**Introduction**

Acute hydrocephalus (HCP) is a common and serious complication of aneurysmal subarachnoid hemorrhage (aSAH), frequently requiring emergent cerebrospinal fluid (CSF) diversion via external ventricular drain (EVD) placement. A substantial proportion of SAH patients with HCP ultimately require permanent CSF diversion, via ventriculoperitoneal shunt (VPS) placement; however, decision making with respect to patient selection and shunt timing is controversial, particularly given the parallel risks of morbidity attributable to under-treatment of chronic HCP, multiple failed attempts at EVD weaning, or placement of an unnecessary VPS. We sought to quantitatively study patients who underwent EVD placement for treatment of SAH-induced HCP, to identify potential predictors of eventual VPS dependence.

**Background**

Aneurysmal subarachnoid hemorrhage (aSAH) incidence in USA: 10-15/100,000. aSAH is associated with significant mortality: 51% case fatality rate, 10% pre-hospital, 25% <24h, 45% <30d days. Survivors are to subject to potentially severe neurologic disability and prolonged advanced care with activities of daily living. Early and late complications are most significant contributors to survivor morbidity. Early complications include acute hydrocephalus, rebleeding, takotsubo cardiomyopathy, seizures, traumatic ICH (e.g. – SDH). Late complications include symptomatic vasospasm, delayed cerebral ischemia, ischemic stroke. Many SAH patients with acute HCP ultimately require prolonged CSF diversion with a ventriculoperitoneal shunt (VPS). Decision making for pt selection and timing controversial. VPS-associated morbidity (acute + chronic) not negligible. Chronic untreated HCP potentially very disabling. Repeated weak failures may be cause adverse neurologic deficits and negatively impact clinical outcomes.

**Methods**

A prospectively maintained SAH database was retrospectively reviewed for patients who underwent EVD placement within 24-hours of admission. Baseline characteristics and ventriculostomy metrics were assessed with respect to VPS placement. Statistical tests included Fisher’s exact/Chi-square, Mann-Whitney, Pearson correlation, and multivariable logistic regression using odds ratios (OR) and 95% confidence intervals (CI).

**Results**

A total of 218 SAH patients were treated with EVD for a median of 12 days (range 1-54 days), with 85 patients subsequently requiring VPS placement (39%). Median age was 56 years (range 24-89 years). There were no significant baseline characteristics between the groups.

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<th>WFNS</th>
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Predictors of VPS placement – Univariate analysis

- Prolonged drainage (any threshold): OR=3.58 (CI=1.62-7.91)
- Prolonged drainage (<24h): OR=5.55 (CI=2.08-14.8)
-任何弱弱失败：OR=2.61 (CI=1.16-6.85)
- Age >55 years: OR=1.03 (CI=1.00-1.05)
- Daily output inversely correlated with age
- Overall output inversely correlated with age

10-day mean and total outputs predicted symptomatic vasospasm

- 169 mL vs. 218 mL p<0.001
- 1712 mL vs. 2103 mL p=0.003
- Not significantly associated w DCI or radiographic infarct

Extended low-pressure drainage was associated with DCI, symptomatic vasospasm, and radiographic infarct

- 3 vs. 5 days for all three endpoints; p=0.03, p=0.003, p=0.02

VPS placement was inversely associated with DCI (p<0.005). DCI was also significantly associated with morbidity at last follow-up (p<0.003).

**Conclusions**

HCP after SAH requires VPS in more than one-in-three patients. Predictors of VPS include duration of EVD drainage, particularly if prolonged drainage at lower pressure is required or persistently high daily drainage is observed. Intraventricular hemorrhage, serial weak failures, and any clamp failure are also associated with requiring EVD. Based on our findings, we recommend consideration for VPS placement in lieu of continued weaning trials after initial failure. Similarly, 10-day average daily drainage >200ml, or the need for >3 days of drainage at ≥5mmHg, should prompt consideration for VPS placement—particularly when observed in combination.

**Key Take Aways**

Acute hydrocephalus is a common and dangerous complication of SAH, requiring long-term CSF diversion in ~40% of EVD patients

Significant predictors of VPS dependence include increased 10-day mean output (>200ml), prolonged low-pressure drainage (>3 days at ≥5mmHg), old age (>55), and IVH (m² 2 or 4)

Early identification of high-risk VPS candidates may minimize potential morbidity associated with weak failures and prolonged EVD placement

Increased CSF output is a significant risk factor for symptomatic vasospasm

Late outcomes may be associated with prolonged low-pressure drainage

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