who remain in our care or were cured, 4 (33.3%) experience a mild developmental delay and 8 (66.6%) are neurologically intact/developing normally.

**Conclusion** We report that trans-umbilical access for endovascular embolization of VOGM and a similar high-flow malformation was a safe and effective therapy for 15 cases which demanded immediate intervention in the neonatal period. The benefits of trans-umbilical access are sparing of the femoral arteries for future treatments and potential applicability to other high-flow fistulas of the brain. It should be noted that this procedure may be the difference between life and death, and as such we stress the importance of effective UA and UV catheterization in the NICU.

**Disclosures** M. Bazil: None. J. Fifi: None. A. Berenstein: None. T. Shigematsu: None.

**0-044 INCREASED INCIDENCE OF RUPTURED CEREBRAL ARTERIOVENOUS MALFORMATIONS AND MORTALITY IN THE UNITED STATES: UNINTENDED CONSEQUENCES OF THE ARUBA TRIAL?**

1A Dicpinigaitis*, 1J Ogulnick, 2J Cooper, 2S Mayer, 2C Gandhi, 2F Al-Mufti. 1New York Medical College – School of Medicine, Valhalla, NY; 2Westchester Medical Center at New York Medical College, Valhalla, NY

**Introduction/Purpose** The findings of the A Randomized Trial of Unruptured Brain Arteriovenous Malformation (ARUBA) trial, which determined that medical management was superior to prophylactic interventional therapy for the treatment of unruptured cerebral arteriovenous malformations (cAVMs), remain polarizing and controversial. Previous analyses of national registry data have demonstrated decreased rates of endovascular and surgical intervention for unruptured cAVMs following the publication of the ARUBA trial in 2014.

**Materials and Methods** Adult cAVM patient admissions were identified in the National Inpatient Sample (NIS) from 2009 to 2019 using International Classification of Diseases, Ninth and Tenth Revision, Clinical Modification codes. The incidence of cAVM rupture and in-hospital mortality were compared between the pre- (2009–2013) and post-ARUBA trial eras (2014–2019) using complex samples weighted estimates.

**Results** Among 121,415 hospitalizations for cAVM during the study period, 31,389 (25.9%) were admissions for acutely ruptured malformations. The incidence of both ruptured cAVM (13.3% vs. 34.4%, p<0.001) as well as rates of in-hospital mortality (2.0% vs. 7.6%, p<0.001) significantly increased in the post-ARUBA trial era. Following multivariable regression analysis adjusting for age, illness severity, and acute neurological condition, the post-ARUBA trial era was independently associated with both cAVM rupture (aOR 1.99, 95% CI 1.72 to 2.29; p<0.001) and in-hospital mortality (aOR 1.94, 95% CI 1.37 to 2.75; p<0.001).

**Conclusion** The incidence of ruptured cAVM increased following 2014, potentially a reflection of a paradigm shift to conservative and non-interventional management strategies in unruptured cAVM patients. Further studies may be necessary to exclude other confounders contributing to this rise.


**0-045 TRANSVENOUS EMBOLIZATION OF SPINAL EPIDURAL ARTERIOVENOUS FISTULA WITH COMPRESSIVE MYELOPATHY**

1S Madhani*, 2S Oushy, 1N Borg, 1G Lanzino, 1H Ciof, 2W Brinjikji. 1Neurosurgery, Mayo Clinic, Rochester, MN; 2Radiology, Mayo Clinic, Rochester, MN

**Introduction** Spinal Epidural Arteriovenous Fistula (SEDAVF) is a rare form of arteriovenous shunting between the epidural arterial arcade and venous plexus, resulting in arterialization of the epidural plexus. Although the current mainstream treatment of such lesions involves trans-arterial embolization (TAE), we present a case describing an alternate trans-venous embolization (TVE) approach for these lesions.

**Materials and Methods** An elderly female with lumbar stenosis and neurogenic claudication presented with progressive leg paresthesias and weakness. On imaging, she was found to have a rapidly shunting spinal epidural arteriovenous fistula with seven arterial feeders from T12-L3. The fistula had extradural venous drainage into epidural and paraspinal venous plexuses. No intradural pathology was noted. After a transfemoral vein access, a microcatheter was advanced within the left ascending lumbar vein. A 4 x 8 mm coil was then deployed within the vein followed by injection of liquid embolization agent.

**Results** Transvenous embolization (TVE) resulted in significant reduction in shunting through the SEDAVF, with a minor residual flow seen from the left L2 artery. To obliterate this, another microcatheter was then navigated through the left L2 artery for TAE with liquid embolization agent (figure 1). Post-procedural angiography showed no residual shunting and computed tomography showed stable canal stenosis. She was discharged home the same day at her neurological baseline.

**Conclusion** TAE although the current mainstream treatment of SEDAVF, carries a risk of reflux into critical arterial branches such as radiculomedullary arteries supplying the spinal cord. TVE is an alternate approach that avoids this complication, increases the likelihood of crossing the fistula due to proximity to the shunt and can be used for treatment of SEDAVF with multiple arterial feeders.


