

Stress Induced Hyperglycemia Determines External Ventricular Drain Placement in Non-Hydrocephalic Aneurysmal Subarachnoid Hemorrhage - A Retrospective Single Center Study

Bappaditya Ray MD; Ayumi Ludwig MD; Lori K Yearout BS; David M Thompson; Bradley N. Bohnstedt MD

College of Medicine and College of Public Health, *The University of Oklahoma Health Sciences Center*, Oklahoma City



Introduction

- Stress-induced hyperglycemia (SIH) may occur after acute brain injuries like acute ischemic stroke, traumatic brain injury, intracerebral hemorrhage and aneurysmal subarachnoid hemorrhage (aSAH).
- Patients with SIH are at heightened risk of deleterious effects like cerebral edema.
- SIH among aSAH patients has not been evaluated systematically.
- Present study examines if SIH has an association of external ventricular device (EVD) placement among non-hydrocephalic aSAH patients.
- Knowledge of such association will help clinicians to be vigilant about the need for intracranial pressure monitoring if SIH is noted after aSAH.

Methods

Retrospective chart review of patients admitted with diagnosis of aSAH from Jan 2011 to Dec 2015.

Exclusion criteria: Patients admitted beyond 3 days of aSAH occurrence; Hydrocephalus (HCP) determined by age-adjusted bicaudate index (BCI)

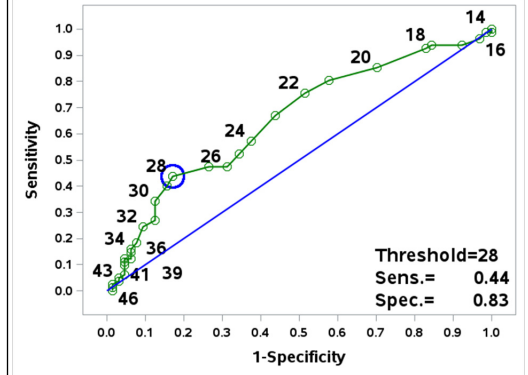
SIH definition: Admission Glucose (AG) to glycated hemoglobin (HbA1c) ratio and Glycemic Gap (GG = AG - 28.7*HbA1c + 46.7).

Statistics: ROC analysis to assess threshold of the ratio and GG predicting who would require EVD at admission

Table 1. Study cohort characteristics

| Baseline characteristics of the cohort | | | | | |
|--|-----|------|------|-------|-------|
| | N | Mean | SD | Min | Max |
| Age | 143 | 51.5 | 12.8 | 17.00 | 87.00 |
| Factor | n | (%) | | | |
| Gender | | | | | |
| Female | 97 | 67.8 | | | |
| Male | 46 | 33.2 | | | |
| History of hypertension | | | | | |
| Yes | 91 | 63.6 | | | |
| No | 51 | 35.6 | | | |
| Unknown | 1 | 0.7 | | | |
| History of hyperlipidemia | | | | | |
| Yes | 21 | 14.7 | | | |
| No | 117 | 81.8 | | | |
| Unknown | 1 | 0.7 | | | |
| History of smoking | | | | | |
| Yes | 85 | 59.4 | | | |
| No | 47 | 32.8 | | | |
| Unknown | 11 | 7.7 | | | |
| History of diabetes | | | | | |
| Yes | 8 | 5.6 | | | |
| No | 135 | 94.4 | | | |
| Diabetes status | | | | | |
| No diabetes | 127 | 88.8 | | | |
| Poorly controlled | 8 | 5.6 | | | |
| New diagnosis | 8 | 5.6 | | | |
| EVD placement | | | | | |
| Yes | 80 | 55.9 | | | |
| No | 63 | 44.1 | | | |

ROC analysis of AG:HbA1c in non-hydrocephalic aSAH patients



ROC analysis shows the best threshold (28) in predicting EVD placement

Results

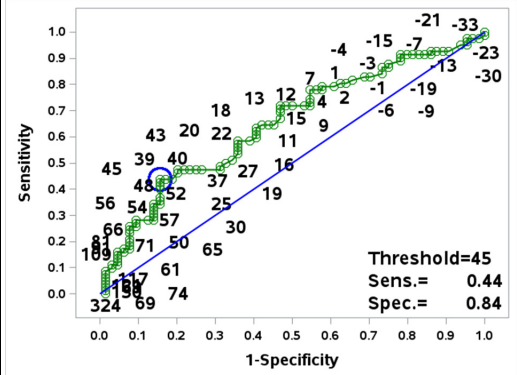
Study cohort consisted of 192 aSAH patients over 5 year period. Forty-nine patients had HCP at admission with 40 (81.6%) needing EVD and 82 (57.3%) of 143 non-HCP patients required EVD (Table 1). AG:HbA1c ratio threshold value of 28 and GG of 44.7 mg/dl afforded a specificity of 0.81 and 0.84 respectively to identify those requiring EVD among non-HCP patients due to SIH.

EVD was placed in 36/47 (76.6%) of those with ratios ≥ 28 , and in 44/96 (45.8%) of those with lower ratios ($p=0.0006$).

Similarly patients defined to have SIH using threshold of 44.7 mg/dl had higher incidence of EVD placement [35/45 (77.8%) vs. 45/98 (45.9%), $p=0.0005$].

Admission SIH did not determine ventriculoperitoneal shunt placement after aSAH in our cohort.

ROC analysis of GG in non-hydrocephalic aSAH patients



ROC analysis shows the best threshold of GG (45 mg/dL) in predicting EVD placement

Conclusions

- SIH is associated with increased incidence of temporary CSF diversion in non-hydrocephalic aSAH population.
- AG: HbA1c and GG thresholds of 28 and ~ 45 mg/dl maybe used as guide for clinicians to remain vigilant regarding need for EVD placement in aSAH patients.
- These results need to be validated in prospective cohort.

Learning Objectives

- State the occurrence of stress induced hyperglycemia after aneurysmal subarachnoid hemorrhage
- Identify patients with stress induced hyperglycemia
- Identify patients who may need for external ventricular device placement in patients stress induced hyperglycemia after aneurysmal subarachnoid hemorrhage

References

- Kerby JD, Griffin RL, MacLennan P, Rue LW, 3rd: Stress-induced hyperglycemia, not diabetic hyperglycemia, is associated with higher mortality in trauma. *Ann Surg* 2012, 256(3):446-452.
- Liao WI, Wang JC, Chang WC, Hsu CW, Chu CM, Tsai SH: Usefulness of Glycemic Gap to Predict ICU Mortality in Critically Ill Patients With Diabetes. *Medicine (Baltimore)* 2015, 94(36):e1525.
- Capes SE, Hunt D, Malmberg K, Pathak P, Gerstein HC: Stress hyperglycemia and prognosis of stroke in nondiabetic and diabetic patients: a systematic overview. *Stroke* 2001, 32(10):2426-2432.