

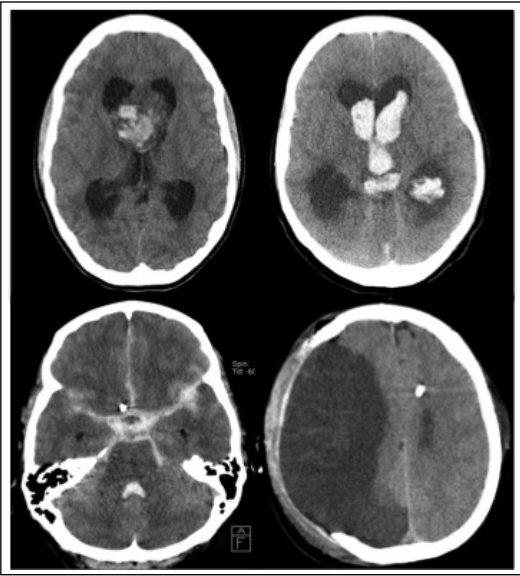
Risk of hemorrhage associated with placement and removal of external ventricular drains in patients with subarachnoid hemorrhage

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Introduction

External ventricular drains (EVDs) are frequently placed to treat acute hydrocephalus, which occurs in approximately 20% of patients with aneurysmal subarachnoid hemorrhage (SAH). Multiple studies have investigated hemorrhage related to EVD placement with rates varying from 0-42%, but few studies have described hemorrhage secondary to EVD removal. With the increased trend of endovascular treatment of aneurysms, patients with SAH often receive anticoagulation and/or antiplatelet agents. We hypothesized that these patients are at higher risk of EVD associated hemorrhage compared to a cohort of patients without SAH.

Demographics	
Total EVDs	470 (371 pt)
Pediatric	64
Adult	406
Location	
Frontal	448
Occipital	12
Temporal	7
Parietal	3
Placement location	
Bedside	284
Intraop	186
Navigation	
Stealth	48 (1 bedside)
U/S	18
Endoscopic	6
None	398



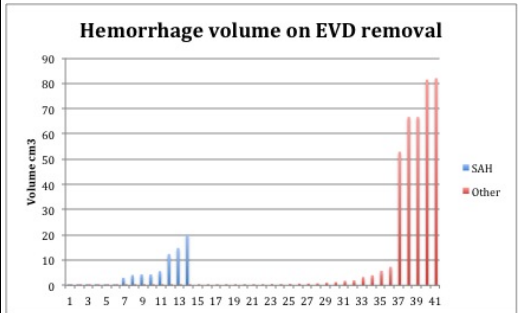
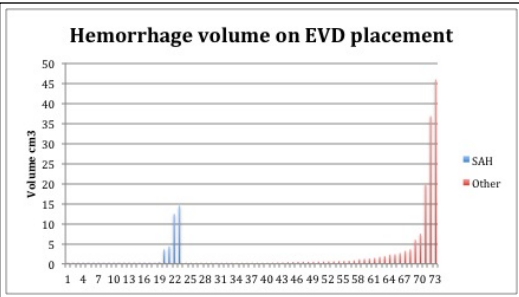
Methods

A database was created for all patients who required EVD placement from March 2008 to June 2014 at our institution. Medical records and all imaging studies were reviewed for hemorrhage on placement and removal of the EVD.

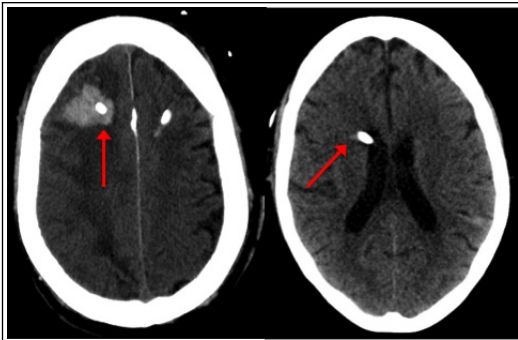
Reasons for EVD	#
Hemorrhage	
SAH	114
IPH/IVH/SDH	83
Cerebellar hemorrhage	8
Tumor	87
Shunt infection/malfunction	52
Hydrocephalus	51
Stroke/Edema	17
Trauma	8
Other	50

Results

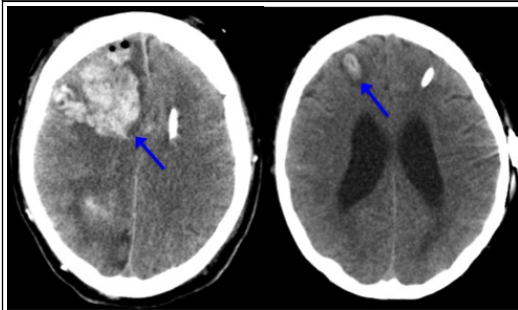
114 EVDs were placed in 87 patients with aneurysmal SAH during the study. Hemorrhage occurred in 25 patients (21.9%) on EVD placement with an average volume of $1.56 \pm 3.8\text{cm}^3$, while 14 patients (25%) had hemorrhage on EVD removal, with an average volume of $4.45 \pm 5.64\text{cm}^3$. 356 EVDs were placed in 287 patients for reasons other than SAH. 70 patients (21.8%) had hemorrhage on placement and 40 (21.9%) on removal with average volumes of $1.16 \pm 4.50\text{cm}^3$ and $9.58 \pm 23.5\text{cm}^3$, respectively.



Comparison of hemorrhage volumes on EVD placement and removal in patients with SAH (Blue) vs non-SAH (Red)



Examples of hemorrhages with EVD placement



Examples of hemorrhage on removal of EVD

Conclusions

Various factors have been linked to the hemorrhage risk with EVD placement, while the risk factors associated with EVD removal have not been investigated. In this study, we found no statistically significant difference in the incidence of hemorrhage on EVD placement or removal among patients with SAH and those with other pathologies.