions:

Counter to widespread perception, Covid-19 pandemic DID worsen many barriers for stroke treatment in Australia and New Zealand. These regions have insufficient stroke centers and these are not spread out widely enough for accessibility. Stroke deaths have increased during the Covid-19 pandemic. Barriers such as time, accessibility, and the patient's fear of hospitals have affected stroke treatment during the pandemic. Several measures can alleviate the impact: stroke awareness is critical. Every hospital needs to have the ability to assess and treat stroke. Hospitals must run simulations to practice and prepare for different scenarios that they could encounter when dealing with stroke patients. In

conclusion, stroke treatment has been affected by the Covid-19 pandemic and it is critical to minimize and overcome these barriers as stroke is one of the leading causes of death in Australia and New Zealand.

Keywords: Ischemic Stroke

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

Impact of COVID-19 on Stroke Care in the United States and Potential Solutions

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Introduction:

The emergence of the COVID-19 pandemic has negatively impacted medical care across the United States, especially so for rural communities. In this qualitative study, we investigated the barriers to the access of adequate treatment of ischemic stroke that have risen due to COVID-19 in urban and rural regions of the United States of America.

Methods:

Using CDC data, we identified 16 regions, consisting of half urban and half rural regions, that had the highest stroke mortality rate and the highest incidence of COVID-19 cases in the country. We compiled a list of neurointerventionalists practicing in these regions and designed a survey that was emailed to each neurointerventionalist. The survey investigated how stroke treatment in their hospital has been affected by the COVID-19 pandemic; it additionally contained a request for a virtual interview to allow neurointerventionalists to discuss in greater detail the barriers to stroke treatment they are facing. Neurointerventionalists from hospitals across four urban regions and three rural regions filled out the survey and were then interviewed by Zoom or phone.

Results:

The survey and the interviews highlighted a number of barriers: hospitals in both urban and rural regions faced an unavailability of ICU beds during COVID surges. As COVID-19 patients continued to occupy ICU beds, thrombectomy-capable hospitals could not accept transfer stroke patients. These patients had to be diverted to other thrombectomy-capable hospitals with vacant ICU beds, resulting in time lost before treatment. Stroke transfer posed more of a challenge in rural regions (as compared to urban communities) due to fewer rural-area hospitals performing thrombectomy. Secondly, both urban and rural regions saw stroke patients delay their arrival to the hospital. In urban regions, stroke patients delayed their arrival by up to a week in some cases. Patients with milder stroke symptoms did not show up to the hospital for treatment at all, hoping the stroke would subside on its own. This pattern has been attributed to patients' fear of contracting COVID-19. In comparison, rural hospitals faced a smaller average delay of up to a few days, as many patients did not see the virus as a threat. The delay was attributed to some patients' fear of the virus, fear of the procedure, or longstanding physician mistrust. Lastly, rural regions encountered an understaffing of nurses; a likely factor is the incidence of layoffs early in the pandemic, which lessened the time spent at a stroke patient's bedside and impacted stroke outcome.

Conclusions:

Urban regions were quicker to adapt to the pandemic than rural regions. They had a greater number of available staff and vacant ICU beds to be able to treat patients with minimal interference. Urban regions could still consider having nearby hospitals communicate with each other so that they can share the burden of care and prevent a single hospital from becoming overwhelmed. Rural regions could

especially focus on hiring travel nurses in cases of understaffing, increasing the number of thrombectomy performing centers, and pushing the education of stroke.

Keywords: Ischemic Stroke, Care, Mechanical Thrombectomy, Treatment, Acute Ischemic Stroke Intervention

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Grant Support: None.

Poster

Is Neutrophilia a Risk Factor for Fast Stroke Progression in Large Vessel Occlusion?

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Introduction:

Rapid stroke progressors with large vessel occlusion (LVO) have a worse prognosis than their time-matched cohorts receiving IV thrombolytics and/or mechanical thrombectomy. Our objective was to evaluate the association of neutrophilia with rapid stroke progression.

Methods:

Initial white blood cell (WBC) and absolute neutrophil counts (ANC) were collected for subjects presenting with acute ischemic stroke secondary to LVO who received IV thrombolytics and/or mechanical thrombectomy within 4.5 and 6 hours, respectively. Rapid stroke progression was determined by Alberta Stroke Program Early CT Score (ASPECTS) on initial CT head. Baseline and discharge NIHSS, age, and follow up mRS were also compared to presenting WBC and ANC. Spearman's rho was used for correlation. Social Science Statistics was used for data analysis.

Results:

From October 2020 to April 2021, the association between neutrophilia and stroke progression was evaluated in 19 subjects receiving tenecteplase (n=16; 6 females; age, 63.25 95% CI [54.9207, 71.5793]) and alteplase (n=4; 2 females; mean age 59, 95% CI [38.13, 79.87]) for LVO causing disabling neurological deficits. Mechanical thrombectomy was attempted in all subjects. The association between higher ANC and lower ASPECTS score reached statistical significance ($r_s = -0.49255$, $p = 0.04457$). There was no significant association of white blood cell (WBC) and ASPECTS score. WBC and ANC were not associated with baseline or discharge NIHSS, age, or follow up mRS.

Conclusions:

Rapid stroke progression as measured by presenting ASPECTS score may be associated with neutrophilia. Larger prospective clinical trials are needed to validate our results.

Keywords: Acute Stroke

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

Optimization of Transport Protocols to Increase the Odds of Thrombectomy

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Introduction:

We sought to determine a distance threshold where mode of transportation impacted treatment options for potential thrombectomy patients.

Methods:

We retrospectively reviewed transferred stroke patients to our comprehensive stroke center within 8 hours of onset from January 2017 to December 2019. In our analysis, all patients had a CTA confirmed large vessel occlusion, NIHSS >10 and arrived within 8 hours of onset as a candidate for thrombectomy. Patients were not treated with thrombectomy if they presented with a completed infarct or hemorrhagic conversion. Patients were transferred by air or ground based on availability and safety. Transfers were grouped based on distance: 0-30 miles, 31-60 miles, 61-90 and > 90 miles. We performed a binomial logistic regression for each distance group to determine a threshold where the odds of receiving thrombectomy statistically decoupled based on mode of transportation.

Results:

Of the 243 patients reviewed, 52.1% (126) received thrombectomy. Transport for 50.8% (123) patients was by air. Hospitals transferring within 0-30 miles accounted for 26.6% (65); 31-60 miles accounted for 22.1% (54); 61-90 miles accounted for 25.8% (63) and >90 miles accounted for 24.8% (60). The odds of receiving a thrombectomy were significantly higher with air transportation (OR 3.0, CI 1.04-8.74, p=0.043) at a distance threshold of >90 miles. At a distance threshold of 10 to 30 miles, the odds of receiving a thrombectomy were significantly higher with ground transportation (OR 5.5, CI 1.15-26.14, p=0.032). There was no difference between modes of transportation for 31 to 90 miles.

