GCRC IRB Protocol
David K. Hahn
Doris Duke Clinical Research Fellow

Retrospective Analysis to Assess the Efficacy of Microsurgical Fenestration of the Lamina Terminalis in Reducing the Incidence of Shunt-Dependent Hydrocephalus following Aneurysmal Subarachnoid Hemorrhage

Study Purpose and Rationale: Subarachnoid hemorrhage following ruptured intracranial aneurysm (aSAH) affects approximately 25,000 to 30,000 people each year. Despite advances in early diagnosis and management, SAH remains a frequent cause of death and disability. Mortality rates after SAH have been reported to be as high as 50% [8]; among the survivors of the initial ictus, 50% are left severely disabled. A common complication of this disease is an increase in the pressure around the brain, called hydrocephalus.

Hydrocephalus contributes significantly to the longterm morbidity in SAH patients, and is more prevalent in patients with higher grade hemorrhages. This is especially true in patients with thick subarachnoid blood or intraventricular hemorrhage (IVH), i.e., Fisher Grades 3 or 4. [8] Altered cerebrospinal fluid (CSF) dynamics after aSAH is the leading cause of shunt-dependent hydrocephalus in adults and accounts for 35% or more of these cases. [1] While shunting is often necessary and sufficient to relieve hydrocephalus acutely, the combined risk of shunt-related complications and shunt failure is 43% at 1 year and 85% at 10 years. [2, 4] Thus, shunt-dependent hydrocephalus contributes significantly to the relatively poor outcome of aSAH years after presentation, and carries considerable morbidity and mortality.

It has recently been reported in retrospective studies that microsurgical fenestration of the lamina terminalis during open surgery for aneurysm clipping may reduce the incidence of shunt-dependent hydrocephalus following aSAH. [5, 7] Fenestration of the lamina terminalis creates an anterior third ventriculostomy, which may improve CSF dynamics, reduce leptomeningeal inflammation and subarachnoid fibrosis, and increase the clearance of blood and CSF from the ventricles. [6]

This retrospective analysis from a single surgeon perspective of all patients undergoing fenestration versus those who did not will serve as a confirmatory study validating or invalidating previous retrospective studies that microsurgical fenestration of the lamina terminalis during open surgery reduces the incidence of post-operative shunt-dependent hydrocephalus.

Such an analysis has the potential to improve the longterm outcome in patients undergoing surgery for aSAH. Previous studies have included multiple surgeons, all Fisher Grade aSAH patients, and have relied on operator recall for generation of portions of the studied cohorts. This study has the potential to resolve many of the issues surrounding the use of this procedure by examining a single surgeon's perspective,

limiting our cohort to those at greatest risk for shunt-dependent hydrocephalus, ie higher Fisher grades, and thus those that may benefit the most from the procedure.

This cohort is composed of patients with thick blood in the subarachnoid space and/or predominately intraventricular or intracerebral hemorrhage (IVH or ICH) on diagnostic head computed tomography (CT) upon admission to the hospital.

Study Design, Procedures, and Statistical Analysis: This study is a retrospective analysis of a single surgeon's experience with fenestration of the lamina terminalis during surgery for clipping of intracranial aneurysms after aSAH. Patients who were confirmed with a diagnosis of aneurysmal SAH by cerebral angiogram, CT angiogram, or lumbar puncture (LP) arriving to Columbia Presbyterian Hospital less than 48 hours from symptom onset will be included in the study.

All patients seen and treated surgically between the dates of January 2000 and January 2006 will be included in the chart review. All patient information analyzed will have already been collected and retrieved from file in either CUMC's electronic patient database, medical records, and/or the surgeon's office files. No new data collection will be acquired.