**0-046 CEREBRAL VASOSPASM FOLLOWING ARTERIOVENOUS MALFORMATION RUPTURE: A POPULATION-BASED CROSS SECTIONAL STUDY**

1A Dicpinigaitis*, 2E Feldstein, 3S Shapiro, 4H Kamal, 5A Baurerschmidt, 6J Rosenberg, 3K Almullen, 7J Pipas, 8N Dangayach, 9J Liang, 10J Bowers, 5S Mayer, 7C Gandhi, 6F Al-Mufti. 1New York Medical College – School of Medicine, Armonk, NY; 2Westchester Medical Center at New York Medical College, Valhalla, NY; 3Goodman Campbell Brain and Spine, Carmel, IN; 4Mount Sinai Hospital, New York, NY; 5University of New Mexico, Albuquerque, NM

**Introduction/Purpose** Limited evidence exists characterizing the incidence, risk factors, and clinical outcomes of arterial vasospasm secondary to cerebral arteriovenous malformation (cAVM) rupture. We utilize a population-based national registry to investigate this largely unexamined clinical entity.

**Materials and Methods** Weighted discharge data from the National Inpatient Sample during the period of 2015 to 2019...
were queried to identify adult ruptured CAVM patients and subsequently those developing angiographically-confirmed vasospasm. Complex samples multivariable logistic regression and chi-square analyses were performed to identify significant associations between clinical covariates and the development of vasospasm, and a CAVM vasospasm predictive model (CAVM-VM) was generated based on the effect sizes of these parameters.

**Results** Among 7,215 CAVM patients identified, 935 developed vasospasm, corresponding to an incidence rate of 1.3%. 110 of these patients (11.8%) subsequently progressed to delayed cerebral ischemia (DCI). Multivariable adjusted modeling identified baseline clinical covariates (age, sex, and hospitalization events) as predictors of vasospasm following multivariable adjustment. Among significant associations, a CHAID decision tree algorithm identified age 50–59 (parent node), hyponatremia, and leukocytosis as important determinants of vasospasm development. The CAVM-VM achieved an area under the curve of 0.73 (95% CI 0.61, 0.82, p = 0.031) following adjustment for baseline covariates. Intraparenchymal and subarachnoid hemorrhage were not associated with the development of vasospasm following multivariable adjustment. Among significant associations, a CHAID decision tree algorithm identified age 50–59 (parent node), hyponatremia, and leukocytosis as important determinants of vasospasm development. The CAVM-VM achieved an area under the curve of 0.73 (95% CI 0.61, 0.82, p = 0.031) following adjustment for baseline covariates.

**Conclusion** This population-based analysis of vasospasm in CAVM identifies common clinical risk factors for its development and establishes progression to DCI as a predictor of poor neurological outcomes.

**Disclosures**


**Proteomics Analysis on Human Cerebral Cavernous Malformations Reveals Novel Biomarkers for the Disease Pathology**

S. Jaushainen*, F. Onyegozari, H. Savander, E. Zarraroni, L. Liu Conze, J. A. Laakso, M. Niemelä, E. Dejana, B. Rezae Jahromi, P. Magnusson. Uppsala University, Uppsala, Sweden; University of Helsinki and Helsinki University Hospital, Helsinki, Finland; FIRC Institute of Molecular Oncology Foundation, Milan, Italy

**Background** Cerebral cavernous malformations (CCMs) are abnormal cystic capillaries with an impaired signaling in endothelial cells originating from venous/capillary bed. They can appear as a sporadic or familial form, caused by somatic and/or inherited loss-of-function mutations in one of risk genes, CCM1–3, or other mutations. They are associated with an elevated risk of intervention or observation confers superior clinical outcomes in these patients.

**Methods** A PRISMA guided systematic literature review and meta-analysis was completed to evaluate the outcomes of intervention of any type versus observation alone in the management of low-grade, Borden Type 1 intracranial dAVF. Data from comparative studies were collected from the literature and pooled together with the authors’ own institutional experience. Primary outcome measures included: grade progression, worsening symptoms, death due to dAVF, permanent complications other than death (i.e. from intracerebral hemorrhage or intervention), and rate of death combined with permanent complication. Spontaneous obliteration and procedural complications were also calculated as secondary outcome measures. A fixed effects model was used to calculate pooled odds ratios (OR) for each outcome variable. Rates of non-comparative variables were also calculated.

**Results** The systematic review yielded 5 comparative studies, that when combined with our experience resulted in a total of 540 patients included in the meta-analysis. The intervention group included 314 patients, while the observation group included 226 patients. There was no significant difference in grade progression (OR: 2.02, 95% CI: 0.51 to 8.03, P = 0.32, I² = 8%), nor in deaths due to dAVF (OR: 3.81, CI: 0.61 to 23.84, P = 0.15, I² = 0%). However, patients within the intervention group had a higher odds of worsening symptoms after intervention (OR: 2.18, CI: 1.08 to 4.43, P = 0.03, I² = 0%). Additionally, intervention was associated with a higher odds of death or permanent complication from either hemorrhage or intervention (OR: 4.35, CI: 1.00 to 19.08, P = 0.05, I² = 0%). Any type of procedural complication occurred in 45/303 (14.9%) patients, with a permanent complication in 9/310 (2.9%) patients. There were no instances (0%) of permanent complications (other than death) due to rupture in either group. Spontaneous obliteration occurred in 24/122 (19.7%) of the observed patients.

**Conclusions** Pooled analysis of patients with low-grade, Borden Type 1 intracranial dAVF indicates that intervention results in a higher odds of symptom progression, and death or permanent procedural complication. These findings suggest that observation could be favored and patients should be selected for intervention judiciously.

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