Conclusions:

Our analysis suggests that air transport beyond 90 miles increases the odds of receiving a thrombectomy for patients arriving within 8 hours of symptom onset. Ground transport, rather than air transport, between 10 and 30 miles may be more beneficial. Our results suggest that specific regional transport thresholds based on distance do exist and if recognized and altered can result in more favorable transfers.

Keywords: Treatment, Stroke

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

Prior Vascular Risk Factors Affecting Presentation Time and Utilization of Acute Ischemic Stroke Therapies

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Introduction:

Multiple factors have been reported to influence the time between onset of symptoms in acute ischemic stroke and hospital presentation. Although education level is one independent factor in presentation, as we previously reported, health literacy has not been fully assessed regarding specific patient knowledge on stroke or its known risk factors. This study aims to determine whether having a history of vascular risk factors such as prior stroke, coronary artery disease (CAD), or atrial fibrillation (AF) influence presentation time and acute ischemic stroke therapy utilization.

Methods:

This study included 250 acute ischemic stroke patients presenting to a large academic community hospital from February to December 2018. Educational level was defined within four categories: Grade School, High School, College or Higher, and Unknown. Last seen normal, symptom onset, and arrival times were acquired. Vascular risk factors chosen for this study included prior stroke, CAD, and AF. History of vascular risk factors was verified by medical documentation showing prior diagnosis by physician. Initial NIH Stroke Scale score, stroke location, vessel involved, LDL, hemoglobin A1c, gender, and race were also obtained. Patients were categorized based on their level of education, the presence or absence of vascular risk factors, and utilization of tPA or thrombectomy (MT). The primary outcomes were onset-to-arrival time (OTA), in minutes, and utilization rates of acute ischemic stroke therapies (either tPA, MT, or both). Subgroup analysis was conducted to associate education level with each vascular risk factor, comparing OTA and acute ischemic stroke therapy utilization rate.

Results:

As previously reported, educational level was inversely associated with OTA and positively associated with utilization of at least one acute ischemic stroke therapy. Prior stroke, CAD, and AF showed a substantial OTA decrease for all education groups except for College. Prior stroke decreased OTA in Grade School by 24% (764 vs. 579); High School by 30% (222 vs. 154) and College by 20% (52 vs. 41). CAD decreased OTA in Grade School by 65% (734 vs. 253), High School by 14% (209 vs. 180), and College by 3% (50 vs 49). AF decreased OTA in Grade School by 88% (764 vs. 91) and High School by 56% (216 vs. 95), but increased in College by 35% (47 vs. 64). History of prior stroke decreased utilization of both tPA and MT by 14%; CAD increased tPA use by 8% and MT by 5%; while AF increased tPA use by 9% and MT by 12%.

Conclusions:

Having at least one prior vascular risk factor (prior stroke, CAD, AF), diagnosed by a physician, was associated with lower OTA in Grade School and High School educated patients. A history of prior stroke

was associated with lower acute stroke therapy utilization (tpa and MT), while both CAD and AF were associated with increased acute stroke therapy utilization.

Keywords: Acute Ischemic Stroke Intervention, Neurointerventional Education, TPA

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

Reasons thrombectomy candidates become ineligible after transfer for treatment in a hub-and-spoke Telestroke model

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Introduction:

The care of emergent large vessel occlusion (ELVO) stroke patients has been revolutionized by endovascular thrombectomy (EVT). Given its robust efficacy, it is crucial to optimize delivery to eligible patients. Within hub-and-spoke hospital system models, some patients first present to distant spoke hospitals and require transfer to hub hospitals for EVT. We sought to understand reasons EVT candidates become ineligible after transfer for treatment.

Methods:

Consecutive EVT candidates presenting to 25 spokes from 2018 to 2020 with pre-transfer CTA-defined ELVO and Alberta Stroke Program Early CT Score ≥ 6 were identified from a prospectively maintained database. Outcomes of interest included hub EVT, reasons for EVT ineligibility, and 90-day functional independence (modified Rankin Scale, mRS ≤ 2).

Results:

258 patients were identified with median age 70 years (IQR 60-81) and 50% female. 44% underwent EVT upon hub arrival, of which 87% achieved Thrombolysis in Cerebral Infarction 2b-3 reperfusion. Compared to EVT-eligible patients, ineligible patients were older (73 vs 68 years, $p=0.04$), had lower NIH Stroke Scale (NIHSS, 10 vs 16, $p<0.0001$), longer LKW-hub arrival time (8.4 vs 4.6 hours, $p<0.0001$), and received less IV alteplase (32% vs 45%, $p=0.04$). The clinical reasons cited for becoming EVT ineligible upon hub arrival included large established infarct (49%), mild symptoms (33%), recanalization (6%), distal occlusion location (5%), subocclusive lesion (3%), and goals of care (3%). Becoming EVT ineligible independently reduced the odds of 90-day functional independence (aOR=0.26, 95%CI=0.12,0.56; $p=0.001$), even when controlling for age, NIHSS, and LKW-hub arrival time.

Conclusions:

Approaches to increase EVT eligibility among ELVO transfers may improve long term outcomes. A primary reason for becoming EVT ineligible is infarct growth. Future studies should explore triaging patients directly to EVT-capable hubs when feasible, improving inter-hospital transfer times, supporting ischemic penumbra before EVT, and developing novel neuroprotective agents.

Keywords: Stroke, Endovascular Therapy, Acute Stroke, Acute Ischemic Stroke Intervention, Ischemic Stroke

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Poster

Stroke Severity Factors in patients with Acute Ischemic Stroke and Heart Failure Stratifying by Age

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Introduction:

The goal of this study is to investigate the clinical risk factors associated with acute ischemic stroke (AIS) severity in heart failure (HF) patients above and below 70 years old using the National Institutes of Health Stroke Scale (NIHSS) as a measure for stroke severity.

Methods:

This study uses retrospective analysis of AIS patients who were previously diagnosed with HF. Data was collected from a regional stroke center from January 2010 to June 2016. Multivariate logistic regression identified the factors associated with stroke severity, with a NIHSS score <7 indicating low severity and a score ≥7 indicating high severity. These results were stratified by patient ages of < and ≥70 years old.

