Neurosurgery Research Day
April 23, 2015

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MUSC Health
Medical University of South Carolina
Changing What’s Possible
Medical University of South Carolina  
Department of Neurosurgery  

Neurosurgery Research Day  

April 23, 2015  

Schedule of Events  

8:00 a.m. to 10:00 a.m.  
Continental Breakfast and Neurological Surgery Resident Research Presentations  
Bioengineering Building Lobby  

10:30 a.m. to 11:00 a.m.  
Remarks by Dr. Sunil Patel, MUSC Neurological Surgery Chair  
Bioengineering Building, Room 112  

11:00 a.m. to 12:00 p.m.  
Cristian Vera Lecture, given by Dr. Rocco Armonda  
Bioengineering Building, Room 112  

12:30 p.m. to 1:00 p.m.  
Presentation of Educational Awards by Dr. Raymond D. Turner, IV,  
MUSC Neurological Surgery Residency Program Director  
Bioengineering Building, Room 112  

1:00 p.m. to 2:00 p.m.  
Lunch  
Drug Discovery Lobby
Neurosurgery Research Day Participants

Avery Buchholz, M.D., MPH

Ron Ron Cheng, M.D.

Fraser Henderson Jr., M.D.

Ryan Kellogg, M.D.

Jonathan Lena, M.D.

Stephen Lowe, M.D.

Guilherme Porto, MS-III

Sam Taylon, M.D.

Jan Vargas, M.D.

Zachary G. Wright, M.D.
ABSTRACTS
Background: Most cases of traumatic spondylolisthesis of the Axis (Hangman’s fracture) can be treated non-operatively with reduction and subsequent immobilization in a rigid cervical collar or HALO. However, in some instances operative management is necessary and can be accomplished using either anterior or posterior fusion techniques. Because open posterior procedures can result in significant blood loss, morbidity and limit cervical range of motion, other less invasive options for posterior fixation are important to develop. Here we describe a minimally invasive, navigation guided technique for surgical treatment of Levine Edwards (L-E) Type II Hangman’s fractures.

Methods: Five patients with L-E Types II Hangman’s fractures requiring operative reduction and internal fixation were treated using percutaneous screw fixation directed through the fracture site. This technique is facilitated using intraoperative 3-D fluoroscopy and neuro-navigation.

Results: Five patients (2 female 3 male), ages (range: 46-67) were operatively treated for L-E type II Hangman’s fractures. There were no intraoperative or postoperative complications. All patients were maintained in a hard collar and then flexion extension radiographs were obtained at 6 months. All patients demonstrated a stable construct upon dynamic imaging.

Conclusion: L-E type II Hangman’s fractures can be safely repaired using percutaneous MIS techniques based on the results presented here. This technique may be appropriate depending on circumstances for all L-E types I & II Hangman’s fractures; however, the degree of associated ligamentous injury and disc disruption must be accounted for. Percutaneous fixation is not appropriate for L-E type III fractures due to significant displacement, ligamentous and disc disruption. This report is meant to serve as a feasibility study and is not meant to show superiority of this procedure over other surgical options.
Abstract: Granular cell tumor (GCT) is a relatively rare, predominantly benign lesion that usually presents as a solitary, painless cutaneous or submucosal nodule. A majority of these tumors are found in the tongue. Complete surgical resection is curative. While GCT is thought to have a Schwann cell origin, reports of GCT in peripheral and spinal nerves are uncommon.

We report the case of a 43 year-old man with neck pain and hand numbness who was found to have a homogeneously enhancing left-sided C2 nerve sheath tumor on MRI. He underwent C2 decompression and en bloc resection of the left-sided C2 nerve sheath tumor with subsequent C1-C2 arthrodesis and instrumentation. Histopathological review revealed granular cell tumor. This is an interesting case of a spinal nerve root location of GCT, with review of the literature yielding only two other cases in a comparable location.
Background: Acute limb ischemia (ALI) is a potentially devastating disease that can potentially require extremity amputation. Treatment for ALI of the lower extremities arteries has traditionally relied on a combination of endovascular infusion of thrombolytic drugs and surgical intervention. Mechanical thrombectomy has been performed with limited reports and outcomes.

