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Differentiating the Need for Neurosurgical Interventions at a Level 1 Trauma Center in Patients with a Mild Traumatic Brain Injury and a Positive CT Head

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Traumatic brain injuries (TBIs) are a leading cause of disability. These include mild traumatic brain injuries (mTBIs), which are defined as head trauma in patients with Glasgow Coma Scale (GCS) of 13 to 15. About 10-15% of mTBI patients will have an intracranial hemorrhage.¹ While most are managed non-operatively², a small portion require neurosurgical intervention and these patients are transferred to tertiary referral centers for higher level of care.³ There currently are no national guidelines to determine the need for transfer of patients with mTBIs from community to level 1 trauma centers.⁴ Identification of factors that place patients at high risk for neurosurgical intervention could determine which patients need to be transferred and decrease the number of unnecessary transfers in low-risk individuals.

Problem Statement

To determine risk factors leading to neurosurgical intervention and subsequent transfer to level I trauma center in patients with mTBI.

- Retrospective chart review of 1650 patients
- This project represents a smaller subset (359 patients)
- Inclusion criteria:
 - GCS 13-15
 - Intracranial bleed present on initial CT scan
 - Date of admission between Oct 1st 2015 to Sept 30th, 2019 to LVHN- Cedar Crest or transferred from another hospital
- Patient charts were reviewed for the following:
 - GCS at initial hospital, on admission, within 24 hrs
 - Past medical history, history of brain ICH
 - Number of ICH, type of bleed, size of bleed
 - Time to and type of neurosurgical intervention
 - Neurological deficits on presentation(Including Pupil size and reactivity to light)
 - Anticoagulation therapy and need for reversal
 - INR at initial hospital and on admission
 - 60-day readmission, 60-day mortality, and in-hospital mortality

	Number of patients	Percent of patients
Number of patients	352	
Mean age, years	77.0	
Gender		
Male	190	53.4 %
Female	166	46.6 %
Medical History		
Congestive heart failure	15	4.2 %
Alzheimer's	10	2.6 %
Previous history of head trauma	35	9.8 %
Cerebrovascular Accident (CVA)	35	9.8 %
Transient Ischemic Attack (TIA)	10	2.8 %
Myocardial infarction	12	3.4 %
Hypertension	234	65.7 %
Diabetes Mellitus	80	22.5 %
Bleeding disorder	13	3.7 %
Chronic aspirin use	63	17.7 %
Anticoagulation therapy	116	32.6 %
Dementia	59	16.6 %
Obesity	48	13.5 %
Chronic obstructive pulmonary disease (COPD)	50	14.0 %
Chronic ongoing alcohol abuse	29	8.1 %
Substance use disorder	7	2.0 %
Current smoker	56	15.7 %
Advanced directive limiting care	115	32.3 %
Functionally dependent health status	150	42.1 %

Figure 1: Patient Demographics

	Neurosurgical intervention	medical management	p-value
Mean age	67	78	0.02
% on Warfarin	55.60%	25.20%	0.0066
% with Neurological Deficit	87%	63%	0.0043
% with CT with any midline shift	81.30%	12.30%	<0.0001
Avg size of midline shift	10.0 mm	4.0 mm	<0.0001
% with Worse second scan	42.30%	15.40%	0.0038
% with SDH	97.00%	53.10%	<0.0001

Figure 2: highest risk factors for neurosurgical intervention vs. medical management only, of SDH 90.6% were convex (p=0.0090) and the most significant neurological deficit was hemiparesis at 24.1% (p=0.0006)

- Among 352 patients with traumatic intracranial hemorrhage (mean age 77 [60-86], 53.4% male), 90.4% did not require neurosurgical intervention.
- Of note, 82.6% repeat CT scans were the same or better than the initial scan.

- Risk factors with higher rate of neurosurgical intervention:
 - CT scan with midline shift >5mm
 - Warfarin use (esp with reversal)
 - SDH (esp convex)
 - Neurological deficit (esp hemiparesis)
 - Worsening repeat CT
- Patients with multiple of these factors would most likely benefit from transfer to a higher level of care.
- These factors could be used to establish protocol for transferring mTBI patients.
- Values based patient centered care: pt transfer is a burden on patients and their families. It would be better for patient care to admit them at the hospital that they regularly receive care.
- Health Systems: reducing unnecessary transfers improves healthcare costs and utilization of resources.
- Limitations include the incomplete dataset and lack of applicability to patients with advanced directives.

The need for neurosurgical intervention was higher in patients with a midline shift >5mm, warfarin use (especially requiring reversal), convex SDH, worsening repeat CT scan, and hemiparesis. Defining factors that are at highest risk for leading to neurosurgical intervention can aid in determining which patients require transfer to higher level of care an early operative intervention. If a patient has these risk factors, transfer to a level 1 trauma center may be warranted. A complete dataset is needed to determine the existence of other factors that may indicate the need for neurosurgical intervention.

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