Results:

A total of 590 patients presented with AIS and a previous diagnosis of HF. The AIS-HF population contained 223 patients that were <70 years old and 367 that were ≥70 years old. In the AIS-HF population, patients who were ≥70 years old who presented with coronary artery stenosis (CAS) (OR = 8.592, 95% CI, 2.123-34.772, P < 0.003), prosthetic heart valve (OR = 22.028, 95% CI, 1.454-333.746, P < 0.026), elevated systolic blood pressure (OR = 1.014, 95% CI, 1.002-1.026, P < 0.024), and tissue plasminogen activator (tPA) administration (OR = 4.002, 95% CI, 1.912-8.377, P < 0.001) were associated with a higher NIHSS. Alternatively, those that presented with gender differences (OR = 0.466, 95% CI, 0.235-0.925, P < 0.029), family history of stroke (OR = 0.084, 95% CI, 0.010-0.726, P < 0.024), obesity (OR = 0.493, 95% CI, 0.261-0.930, P < 0.029), smoking (OR = 0.253, 95% CI, 0.063-1.022, P < 0.054), serum creatinine (OR = 0.629, 95% CI, 0.399-0.992, P < 0.046), INR level (OR = 0.457, 95% CI, 0.191-1.094, P < 0.079) were associated with a lower NIHSS.

Conclusions:

The data revealed a variety of components that may affect Stroke Severity in AIS patients with HF. The associated factors exhibited significant differences between distinct age groups. AIS-HF patients ≥70 years old who presented with CAS, prosthetic heart valve, elevated systolic blood pressure, and received tPA administration were associated with higher stroke severity (≥7 NIHSS) compared to <70 years old group. Identifying more concrete clinical and demographic associations may aid in the identification and evidence-based management of patients who suffer from AIS.

Keywords: Stroke, TPA, Ischemic Stroke, Acute Stroke, Decision Analysis

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

Vast Global Disparities in Mechanical Thrombectomy Access: A Report from the MT2020+ Regional Committees

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Introduction:

Mechanical Thrombectomy has been established as a highly cost-effective therapy for large vessel occlusion stroke (LVOs) since 2015. However, access to MT for eligible MT patients is restricted due to multiple barriers and time constraints. MT 2020+ is a global stroke campaign aimed at accelerating access to mechanical thrombectomy (MT) using public health interventions (PHI) through a regional committees (RCs) network.

Methods:

MT2020+ conducted an electronic survey in 22 RCs of different income levels in from November 2020-February 2021 with a questionnaire that included MT eligible patients, centers, operators, procedures and reimbursement. MT access was defined as the proportion of estimated MT eligible patients receiving MT. Linear regression models were used with countries classified by World Bank income classification.

Results:

For high, upper middle and lower middle income countries, MT access was 15.75 %, 3 % and 0.06 %, MT Centers per million population were 0.95, 0.53 and 0.08 and MT operators per million population were 1.38, 0.81 and 0.10, respectively. On univariate analysis, MT access rate was significantly associated with: income class ($p < 0.011$), reimbursement for MT ($p < 0.001$) and % of GDP spent on healthcare ($p =$

0.001). On multivariate linear regression models, the factors that independently predict MT access were World Bank income class ($p < 0.029$) and reimbursement ($p = 0.002$). Top areas where MT2020+ could assist the RCs were identified to be: training MT operators (75 %), approaching healthcare policymakers (50%) and reducing procedural costs (35%).

Conclusions:

There is a vast disparity in MT access across the globe. Country's income and reimbursement for MT were independently predictive of MT access for LVOs. These findings help prioritize PHI to accelerate MT access.

Table 1. Univariate and Multivariate Analysis of predictors of MT access

	Univariate Analysis			Multivariate Analysis		
Variables	B-Coeff	Conf Interval	P value	B-Coeff	Conf Interval	P value
Income Level						
Lower Middle v/s High Income	-2.45	-4.00 to -0.91	0.005	-2.8	-4.1 to -1.5	<0.001
Upper Middle v/s High Income	-0.78	-2.26 to 0.70	0.273	-1.23	-2.3 to -0.137	0.029
Reimbursement for MT	2.90	1.74 to 4.06	<0.001	1.63	0.68 to 2.58	0.002
% of GDP spent on Healthcare	0.40	0.18 to 0.62	0.001	0.039	-0.13 to 0.209	0.635
Number of MT operators	0.0013	-0.0006 to 0.032	0.187	1.05	-0.35 to 2.45	0.120

Keywords: Acute Stroke, Acute Ischemic Stroke Intervention, Mechanical Thrombectomy, Ischemic Stroke, Endovascular Therapy

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

Very Low Rates of Intracerebral Hemorrhage in Patients Transferred for Mechanical Thrombectomy

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Introduction:

Background: A common convention among stroke patients being transferred for mechanical thrombectomy, particularly if intravenous thrombolysis has been given, is to undergo a repeat plain brain CT at the treating stroke center. The most concerning among several concerns is the discovery of intracerebral hemorrhage (ICH) which would obviate the value of thrombectomy. This practice has been shown in a previous series to result in a median treatment delay of 20 minutes[1]. By determining the actual incidence of any ICH seen on neuroimaging in patients who undergo repeat imaging on arrival to comprehensive stroke center prior to intervention, we can better determine the true value of this convention of repeat imaging.

Methods:

Retrospective review of all patients transferred to a single academic comprehensive stroke center for mechanical thrombectomy. We evaluated for the frequency of repeat imaging, the rate of ICH and the rate of undergoing mechanical thrombectomy.

Results:

There were 682 patients transferred directly for mechanical thrombectomy evaluation over the study period. Intravenous Alteplase was administered to 391 patients prior to arrival and 2 had it on arrival to destination hospital. Plain head CT was repeated at the hub hospital in 590/682 patients (86.5%) (348 with thrombolytics and 242 without. A new intracerebral hemorrhage (ICH) was detected in 9 patients. In only 3 of the 9 patients was mechanical thrombectomy deferred solely due to the ICH (other 6 had no evidence of LVO (4), low ASPECTS (1) or exam improvement (1)).

Conclusions:

In patients being transferred for mechanical thrombectomy, the rate of ICH on arrival to site hospital was 1.5%. In only one third of those patients (0.5%) was the decision to not proceed with mechanical thrombectomy related to the new ICH. Given the delays in door to puncture times associated with repeat imaging indicated in literature and the low yield in detecting ICH in transfer patients, repeating neuroimaging at comprehensive stroke center obtained for the purpose of ruling out ICH on patients transferred for MT should be reconsidered. Limitations: Our study reflects a single center experience. Other indications for repeat imaging at comprehensive stroke center such as assessment of infarcted core, and presence of large vessel occlusion might still warrant repeat imaging at comprehensive stroke center.