Acute ischemic stroke (AIS) has many technical parallels to ALI, in that rapid and effective methods of revascularization are crucial. Advancements in catheter technology in the Neuroendovascular space have revolutionized mechanical thrombectomy for stroke in safety, efficacy and procedural time. The ADAPT technique has been previously reported in the stroke literature and is based on the premise of using very trackable large bore aspiration catheters to simply aspirate and remove the clot directly. Here we present a case of ALI that we treated with the ADAPT technique.

Methods: The records of patient AB (MRN 1629158) including pertinent imaging, labs, notes, and medication records were reviewed in detail. A literature search was performed on the topics of acute limb ischemia and thrombectomy of the peripheral and central vasculature.

Results: The patient’s acute popliteal occlusion was evacuated rapidly from the contralateral leg using three passes of two different-sized aspirations catheters. The patient was placed on a low dose heparin drip overnight, but no tPA was administered. The pulses in the right lower leg were palpated and noted to be stronger than at their baseline prior to the diagnostic angiogram performed earlier that morning, and the patient has remained unaffected at one-month follow-up.

Conclusion: The 5MAX aspiration catheter offered a platform not only for direct aspiration with excellent trackability but also a conduit for smaller aspiration catheters in more distal branches, in this case down to the dorsalis pedis at the level of the fore foot. While our approach builds upon literature in peripheral vascular disease, we believe the adaptation of new neurointerventional tools and techniques may accelerate further study of the role for aspiration techniques in thromboembolic disease.
Background: The pathogenesis of idiopathic intracranial hypertension (IIH) is unknown; however there is evidence of an association of IIH with venous outflow obstruction and venous sinus stenting may be an effective treatment in select patients. Therefore, evaluation of venous sinuses for areas of significant stenosis using MR venography (MRV) is critical in triaging patients for invasive evaluations/treatment. The transverse sinuses (TS) are frequently asymmetric and demonstrate filling defects due to arachnoid granulations. We determined the clinical significance of these MRV findings using catheter-based venous pressure measurements (CVPM) as the gold standard.

Methods: The study included 73 IIH patients who had undergone both MRV and CVPM. The percentage stenosis of the TS was calculated with reference to the superior sagittal sinus using three methods in blinded fashion. 1.) Two attendings and one fellow neuroradiologist visually analyzed the MRVs to calculate the degree of right and left TS stenosis. 2.) The catheter venographic images of the same patients were visually analyzed by a neurosurgery fellow to calculate the percentage stenosis of the TS. 3.) Finally, the same set of MR venogram studies were analyzed using iNtuition (TeraRecon, CA) to automatically generate percentage stenosis. These results were then statistically compared with pressure drops across the TS from CVPM.

Results: Out of the 73 IIH patients, 32 were found to have significant pressure drops across one or both of their TS at CVPM and subsequently underwent stent placement. Intraclass correlation coefficients revealed moderate agreement on MRV for the right (0.63) and fair agreement on the left (0.54). The ratings by the attending neuroradiologists correlated significantly with pressure drops across both TS (Right: r=.449, p<.001; r=.493, p<.001) (Left: r=.372, p=.007; r=.417, p=.002). Computer automated stenosis grading significantly correlated with pressure drops across the right but not the left TS (Right r = .381, p = .001; Left r = .173, NS). Ratings by the radiology fellow and ratings based on catheter venographic images were not significantly correlated with pressure measurements.

