Volumetric Modeling of Patient Dispositions in Acute Subdural Hemorrhage

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Introduction

Background

- Acute subdural hemorrhage (SDH) is a life-threatening bleed between the dura and the brain. It constitutes more than 12% of all traumatic brain injuries [1].

Objective

- This study seeks to quantify the effects of various factors on patient outcomes in acute SDH.

Methods

Data Acquisition

- 50 patients with acute SDH admitted to Rhode Island Hospital in 2010 were randomly selected retrospectively from the trauma registry.
- The patient disposition categories were "Death/Hospice," "Nursing/Rehab," and "Home."
- SDH volumes at multiple locations and midline shifts were measured by CT as shown in Figure 1.

Statistical Analysis

- Logistic regressions were performed for all possible combinations of variables.
- The best models were selected using the Akaike information criterion (ΔAIC = 2).
- The most conservative model within this subset was chosen for interpretation.

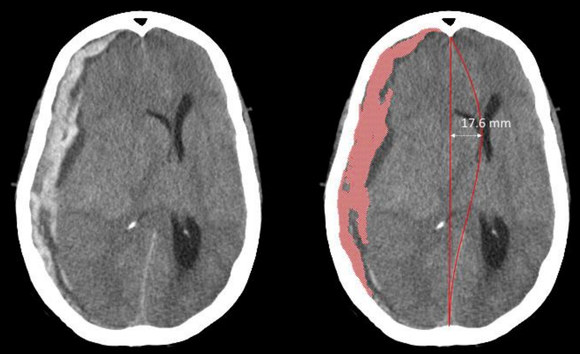


Figure 1. Volume and Midline Shift Measurements

Results

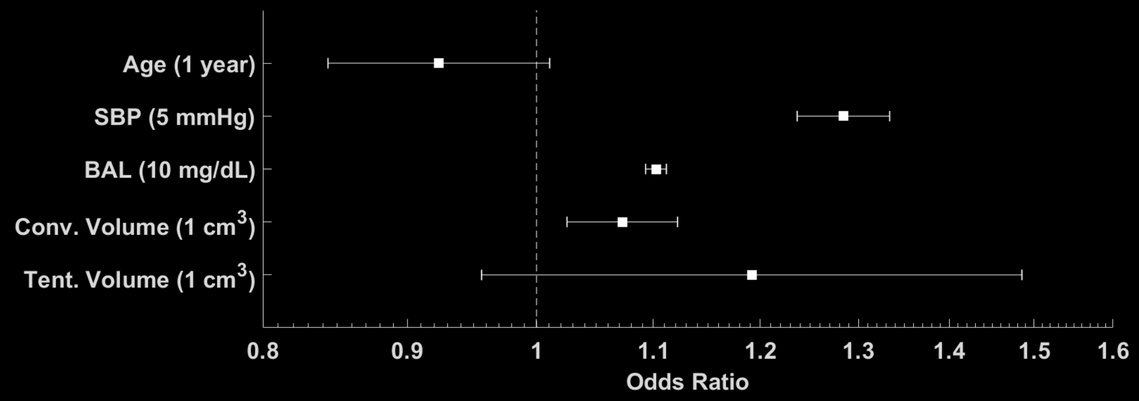
- Our model-selection process removed from consideration the variables: sex, epidural hemorrhage, subarachnoid hemorrhage, intraparenchymal hemorrhage, falcine SDH volume, midline shift distance, and craniotomy.
- Variables kept by our process are listed in Table 1 with associated odds ratios, 95% confidence intervals, and *p*-values. Variables that had a statistically significant ($p < 0.05$) impact on disposition are highlighted.
- The relative effects of real-valued variables on disposition are shown in Figure 2.

Table 1. Variable Statistics

Variable (Unit change)	Death/Hospice Odds Ratio	95% CI	*p*-value
Age (1 year)	0.92	[0.84, 1.01]	0.08
Systolic Blood Pressure (5 mmHg)	**1.28**	**[1.24, 1.33]**	**0.009†**
Blood Alcohol Level (10 mg/dL)	**1.10**	**[1.09, 1.11]**	**0.02**
Convexity SDH volume (1 cm^3)	**1.07**	**[1.03, 1.12]**	**0.002†**
Tentorial SDH volume (1 cm^3)	1.19	[0.96, 1.49]	0.12
Platelets (Administered)	193.12	[0.43, 86280.20]	0.09
Ventriculostomy (Performed)	11.24	[0.50, 254.39]	0.13

†Statistically significant following Benjamini-Hochberg procedure with α = 0.05.

Figure 2. Variable Associations with Death/Hospice



Conclusions

- Removal of a variable from our model indicates it has little independent effect when controlling for the included variables.
- Platelets and ventriculostomy may not have had a significant effect on disposition due to the small number of patients in our sample given these treatments.
- The convexity was the only SDH location that demonstrated a significant negative trend with outcome as similarly demonstrated by [2].
- Even accounting for injury size, blood pressure and blood alcohol were negatively associated with outcome. We hypothesize these variables may inhibit clotting, leading to greater bleed expansion.

Future Directions

- Expand study population to include all SDH patients in the trauma registry.
- Automate bleed segmentation.
- Extend analysis to follow-up CTs.

References

[1] Servadei, F., et al: CT prognostic factors in acute subdural haematomas: the value of the 'worst' CT scan. **Br. J. Neurosurg:14(2):**110-116, 2000.

[2] Bajsarowicz, P, et al: Nonsurgical acute traumatic subdural hematoma: what is the risk? **J. of Neurosurg:123**:1176-1183, 2015.

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