Keywords: Door To Groin Puncture, Endovascular

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Poster

Assessing Correlation Between Styloid Length and Internal Carotid Artery Dissection in EAGLE Syndrome Patients.

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Introduction:

Eagle Syndrome (ES) also known as styloid-carotid artery syndrome is caused by elongation of the styloid process or calcification of the stylohyoid ligament. Usually, normal stylohyoid process is 2.5 cm in length. However, it is classified as an elongated styloid process if its length is more than 2.5 cm. Carotid Artery dissection which is a significant cause of ischemic stroke in all age groups is a known rare complication of ES. Goal of our study is to assess for correlation between degree of styloid process lengthening and grades of Carotid and Vertebral Dissections in adult population.

Methods:

Retrospective database review of adult patients with known cervical dissections (traumatic and non-traumatic) were analyzed from Level I Comprehensive Stroke Center. Patients in pediatric age group (less than age 18 years) were excluded. Deidentified patient information including patient's age, demographics, past medical history, mechanism of injury (if applicable) prior to initial clinical presentation, initial clinical presentation, methodology for diagnosis of cervical dissection (Internal Carotid vs External Carotid vs Vertebral Arteries) along with measurements of stylohyoid ligaments and degrees of dissections bilaterally were retrieved and analyzed. Data analysis was performed by using IBM SPSS Statistics Software 28.0.

Results:

Total number of patients were 111 (N). Mean age of patients was 52.97 (± 16 years). Demographic distribution: African Americans (47/111), Caucasians (62/111) and Others (2/111). Gender distribution: Males (55/111) and Females (56/111). Mechanisms of injury based on available data were as follows: Mechanical Fall (21); MVC (21) and other mechanisms (12). 43/111 patients did have a headache as compared to 68/111 who did not during initial clinical presentation. Imaging confirmation for arterial dissection was performed via MRA (6/111); CTA (98/111) and DSA (7/111). Average styloid length for patients with Eagle syndrome was 3.1 cm vs non-Eagle group which was 2.38 cm. In Non-Eagle Syndrome group (Styloid length <2.5 cm), average grades of arterial dissections were as follows: Left Vertebral Artery dissection-2.1; Left Internal Carotid Artery-2.1; Right Internal Carotid Artery-0.40 and Right Vertebral Artery-2.5. For Eagle Syndrome patients (Styloid length >2.5 cm), average grade of arterial dissections were as follows: Left Vertebral Artery-2.6; Left Internal Carotid Artery-3.38; Right Internal Carotid Artery dissection-2.3 and Right vertebral artery dissection-1. Based on statistical analysis (paired samples T-test), styloid length of more than 2.5 cm was significantly correlated with left

internal carotid artery dissection (p value 0.012; $p < 0.05^{***}$). For dissections in other arteries including Right Internal Carotid (p value 0.91), Right Vertebral (p value 0.12) and Left vertebral (p value 0.488) no statistical significance was found when both groups were compared.

Conclusions:

From our study we can conclude that in patients with EAGLE syndrome styloid length more than 2.5 cm is significantly correlated with higher risk of Left Internal Carotid Artery dissection.

Keywords: Ischemic Stroke, Cerebral, Cerebrovascular Disease, Head And Neck Malformation Therapy, Acute Stroke

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Grant Support: None.

Poster

Factors Associated with Gender Differences in Patients with Lewy Body Dementia

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Introduction:

Several studies have investigated gender differences in patients with Lewy Body Dementia (LBD), however, whether the observed differences are associated with demographic and pharmacological factors is not fully understood. The current study tested the hypothesis that specific demographic or pharmacological factors may contribute to the observed gender difference.

Methods:

A 5-year data collected from a regional registry from 608 LBD patients including 332 men and 276 women were analyzed. Factors associated with men and women patients with LBD were determined using the logistic regression model. Multicollinearity was evaluated using variance inflation factors (VIFs), with values greater than five suggestive of multicollinearity

Results:

The results indicate that Caucasian men (94.3% vs 83.3%) were more likely to present with LBD. In the adjusted analysis, increasing age (OR= 1.042, 95% CI, 1.025- 1.058, P < 0.001) was more likely to be associated with women with LBD, while olanzapine (OR=2.871, 95% CI, 1.902-4.334, P< 0.001), buspirone (OR= 2.388, 95% CI, 1.527-3.735, P< 0.001), escitalopram (OR= 1.444, 95% CI, 1.079-1.932, P=0.014) and tobacco use (OR=1.424, 95% CI, 1.075-1.887, P=0.014) were associated with men with LBD

Conclusions:

More men presented with LBD compared to women. Our findings reveal specific demographic and pharmacological factors that contribute to gender differences among LBD patients.

Keywords: Epidemiology

Financial Disclosures: The authors had no disclosures.

Grant Support: NIH NIA R25

Poster

Imaging Follow-Up in Carotid Webs: Is There Vascular Remodeling?

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Introduction:

Carotid web (CaW) is a shelf-like fibrotic projection at the carotid bulb and constitutes an underrecognized cause of ischemic stroke. Atherosclerotic lesions are known to have dynamic remodeling with time however, little is known regarding the evolution of CaW over time. We aimed to better understand if CaW is a static or dynamic entity on delayed vascular imaging.

Methods:

This was a retrospective analysis of the CaW database at our comprehensive stroke center, including patients diagnosed with CaW between September 2014 through June 2021. Patients who had at least two good quality CT angiograms (CTAs) that were at least 6 months apart were included (CTAs with CaW and superimposed thrombus were excluded). CaW were quantified with 3-D measurements using Horos software. This was done via volumetric analysis of free-hand delineated CaW borders on thin cuts of axial CTA (Figure 1 Panel A). NASCET criteria was used to evaluate the degree of stenosis.

Results:

Sixteen CaW in 13 patients were identified and included. The median imaging follow-up window was 16 months (IQR 12-22, range 6-29). Median patient age was 45.5 years-old, 69% were women, 25% had hypertension, 38% hyperlipidemia, 25% diabetes mellitus, 0% atrial fibrillation, and 13% active smokers. 75% of the included CaW were symptomatic while 25% were asymptomatic. Median volume of CaW on initial CTA (8.52 mm³ [IQR 3.7-13], range 2.2-30.4) was comparable to median volume of CaW on most recent CTA (8.47 mm³ [IQR 4.0-12.8], range 2.3-29.4; $p < 0.001$ (Figure 1 Panel B). The CaW volumetric measurement correlation between the initial and most recent CTA was near perfect ($r_s = -0.99$, $p < 0.001$). The median change in measured volume of CaW between first and last CTA was -0.19 mm³ [IQR -0.6-0.4], range -1-0.8. Median degree of stenosis was 8.1% [IQR 4.5-17.1], range 0.4-31.2. The duration of follow-up imaging was not correlated with the change in CaW volume (Kendall tau-b [τ_b] = -0.17, $p = 0.93$). The initial CaW volume was not found to be correlated to the degree of stenosis ($\tau_b = -0.08$, $p = 0.65$).