Conclusion: Findings at MRV correlate with clinically relevant pressure drops across the TS obtained from CVPM. While variant sinus anatomy is common, these findings have clinical significance, particularly in symptomatic IIH patients.
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Resident Name: Jonathan Lena, M.D.  PGY: 7

Title: Deep venous pressure, waveform, and blood gas determination as a guide for endovascular treatment of a vein of Galen malformation in a neonate

Co-investigators: Alejandro Spiotta M.D.; Aquilla Turk D.O.; M. Imran Chaudry M.D.; Raymond Turner, M.D.

Faculty Mentor: Raymond Turner, M.D.

Background: Vein of Galen malformations (VOGMs) are complex lesions with surgical mortality rates historically ranging from 88%-100%. A mortality rate of 15% is observed with endovascular treatment of VOGMs. The presentation of VOGMs can vary with age and may include high-output congestive heart failure, hydrocephalus, or developmental delay. In children, the endovascular treatment of VOGMs is often staged, primarily due to concerns surrounding radiation and iodinated contrast exposure. Cardiac function may be monitored during the procedure and provide valuable feedback as to how effective the embolization procedure is. However, in the absence of objective neurovascular endpoints, serial angiography must be performed to assess the degree of reduction of arteriovenous (AV) shunting across the fistula during the course of a treatment.

Case Presentation: A newborn male was observed to have a vein of Galen malformation on head ultrasound at an outside facility. He was transferred to our institution where MRA of the head demonstrated an extensive tangle of dilated arteries and a massively dilated vein of Galen (Figure 1A). On day 1 of life he was noted to have cardiomegaly and increased respiratory distress due to worsening congestive heart failure. The patient was intubated and taken emergently for coil embolization of the VOGM.

Results: The patient was placed under general anesthesia. Access to the left common femoral vein was achieved using the Seldinger technique and a micropuncture kit. A microcatheter was advanced over a guidewire into the torcula and a sample of blood was obtained for blood gas analysis (Table 1). The microcatheter was advanced into the dilated vein of Galen. Venography was performed (Figure 2A). Venous pressures were measured before, during, and after coil embolization through the microcatheter by connecting the catheter to a pressure transducer. Repeat blood gas analysis from the torcula was performed demonstrating a pO2 of 52 mm Hg and a pCO2 of 52 mm Hg (Table 1). The embolization procedure was concluded at this time.

MRA of the head on post-embolization day 5 demonstrated a reduction in the number and extent of arterial feeders as well as decreasing prominence of the venous drainage, consistent with decreased AV shunting (Figure 1B). On post-embolization day 6, there was increased bilateral interstitial edema and worsening congestive heart failure. The patient underwent a second stage transvenous embolization that same day. An additional 285 cm of coils were added to the coil mass already within the dilated vein of Galen. Venous pressure monitoring at the conclusion of this procedure was 18 mm Hg.

Conclusion: As total obliteration of a VOGM is often not desired in a neonate, measurement of venous pressures as well as analysis of venous waveforms and blood gas within the deep venous system may be a useful tool for the neuro-endovascular surgeon in determining an embolization endpoint.
Background: Subarachnoid hemorrhage (SAH) affects as many as 30,000 individuals per year in the United States, with 80% of cases resulting from aneurysmal rupture. It is commonly thought that this condition results in a systemic inflammatory and thrombotic response. While the standard of care for this condition is rapidly shifting to coiling instead of clipping, there is some debate as to whether the technique of balloon-assisted coiling is safe in cases of aneurysmal SAH. We present a group of patients with and without SAH treated with balloon-assisted coiling.

Methods: We undertook a retrospective chart review of 77 consecutive patients with and 81 consecutive patients without SAH treated by balloon-assisted coiling between 2010 and 2012 at the Cleveland Clinic. We collected data with regard to demographics, procedural factors including number and time of balloon inflations, and analyzed each patient with a postoperative MRI assessing number and volume of diffusion-weighted imaging (DWI) abnormalities in both the vascular territory distal to the aneurysm of interest and in territories unrelated to the aneurysm. Outcome was measured by stratifying patients into groups with mRS=0-2 or mRS=3-6.

