E-002 DEVELOPMENT OF A PHANTOM THAT CAN MIMIC IDIOPATHIC INTRACRANIAL HYPERTENSION AND TRANSVERSE SINUS STENOSIS

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Purpose Idiopathic Intracranial Hypertension (IIH) is a pathologic elevation of the intracranial pressure (ICP) with normal CSF composition which mostly affects younger women who are obese. IIH is most commonly presented along with focal stenosis of venous transverse sinus (TS). Venous sinus stenting (VSS) is an effective procedure that can resolve PT in patients with IIH and TS stenosis but has significant relapse rates. A benchtop phantom that can reliably mimic IIH pathophysiology and induce TS stenosis would allow evaluation of factors causing restenosis.

Materials and Methods Our benchtop phantom constitutes an interchangeable 3D printed TS flow model submerged in a rigid water-filled chamber akin to dura mater. The phantom is equipped with an underwater pressure sensor connected to a microcontroller and capable of continuously relaying the ICP values to a computer in real time. Two calibrated needle gauges connected externally on either side of the TS flow model monitor IVP gradient across the stenosis (figure 1A). ICP is manipulated by infusing additional water analogous to increasing CSF, through the inlet provided on top of the phantom. To better approximate the compliance of the TS *in vivo*, we tested seven thin-walled flow models of same size made of four different materials with a range of shore hardness factors (27A – 60A). With glycerol-water mixture pumped through the model, the ICP was increased in the phantom from 0 – 60 cmH_2O in 5 cmH_2O increments and IVP gradient was recorded across the stenosis (n=3 trials per flow model). Measurements were obtained with the phantom positioned to resemble TS in both upright and supine positions respectively.

Results Among all the flow models tested, the model 3D printed with Agilus 30A was found to be a good surrogate for TS when the phantom was oriented in supine position. It produced a stenosis with a mean IVP gradient of 7.84 mmHg at a mean ICP of 25.5 cmH_2O, agreeing with typical lumbar puncture opening pressure values (>25 cmH_2O) seen in most IIH patients (figure 1B).

Conclusion We developed a benchtop phantom that can mimic the pathophysiology of IIH and can reliably induce TS stenosis by increasing the ICP to the levels typically observed in patients. We anticipate that our phantom will facilitate evaluating anatomical and physiological parameters that induce restenosis and will eventually allow testing of new devices that could minimize VSS relapse rate in IIH patients.

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E-003 QUALITY OF LIFE, NEED FOR RETREATMENT, AND THE RE-EQUILIBRATION EFFECT AFTER VENOUS SINUS STENTING FOR IDIOPATHIC INTRACRANIAL HYPERTENSION

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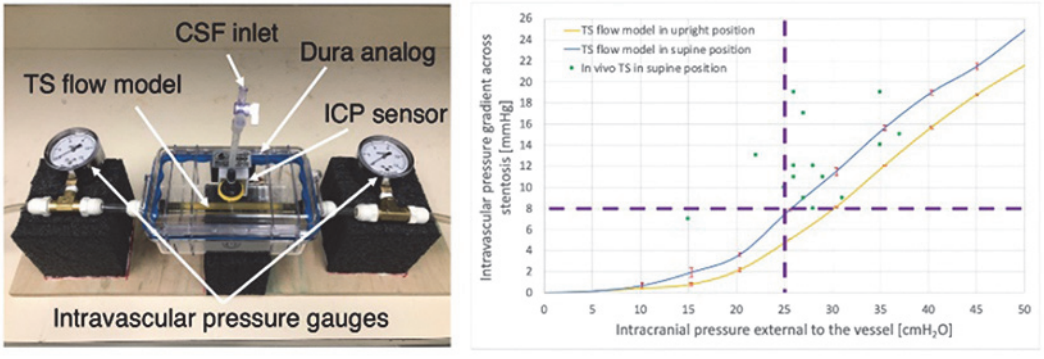
Introduction Venous sinus stenting (VSS) is increasingly being used as a treatment for idiopathic intracranial hypertension (IIH). This study aimed to look at long term outcomes and need for further surgical intervention in patients following VSS.