Conclusions:

The volume of the CaW was not found to change over time, reinforcing the idea that this is a relatively static lesion. The CaW volume was not found to correlate with the degree of stenosis caused by it. Further longitudinal studies with longer follow-up intervals are warranted.

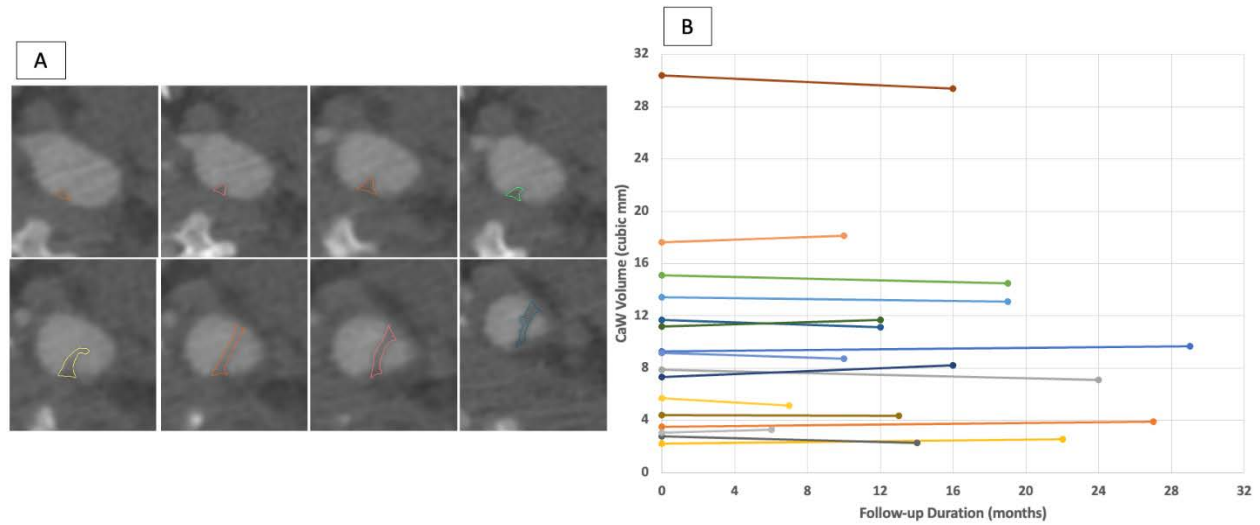


Figure 1: Panel A: Representative cuts of the 3-D volumetric measurement.
Panel B: The volumetric measurements for all 16 carotid webs on initial CTA and follow-up CTA, with each color representing a carotid web.

Keywords: Angiographic Ct, Carotid, Vascular Imaging, Ischemic Stroke

Financial Disclosures: The authors had no disclosures.

Grant Support: None.

Poster

Initial Experience Using the Transvenous Embolization for Intracranial Arteriovenous Malformations in a Reference Endovascular Center

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Introduction:

Transvenous embolization (TVE) is used in cases of arteriovenous malformations (AVMs) with specific characteristics such as small size (<3 cm), deep location, single draining vein and the absence of adequate feeders. High complete obliteration rates have been reported. Therefore, our study aimed to analyze our initial experience using the TVE for treatment of AVMs.

Methods:

Between May 2018 and January 2021, consecutive patients who underwent TVE of AVMs were selected. Demographics, radiological and clinical variables were collected. The modified Rankin Scale (mRS) was used to determine clinical outcomes and was dichotomized (good clinical condition: mRS ≤2; poor clinical condition: mRS >2). Complete obliteration was defined as the total absence of the nidus and vein, subtotal obliteration was defined as the embolization of >95% of nidus and partial obliteration was defined as the embolization of <95% of nidus. Procedure-related complications were defined as those that occurred during the procedure and were divided as intraoperative rupture and thrombosis.

Results:

Twenty-one patients harboring 21 AVMs were evaluated. Fourteen patients (67%) were women. The mean age was 24.5 ± 14.1 years (7 – 48 years). A good preoperative clinical condition was present in 20 patients. Twenty AVMs were ruptured (95.2%). The most frequent locations were thalamus/basal ganglia in 6 patients (29%), followed by temporal/insular in 5 patients (24%). Spetzler-Martin grades III, II and I were present in 11, 9 and 1 patients, respectively. The mean number of feeders was 2.1 per AVM. The feeders arised from the MCA in 9 cases, followed by PCA in 5 cases, ACA and AChOA in 3 cases, AICA in 2 cases, and ECA and PCom in 1 case, respectively. The mean number of veins was 1.3 per AVM. Deep venous drainage was present in 12 cases (57%). The mean size of the AVM nidus was 15.7 ± 7.8 mm (3.7 – 34 mm). Previous trans-arterial embolization was done in 10 patients (47.6%). Pre-embolization hematoma evacuation was done in 4 patients (19%). An immediate complete obliteration was achieved in 18 patients (85.7%), whereas a subtotal and partial obliteration were achieved in 2 and 1 patients, respectively. A poor post-operative clinical condition occurred in 4 patients (20%). Procedure-related complications occurred in 4 patients (20%): 3 cases with intra-operative rupture of the AVM nidus and 1 case of a thrombus in the M1 treated with stent retriever. Mortality occurred in 3 patients (14.2%) of which two presented intra-operative rupture with intracerebral hematomas that required decompressive craniectomy. One patient presented a post-operative bleeding of the AVM nidus that required external ventricular drainage and decompressive craniectomy. Follow-up angiography was done in 4 cases with total obliteration of all the cases (100%).

Conclusions:

The transvenous approach has emerged as an alternative to trans-arterial approach with high grades of immediate total obliteration rates, but with potential procedure-related complications. Thus, this technique should be used in selected cases in order to achieve complete cure rates.

Keywords: Cerebral Arteriovenous Malformations, Endovascular Therapy, Avm Embolization, Embolization

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Poster

Modern Brain Arteriovenous Malformation Models

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Introduction:

Research of William Hunter's hypothesized (then discovered) arteriovenous varix (now arteriovenous malformation/AVM) has developed exponentially over the previous quarter-millennium.¹ Virchow and Luschka's subsequent contributions (nearly 100 years later) by identifying an AVM of the brain and its congenital nature were two of the first significant developments made in the field.^{2,3} AVMs present as an erroneous connection (known as a fistula) between an artery and a vein that bypasses the capillary circulation.⁴ The arteries and arterioles contributing to the malformation are known as feeders which connect to the draining veins via a plexiform vascular network known as a nidus. Prior to the design of a synthetic anastomosis coupled with vessel ligation by Spetzler et al, animal models were largely based on embolization or study of the normal anatomy. The animal and early genetic models have been reported on at length and numerous times across the literature, but novel developments spanning the previous decade have ushered in a technological revolution of vascular modeling that warrants discussion and analysis.