Results: 77 patients underwent BAC of a ruptured cerebral aneurysm and 81 underwent BAC of an unruptured cerebral aneurysm. No significant differences were noted between the groups with respect to demographic factors except that SAH patients were more likely to be active smokers (57.1% vs 42.9%, p=0.03). Procedural characteristics were also similar, except for a significantly shorter cumulative balloon inflation time than unruptured patients (12.3 vs 19.2 minutes, p=0.004). SAH patients were significantly more likely to have a higher number and volume of DWI abnormality than non-SAH patients (4.0 vs. 3.0, p=0.04. for number and 1.3 vs. 0.3, p=0.004 for volume). There was no correlation between demographic factors except anti-platelet status with DWI. Those pre-procedurally on antiplatelets had higher median volume of DWI (3.96 vs. 0.93, p=0.02). Patients with DWI abnormalities had significantly worse outcomes (81%vs95.6% mRS 0-2, p=0.03). Patients with DWI abnormality were more likely to have a 4 vessel angiogram than those without (70.5% vs 48%, p=0.01). There was no difference in DWI abnormalities in the vascular territory distal to the aneurysm between the two groups (66.7% vs 88.2%, p=.15), but the SAH group had significantly more DWI in unrelated vascular territories (81.5% vs 47.1%, p=0.02). SAH had an overall higher DWI rate (75% vs 21%, p<0.0001) than those without subarachnoid hemorrhage.

Conclusion: While the early literature suggested balloon-assisted coiling posed a higher procedural complication risk than stand-alone coiling, most of the more recent literature suggests otherwise. While some studies suggest it is more dangerous in SAH, we show that the balloon itself is not responsible for the ischemic complications; rather, angiography itself appears to be the culprit. We attribute this to the pro-inflammatory, pro-thrombotic response seen in aneurysmal SAH. While patients pre-operatively on antiplatelets have a higher rate of DWI, we propose that this is because they compose a higher baseline cardio-and-cerebrovascular risk strata than those who are not.
Background: Patients with acute brain injuries require strict physiologic control to minimize morbidity and mortality. This study aimed to assess in-hospital compliance to strict physiologic parameters (BP, HR, ICP, and SpO2) in these populations.

Methods: Patients with severe cerebrovascular events were admitted to the Neurointensive Care Unit (NSICU) and were continuously monitored using the BedMasterEX (Excel Medical Electronics Inc., FL) system, which recorded hemodynamic data via an arterial catheter continuously in 5-second intervals. Furthermore, we investigated the impact of healthcare provider shift changes (6-8 AM/PM) and of day (6A-6P) v. night (6P-6A) shifts in hemodynamic control.

Results: Fifty patients admitted to the NSICU, 50% male, mean age 59.7 ±13.9 years with subarachnoid hemorrhage (23), ischemic stroke (8), subdural hematoma (4), intracerebral hemorrhage (3), intraventricular hemorrhage (2) and miscellaneous injuries (10) were enrolled. Data represented 2,337 total hours of continuous monitoring. Systolic BPs (SBP) were on average outside of recommended ranges 32.26 ±30.46% of the monitoring period. We subdivided adherence to ideal SBP range: optimal (≥99% of time spent in NSICU within range) was achieved in 12%, adequate (90%) in 16%, suboptimal (80%) in 20%, inadequate I (70%) in 12%, and inadequate II (<70%) in 40% of patients. Comparison of shift change %time and day vs. night %time out of parameter yielded no statistically significant differences across SAH patients.

Conclusion: Hemodynamic management of patients with cerebrovascular injuries, based on targeted thresholds in the NSICU, yielded optimal control of SBP in only 28% of our patients (within parameters ≥90% of time).
**Background:** Third nerve palsy found on neurologic exam is often an ominous sign. We present a case report of an isolated unilateral third nerve palsy found own post-operative day zero of a patient who had undergone unilateral carotid endarterectomy. Additional work up of this patient yielded significant carotid stenosis. Review of the literature shows that third nerve palsy shortly after carotid endarterectomy can be indicative of carotid dissection and/or pending occlusion.