All patients will placed into one of two arms, depending on their surgical procedure they received as described by their operative notes: those patients receiving aneurysm surgery and that received fenestration and those that did not receive fenestration. Patient records will be reviewed for occurrence of hydrocephalus throughout their hospitalization, baseline neurological assessment including an NIH Stroke Scale, Glasgow Coma Scale, modified Rankin score, Lawton PSMS and Barthel index, grade of SAH will be assessed at presentation by head CT (Fisher Grade) and admitting neurological exam (Hunt and Hess Grade).

Charts will also be reviewed for follow up visits and outcomes assessment, particularly at 3 and 12 months after the patient's aSAH in order to evaluate their longterm neurological status, disability, emotional status, social and cognitive functioning, and overall quality of life.

Primary Outcome measure: (1) Presence of shunt-dependent hydrocephalus as determined by VP shunt placement after surgery while in hospital

Statistical Analysis: Fisher grade 3 and 4 patients with ruptured anterior circulation aneurysms will be examined. Currently, the incidence of shunt-dependent hydrocephalus in Fisher grades 3 or 4 patients is estimated at 35 to 50%. Previous study has shown a decrease in shunt placement of 12% vs. 2%. With an alpha of 0.05 and a power of 0.8, power analysis demonstrates a need of 244 total patients to show a treatment effect with 122 patients each in the treatment and no treatment groups. This is based on a Chi square Power Analysis for categorical data.

The following statistical measures will be taken to analyze the data: Chi square test for categorical data (e.g., presence or absence of shunt-dependent hydrocephalus), and multivariate analyses using logistic regression where appropriate.

Confidentiality of Study Data: A completely deidentified database will be constructed. All retrospective data will be recorded without patient identifiers. Deidentification will involve the replacement of direct patient identifier from data sets with a linking code by which the data remain identifiable. For linking purposes, we use study specific codes, rather than medical record numbers, social security numbers, or other easily decoded combinations of initials and birth dates. More specifically, all clinical data and followup information will be locked in a secure metal file cabinet with only the PI and coinvestigator having keys. Digital files will be maintained on the primary investigators computer with password protection. Access to the linking files will be restricted to the PI, coinvestigator, and the research team at Columbia University, and only given on an as needed basis.

Potential Risks: There are no risks to patients as this is a chart review analysis.

REFERENCES:

1. Katzman, R., Normal Pressure Hydrocephalus, in Dementia, W. CE, Editor. 1977, F.A. Davis: Philadelphia. p.6992.
2. Borgbjerg BM, G.F., Alberck MJ, Hauerberg J, Borgessen SV. A comparison between ventriculoperitoneal and ventriculoatrial cerebrospinal fluid shunts in relation to rate of revision and durability. Acta Neurochir (Wien), 1998. 140: p. 459465.
3. Lam Ch, V.J., Comparison between ventriculoatrial and ventriculoperitoneal shunting in the adult population. British Journal of Neurosurgery, 1997. 11: p. 4348.
4. Udvarhelyi GB, W.J., James AE Jr, Bartlet D. Results and complications in 55 patients with normal pressure hydrocephalus. Surgical Neurology, 1975. 3: p. 271275.
5. Sindou, M. Favourable influence of opening the lamina terminalis and Lilliequist's membrane on the outcome of ruptured intracranial aneurysms: A study of 197 consecutive cases. Acta Neurochir (Wien), 1994. 127: p. 1516.
6. Tomasello F, d¡ Avella D, de Divitiis O. Does lamina terminalis fenestration reduce the incidence of chronic hydrocephalus after subarachnoid hemorrhage? Neurosurgery, 1999. 45: p. 827832.
7. Komotar, R.J., et al. Microsurgical fenestration of the lamina terminalis reduces the incidence of shuntdependent hydrocephalus after aneurysmal subarachnoid hemorrhage. Neurosurgery, 2002. 51(6): p. 140312; discussion 14123.
8. Dehdashti AR, Rilliet B, Rufenacht DA, De Tribolet N. Shuntdependent hydrocephalus after rupture of intracranial aneurysms: a prospective study of the influence of treatment modality. J Neurosurg, 2004. 101: 402407.