Methods:

Parameterization of a PubMed query to include all literature including the words "brain," "arteriovenous malformation," and "model," yielded 489 articles.

Results:

After extraction of relevant literature and full-text screening, 41 articles were chosen for detailed review.

Conclusions:

While centuries of treatment efforts have progressed from reliance on surgical resection to endovascular approaches (E.g. glue embolization or coiling) and stereotactic radiosurgery (SRS), it was only 43 years ago that the pathology was first modeled in the laboratory.⁶ AVM modeling began with an outgrowth of highly specialized, yet not standardized, simulations of feline, canine, murine, primate, swine, ovine, and even leporine origin. These models were motivated by advancements in microsurgical techniques that permitted their creation, development of new technologies to investigate within them, and theories that these AVM representations could support or refute. The first functional model of AVM by anastomosis of the left rostral CCA and caudal JV was developed to study normal perfusion pressure breakthrough theory: its configuration is still employed by animal AVM models in the modern day (though largely in sheep and pigs). The elegance of the CCA-JV fistula became a component of the now oft-used RM AVM model which relies on retrograde flow through the RMs via CCA-JV anastomosis. Similarly, the use of this functional AVM animal model has informed the molecular underpinnings of such lesions as well. Technological innovations outside of neurosurgery have greatly impacted the development of novel AVM models in the form of three-dimensional flow models printed into silicon

models and combined with advanced imaging technology such as 4D flow MRI. Technological developments in preservation solutions, catheterization tools, and imaging technologies have also allowed for advent of the cerebrovascular placental model for testing of treatments such as radiosurgery, glue embolization, coiling, as well as histological assessment of tissue directly after intervention.

Keywords: Avm Embolization, Cerebral Arteriovenous Malformations, New Innovation, Neurointerventional Training, Neurointerventional Education

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Poster

Transcranial Arterial Embolization of an dAVF: A Case Report

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Introduction:

We detail the management of a woman with a posterior fossa dAVF (dural arteriovenous fistula) that was unable to be treated by standard transarterial or transvenous embolization or microsurgical ligation. She underwent craniotomy for surgical exposure and direct access of her left middle meningeal artery followed by microcatheter embolization with favorable results.

Methods:

This is a case report, which describes a case of a difficult to access dAVF.

Results:

A 72 year-old woman presented with vertigo, nausea, and vomiting one week following a fall. CT head disclosed cerebellar vermis intraparenchymal hematoma and CT head angiography was suspicious for underlying vascular malformation. Diagnostic cerebral angiogram demonstrated extensive tentorial and suboccipital dural arteriovenous fistula (dAVF) fed by branches of both middle meningeal and occipital arteries with direct cortical venous drainage and venous aneurysmal ectasia directly adjacent to the vermian hemorrhage (ruptured Cognard grade 4). Left vertebral artery angiogram demonstrated excessive tortuosity of vertebral enlarged posterior meningeal artery, which was unable to be catheterized sufficiently beyond its origin despite different microwires and microcatheters due to tortuosity. Transfemoral venous approach was also attempted, however, this was also unsuccessful and decision was made to proceed with microsurgical treatment.

The following day a suboccipital craniotomy was performed, but was ultimately aborted due to nearly uncontrollable bleeding from bony exposure and dural access secondary to severe venous hypertension. The next day percutaneous endovascular treatment was attempted a second time. A small right middle meningeal artery (MMA) contribution to the fistula was embolized with liquid embolic but, again because of excessive tortuosity and insufficient microcatheter access, right MMA occlusion occurred without embolic agent reaching the fistula. Similar access related difficulties due to tortuosity were encountered in accessing the left middle meningeal and occipital arteries contributing to the fistula. Repeat transvenous access was also attempted from the occipital and right transverse sinuses, but microcatheter access to the fistula was unable to be established beyond the venous outflow from the aneurysm, and, given the risks of hemorrhage related to embolization of the venous outflow without occluding arterial inflow into the ruptured aneurysm, transvenous embolization was not performed. A few days later, after the patient was given time to recover from the prior procedures, the patient underwent left temporal craniotomy in a hybrid operating room/interventional radiology suite for direct cannulation of the left MMA. Localization of the craniotomy site over the left MMA access point was planned by transfemoral cerebral angiogram and a transcarotid/peripheral access kit was used to catheterize the left MMA directly following surgical exposure. An .017 microcatheter was advanced

close to the fistula point using standard biplanar roadmap fluoroscopy, and Onyx embolization of the fistula was performed to complete occlusion, without complication.

Conclusions:

For cerebrovascular disorders that are inaccessible by traditional endovascular and surgical means, a hybrid approach should be considered.

Keywords: Cerebral Arteriovenous Malformations, Avm Embolization, Endovascular Therapy, Intracerebral Hemorrhage

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Poster

Transvenous Embolization in Vein of Galen Malformations as the Last Procedure

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Introduction:

Vein of Galen Malformations (VOGM) are a rare, congenital, vascular malformation representing <1% of all arteriovenous malformations. Treatment is typically performed in infancy and transarterial embolization (TAE) is the most common treatment method. While conventional methods allow for a total or near-total obliteration in 80% of cases, there is a subset of patients for whom TAE is ineffective (E.g. the residual arterial supply is through small feeders non-amenable to TAE). In these cases, transvenous embolization or coiling (TVE) is the technically simplest approach. We assessed the immediate angiographic and clinical outcomes of our VOGM cases treated with TVE. All relative technical details are reported. Immediate angiographic outcomes and clinical outcomes are reported.

Methods:

A retrospective review of our institutional database was performed to identify all VOGM patients who underwent TVE as the final-stage procedure between January 2004 and December 2020.

Results:

We describe a cohort of 13 patients, one of whom underwent partial TVE for palliative measures and was excluded. All of the 12 patients that met our eligibility criteria had undergone more than 3 transarterial embolizations with nBCA. The mean age of our cohort was 8.2 (SD: 6.3) years. Ten patients were treated with coils and two with the Chapot "Pressure cooker" (ChPC) Technique. In these two cases, predicting hemorrhage post-procedurally proved difficult; as a result, we attempted to occlude the remaining arterial supply using transvenous ChPC. Complete immediate angiographic obliteration was achieved in nine patients. Stereotactic radiosurgery was performed in 2 of the remaining patients and full obliteration was achieved. Immediate post-procedural (within 48 hours) hemorrhagic complications were noted in two patients treated with coils: one of these ended in mortality and the second suffered from significant neurological impairment. In total, eight patients had normal development, three had a moderate delay with hemiparesis and one patient died.