Methods Retrospective analysis was performed on a prospectively-maintained single center database to identify patients with medically refractory IIH who underwent VSS with associated pressure gradient. The senior author performs both VSS and CSF shunting for IIH. Patients with persistent or severe recurrent symptoms after VSS undergo lumbar puncture (LP) to evaluate the effect of VSS on intracranial pressures, therefore need for LP serves as a marker for disease recurrence.

Results 81 patients underwent VSS with a mean follow-up of 10 months (median 6 months, range 2 weeks – 38 months). Forty-four (54.3%) patients underwent repeat LP after VSS due to persistent or recurrent symptoms following the intervention at a mean of 12 months (median 7 months, range



Abstract E-002 Figure 1 A) Benchtop model of Idiopathic Intracranial Hypertension (IIH) and Transverse Sinus (TS) Stenosis with internal components labeled. B) Mean intravascular pressure gradients observed across stenosis under increased intracranial pressure (ICP) using transverse sinus model 3D printed using Agilus 30A (n = 3) oriented in upright and supine positions respectively with respect to in vivo measurements. In vivo venous manometry and lumbar puncture measurements were obtained from IIH patients (n=15) lying in supine position who were treated later by venous sinus stenting (VSS) intervention. All the patients had an opening cerebrospinal fluid pressure (CSFp) of 25 cmH_2O, measured by lumbar puncture and a pressure gradient of >8 mmHg across the transverse sinus stenosis before the intervention (purple dashed lines)

2 – 43 months). There was a mean decrease in opening pressure (OP) on LP from pre- to post-VSS of 9.1 cm H2O (median 9.5 cm H2O). Of the 44 patients, 18 (22.2%) underwent repeat angiogram to evaluate for candidacy for repeat stenting, of which 5 (27.8%, 6.2% of total) patients underwent a second stenting procedure. Eighteen of the 44 (41.9%, 22.2% of total) patients underwent a subsequent CSF shunting procedure at a mean of 7.1 months (median 5.7 months) following VSS. Overall, a total of 21 (25.9%) patients underwent further surgical intervention following VSS. Forty-six patients were administered quality of life (WHOQOL-BREF) and symptom severity questionnaires (HIT-6) at initial consultation and each subsequent visit. There was an overall increase in quality of life scores with mean pre-stenting and last follow-up (post-VSS) scores of 61.2 (SEM 2.5) and 71.2 (SEM 3.9), respectively. There was an overall decrease in HIT-6 scores with mean pre-stenting and last follow-up (post-VSS) scores of 62.7 (SEM 1.7) and 55.8 (SEM 2.9), respectively.

Conclusions VSS is an effective treatment for venous sinus stenosis in IIH, however, this study found higher rates of symptomatic recurrence and need for further surgical intervention than has previously been reported in the literature. Recurrence of symptoms occurs at a median of 7 months even though OP remain lower at follow-up LP suggestive of a re-equilibration phenomenon.

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E-004 SEX-BASED DIFFERENCE IN THE UTILIZATION OF ENDOVASCULAR THERAPY IN CEREBRAL SINUS THROMBOSIS: THE USA BASED STUDY

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Introduction Cerebral sinus thrombosis (CVT) is an overall uncommon cause of cerebral venous infarction that accounts for approximately 0.5–1% of all strokes. The initial treatment for CVT is systemic anticoagulation, which has been associated with improved neurological outcomes in small randomized studies. However, with anticoagulation alone, large and extensive thrombi are unlikely to dissolve, and thus approximately one-third of patients with severe presentation have a high risk of incomplete recovery. Endovascular intervention is an alternative option for patients with neurological deterioration despite the use of anticoagulation or with the development of new or worsening intracerebral hemorrhage (ICH) on anticoagulation. Current endovascular techniques include direct catheter thrombolysis, balloon-assisted thrombectomy, rheolytic catheter thrombectomy, aspiration thrombectomy, and stent retriever thrombectomy. Prior studies have reported a higher risk of mortality and poor outcomes in the EVT group. However, there is a lack of contemporary data regarding sex-based differences in outcomes. The goal of our study was to understand the sex-based trend of EVT utilization and differences in outcomes following CVT.