**Results:** Literature review yields few similar case reports. Also reported are third nerve palsies as presenting symptoms for ipsilateral carotid stenosis. More traditional workups for these third symptoms were often undertaken; usually including head computed topography scans as well as diagnostic cerebral angiography. Head CT’s were reviewed as normal and often high-grade stenosis was seen along with normal intracranial vasculature. Patient’s most often presented without hemispheric symptoms from their carotid disease that would otherwise clue in clinicians to evaluate these same patients for ischemia. The mechanism behind the manifestation of these third nerve palsies is believed to be ischemic in nature. Most likely due to slow flow in the distal carotid artery distal to the region of stenosis.

**Conclusion:** Isolated third nerve palsy after carotid endarterectomy is a rarely observed phenomenon. If found, immediate work up should be undertaken to determine if a carotid vessel abnormality exists and appropriate subsequent management pending these results.
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Resident Name: Jan Vargas, M.D.  
PGY: 4

Title: Acute stroke following carotid endarterectomy: time for a paradigm shift?  
Multicenter experience with emergent carotid artery stenting with or without intracranial tandem occlusion thrombectomy.

Co-Investigators: Alejandro Spiotta, M.D.; Scott Zuckerman, M.D.; Maxim Mokin, M.D., Ph.D.;  
Azam Ahmed, M.D.; J Mocco, M.D.; Raymond Turner, M.D.; Aquilla Turk, D.O.;  
M. Imran Chaudry, M.D.; Phil Myers, M.D.

Faculty Mentor: Alejandro Spiotta, M.D.

Introduction: Stroke in the immediate post-operative period following carotid endarterectomy (CEA) is a rare complication. Many centers have begun incorporating angiography before surgical re-exploration, which has the advantage of confirming carotid occlusion and treating tandem intracranial lesions, if present. The aim of this study is to determine the safety and efficacy of this strategy.

Methods: A retrospective review was performed of all cases undergoing acute stenting of the carotid artery following carotid endarterectomy from November 2009 to June 2013 at four centers. Charts and angiographic images were reviewed. Eleven cases of carotid thrombosis within 72 hours of CEA and subsequent treatment strategies are summarized.

Results: All patients had greater than 50% carotid stenosis prior to carotid endarterectomy. One patient had intraoperative occlusion and dissection of the ICA which was noted on intraoperative carotid duplex ultrasound. All patients underwent post-operative computed tomography (CT) or computed tomography perfusion (CTP) scans with subsequent cerebral angiography and stent reconstruction within 11 hours of symptom onset. In all cases, carotid recanalization was successfully completed between 32 to 160 minutes from groin puncture. There were no procedural complications. Four patients had a tandem middle cerebral artery occlusion, three of which underwent successful recanalization.

Conclusion: Emergent endovascular evaluation in the setting of acute post CEA thrombosis is a safe and timely treatment option, with the benefit of detecting and treating embolic intracranial lesions. Immediate angiography and intervention in this rare surgical complication shows promising initial results.
Background: Cerebrospinal fluid leaks have been described to cause syndromes such as subdural hematomas and conformational changes to the brain, particularly downward herniation.

Methods: A 77 year old man underwent upper cervical spine surgery with resultant CSF leak and formation of subdural hematomas. He became unresponsive, developing decerebrate posturing. This reversed when the patient was laid flat. He was able to ambulate after the placement of bilateral subdural evacuating port system drains and slow return to upright posture.

Results: The patient had a uniquely rapidly reversible case of brain stem dysfunction resulting from CSF leak.

Conclusion: In cases of brainstem dysfunction caused by CSF leak, rapid diagnosis is vital and may result in reversal of the change. In this case, SEPS was a viable treatment for the resultant subdural collections.