Conclusions:

To the best of our knowledge, this is the first report of TVE being used as a final-stage cure attempt for VOGMs after multiple TAE sessions. We advocate that TVE for the treatment of VOGMs is a feasible option as a final-stage attempt for cure. It is particularly effective if the dilated VOG becomes small enough. To prevent incomplete occlusion and reduce the risk of post-procedural hemorrhagic complications, the ChPC technique using liquid embolic material should be considered.

Patient	VOGM Classification	Age at TVE	Treatments before TVE	TVE technique	Outcome, Event	Clinical Outcome
1	Choroidal	15	2	Coiling	Complete Obliteration	Normal
2	Choroidal	9	5	Coiling	Complete Obliteration	Normal
3	Mural	4	7	Coiling	Complete Obliteration	Normal
4	Choroidal	5	11	Coiling	Complete Obliteration and Hemorrhage	Moderate Delay and Hemiparesis
5	Choroidal	5	6	Coiling	Complete Obliteration	Normal
6	Choroidal	18	5	Coiling	Hemorrhage	Death
7	Choroidal	20	11	Coiling	Complete Obliteration	Normal
8	Choroidal	1	4	Coiling	Complete Obliteration	Normal
9	Choroidal	1	4	Coiling	Complete Obliteration	Moderate Delay and Hemiparesis
10	Choroidal	6	4	Coiling	Complete Obliteration	Moderate Delay and Hemiparesis
11	Choroidal	6	14	Pressure Cooker	Complete Obliteration	Normal
12	Choroidal	8	4	Pressure Cooker	Complete Obliteration	Normal

Keywords: Embolization, Endovascular Therapy, Coiling, Pediatric Intervention, Interventional Neuroradiology

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Poster

Transvenous Embolization of Vein of Galen Aneurismal Malformations Using the “Chapot Pressure Cooker” Technique

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Introduction:

There are various procedural techniques described in the literature to treat VGAM: 1) transarterial embolization (TAE) via a transfemoral or transumbilical approach, 2) transfemoral or transthoracic venous coiling, and 3) the combined transarterial and transvenous “trapping” of the fistula. The transarterial technique has permitted our team to obtain total or near-total obliteration in approximately 80% of cases; however, there is a patient population in whom the residual arterial supply is comprised of small perforators. In these patients, transvenous embolization (TVE) is an attractive option, but its safety is unclear. Here we report the first two VGAM patients treated using the Chapot “pressure cooker” technique (ChPC).

Methods:

Two patients, one 5-year-old and one 7-year-old, both presented with congestive heart failure in the newborn period and were subsequently treated in the newborn period with multiple, staged TAEs with n-BCA for choroidal VGAMs. We achieved progressive reduction in shunting and flow but were unable to accomplish complete closure of the malformation: in both patients, a small residual with numerous perforators persisted. The decision was made to perform transvenous embolization using the ChPC. In this technique, a guiding catheter is placed transjugular into the straight sinus (SS). One or two detachable tip microcatheters are advanced to the origin of the SS. Another microcatheter is advanced and the tip placed between the distal marker and the detachment zone of the former. Coils, and n-BCA if necessary, are used to prevent reflux of Onyx. This forces the Onyx to occlude the vein and the most distal arterial segment.

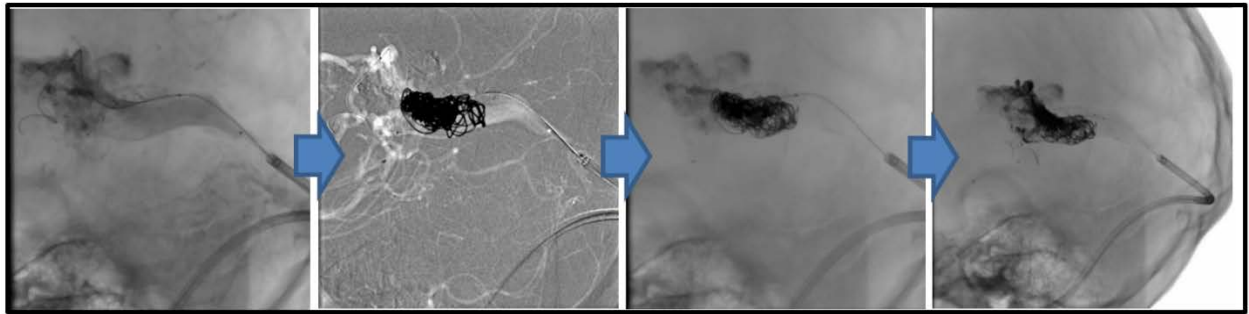
Results:

Both patients had complete occlusion of the VGAM after ChPC.

Conclusions:

This is the first report to describe TVE to cure VGAM after multiple sessions of TAE. This is also the first report to apply ChPC to VGAM treatment. In this study, we recognized two important factors of traditional VGAM treatment that may cause interventionalists to consider the ChPC to treat VGAM: 1) without liquid embolic, deployed coils may not occlude the fistula entirely. 2) There is the concern of causing delayed bleeding should the arterial component of the fistula rupture. ChPC ameliorates these issues by offering complete closure of the fistula with liquid embolic material in TVE. Not only is the residual vein blocked, but also the incoming arterial supply which prevents delayed bleeding. In endovascular treatment of VGAM, TVE is a feasible option once the dilated vein of Galen becomes small enough. To prevent incomplete occlusion or post-procedural hemorrhagic complications, the use of the

ChPC using DMSO liquid embolic material is a promising and necessary introduction to the neurointerventionalist's treatment arsenal.



Keywords: Avm Embolization, Cerebral Arteriovenous Malformations, Treatment, New Innovation, New Technique

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Poster

Delayed Vasospasm and Cerebral Ischemia Following Mild Traumatic Brain Injury

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Introduction:

Post-traumatic vasospasm (PTV) is a significant cause of morbidity and mortality following traumatic brain injury (TBI).¹ Delayed PTV is thought to occur due to inflammation from SAH.¹ The risk of symptomatic PTV is associated with the severity of TBI.^{1,2,3} Treatment of PTV traditionally involves agents used in aneurysmal vasospasm such as Nimodipine. Intra-arterial and intravenous verapamil and milrinone have been utilized to treat PTV.⁴ We present a rare case of delayed cerebral ischemia caused by PTV without SAH treated with intra-arterial milrinone and oral verapamil.