Methods We used the Nationwide Inpatient Sample database from the year 2005–2015 to identify CVT hospitalizations who treated with EVT using ICD-9 CM code. To make the data nationally representative, weights were applied as per NIS recommendations. Chi-square test and student's T-test were used for categorical and continuous variables to analyze descriptive data, respectively. A multivariate logistic regression model was performed on outcomes variables (discharge to home and in-hospital mortality) to avoid confounding effects.

Result A total of 46,537 CVT were extracted from the years 2005–2015. Among them, 2,065 treated with EVT (female N=1,384 and male N=681). The mean age of the EVT treated group was male 48.7±1.38 vs. female 43.0±1.05 (p=0.002). While in medically treated group mean age was male 49.5±0.38 vs. female 40.6±0.26 (p<0.001). After adjusting comorbidities, multivariable models did not show a statistical difference in mortality and home discharge among medically, and EVT treated gender groups (table). The overall trend of EVT utilization was increased from 29 cases in 2005 to 57 cases in 2015 per 1000 CVT hospitalization (trend p=0.04). EVT in female group trended up (26 cases in 2005 to 57 cases in 2015; p=0.04) while in male, EVT cases also

Abstract E-004 Table 1 Outcomes of Cerebral Sinus Thrombosis Hospitalizations in the US (2005–2015)

	Female (N)	Male (N)	Odds ratios	Lower limits-Upper limits	P-value
Discharge to home					
Medically treated group (N=44,473)	30,970	13,503			
Univariate model (female vs. male)			1.82	1.66–2.00	<0.001
Multivariate model (female vs. male)			1.03	0.91–1.16	0.69
EVT treated group (N=2,065)	1,384	681			
Univariate model (female vs. male)			1.02	0.68–1.51	0.94
Multivariate model (female vs. male)			0.70	0.40–1.24	0.22
In-hospital mortality					
Medically treated group (N=44,473)	30,970	13,503			
Univariate model (female vs. male)			0.45	0.35–0.57	<0.001
Multivariate model (female vs. male)			0.78	0.57–1.06	0.11
EVT treated group (N=2,065)	1,384	681			
Univariate model (female vs. male)			1.64	0.83–3.24	0.15
Multivariate model (female vs. male)			1.60	0.62–4.11	0.33

–Multivariate model: Patient-level characteristics including Age, gender, Charlson comorbidity index, race, hematological conditions, CNS infections, brain tumors, any cancers, inflammatory conditions, traumatic brain injuries, DM, hypertension, drug abuse, smoking, EtOH abuse, seizures disorders, coma, cerebral edema, hydrocephalus, migraine, intracranial hemorrhage, ischemic stroke, ventriculostomy, invasive mechanical ventilation, tracheostomy and PEG tube.
–Hematological conditions, including sickle cell disorders, coagulation, hemorrhagic disorders, polycythemia, hypersplenism, and diseases of the spleen.
–Systemic inflammatory disease which includes systemic lupus erythematosus, rheumatoid disorders and other related conditions, and other connective tissue disorders.
–CNS infections include meningitis, encephalitis, other CNS infection and poliomyelitis
–Charlson comorbidity index: The severity of co-morbid conditions was defined using the Charlson-Deyo Co-morbidity Index (CCI). CCI is an established measure to quantify the burden co-morbid conditions; the scores range from 0 to 33 with a higher score indicating a greater burden of concomitant diseases. Derived from: Roffman CE, Buchanan J, Allison GT. Charlson Comorbidities Index. *Journal of physiotherapy.* 2016;62(3):171.