Methods:

This is a case report of a case of a 16-day delay of cerebral ischemia secondary to PTV.

Results:

A 19-year-old female without significant medical history presented to the emergency room as the restrained driver in a motor vehicle collision involving a car versus a tree. The patient's Glasgow Coma Scale score was 13 and the initial head CT did not demonstrate SAH with a Rotterdam score of 0. There were multiple fractures and soft tissue contusions noted on imaging which required surgical correction and splinting. The patient's hospital stay was complicated by a large retroperitoneal hematoma requiring blood transfusions and surgical evacuation. 16 days after admission, the patient experienced sudden-onset right upper extremity paralysis and weakness of the right leg. CT head demonstrated loss of gray-white differentiation in the left middle cerebral artery (MCA) territory and CT angiography demonstrated 70% stenosis of the left supra-clinoid internal carotid artery (ICA) and proximal left MCA. Cerebral angiography demonstrated 60% stenosis left supra-clinoid ICA and 60% stenosis at the origin of the left MCA consistent with PTV. Left MCA stenosis improved to 20% post 10 mg intra-arterial milrinone in the left ICA (Figure 1). The patient also received verapamil orally. Transcranial doppler demonstrated elevated peak systolic velocities at 298 cm/s in the left MCA and 276 cm/s in the left ICA. Six days later this improved to 150 cm/s in the left MCA and 151 cm/s in the left ICA. The patient continued to be unable to move her right side against gravity with dense expressive aphasia and dysarthria at discharge to inpatient rehabilitation. At follow-up 4 weeks later, her right hemiparesis had improved significantly to being able to stand with assistance and her expressive aphasia had improved from one word to occasionally forming several word sentences.

Conclusions:

PTV is a potentially devastating complication of TBI. As our case demonstrates, the presence of mild TBI and absence of SAH may be falsely reassuring.² Additionally, our case report demonstrates that intra-arterial milrinone causes radiographic improvement in PTV. Further studies are needed for the best screening and diagnostic exams for PTV and therapeutic interventions.



Figure 1: Digital subtraction angiography of the left ICA pre (A) and post (B) intra-arterial milrinone.

Keywords: Vasospasm Intervention, Vasodilator, Angiogram

Financial Disclosures: The authors had no disclosures.

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Poster

Safety And Efficacy Of Daily Intra-arterial Endovascular Therapy For Refractory Cerebral Vasospasm Following Subarachnoid Hemorrhage

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Introduction:

Delayed cerebral ischemia (DCI) and cerebral infarction (CI) due to vasospasm is a major cause of death and disability after aneurysmal subarachnoid hemorrhage (aSAH). Transluminal balloon angioplasty (BA) and super-selective intra-arterial (IA) infusion of vasodilators are considered for refractory vasospasm. We examined the safety and efficacy of repeated daily IA treatment in vasospasm.

Methods:

We reviewed records a single center of vasospasm treatment for aSAH from 2016 through 2019. Primary endpoints were rate of cerebral infarctions and safety related to daily treatments. Secondary endpoints were mortality and favorable clinical outcome at hospital discharge defined as modified Rankin scale of scores 0-2.

Results:

Of 426 patients with SAH, 197 were aneurysmal with 79 with DCI. Forty-five out of 79 underwent IA treatment, of which 14 underwent 1 or 2 treatments (Group 1) and 31 underwent ≥ 3 treatments (Group2). Incidence of CI were similar (Group 1: 42.8%; Group 2: 54.8% , $p=0.45$) Good clinical outcomes at discharge were seen in 36% in Group 1 and 16% in Group 2 ($p=0.15$). Mortality was 7% in group 1 and 26% in group 2 ($p=0.17$).

Conclusions:

Complications including vessel dissection, systemic hypotension and seizures did not increase with repeated treatments. CI was not noted to differ, but the outcomes were worse in group 2 which may relate to severity of SAH rather than DCI.

	Group 1, n = 14	Group 2, n = 31	p value
Age, median (IQR)	62 (53-70.5)	54.5 (46.5-60)	-
Hunt Hess, median (IQR)	2(1, 3.25)	3(2,4)	0.05
Modified Fisher Scale, median (IQR)	4(3,4)	4(3,4)	0.55
Number of treatments, median (IQR)	2(1,2)	5(3.5,7)	<0.00001
Incidence of CI	6/14	17/31	0.45
Frequency of complications	3/14	3/31	0.29
Favorable modified Rankin Scale score at discharge (0-2)	5/14	5/31	0.15
In hospital mortality rate	1/14	8/31	0.17

Keywords: Subarachnoid Hemorrhage, Balloon Angioplasty, Intra-Arterial Therapy, Endovascular Therapy, Vasospasm Intervention

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Poster

Stent Length is Associated with Restenosis of the Vertebral Artery Ostium

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Introduction:

Background: Stenosis of the vertebral artery ostium (VAOS), while under-diagnosed, is common and may cause 25% of posterior circulation infarctions. Stenting is widely employed as a secondary prevention strategy, but is associated with high rates of restenosis. Objective: To identify factors associated with higher risk of VAOS recurrence after stenting.

Methods:

A combined retrospective cohort of subjects who underwent vertebral ostial stenting at two academic hospitals: SSM Health Saint Louis University Hospital and the University of Iowa, was analyzed. The demographic profile of the subjects, medical comorbidities, periprocedural complications, 30 day complications, and change in Modified Rankin score, and radiographic follow up were analyzed using IBM SPSS Statistics version 26.

Results:

There were 80 patients who underwent vertebral artery stenting in this cohort. 72.5% (n = 58) were male, 70% (n=56) were Caucasian. Hypertension (67.5%, n=54) and hyperlipidemia (65%, n=52) were the most prevalent vascular risk factors. Of these subjects, 31 underwent radiographic follow up with catheter angiography. The mean interval at which the last angiogram was performed was, 9.3 months (+/- 4.3). Independent samples t-tests and univariate linear regression models revealed that four factors were identified as most associated with in-stent restenosis: hypertension, diabetes mellitus, stent length, and post-stent residual stenosis. When analyzed as a backwards stepwise multivariate model, stent length was the only variable that trended towards significance (t=1.74, p=0.09). Additionally, only 4 of the 31 patients did not have HTN and none of them had a recurrence of stenosis post-procedure.

Conclusions:

Stent length may be associated with risk of recurrent stenosis after vertebral ostial stenting. This along with risk factors such as hypertension should be studied in future prospective studies as possible predictors of in-stent restenosis.

Keywords: Vertebral, Stenting

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