

Research Letter

Outcome predictors for severely brain-injured patients directly admitted or transferred from emergency departments to a trauma center

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Dear editor,

After sustaining severe traumatic brain injury (TBI), patients frequently require invasive mechanical ventilation (MV). However, up to 26% of patients require tracheostomy due to failure to wean from the ventilator.^[1] The decision of when to perform tracheostomy is important as it balances the risk between avoiding prolonged MV and avoiding risk of tracheostomy. Early predictors for tracheostomy, i.e., clinical factors when patients first present to an Emergency Department after trauma or when patient first arrive at a regional trauma center, can help clinicians' medical decision-making process.

We retrospectively analyzed the charts of 201 adult patients who sustained severe TBI and received MV >72 hours at our regional trauma center from January to December 2014. Forty-eight (24%) patients were transferred from another hospital's ED and 153 (76%) patients were admitted directly from sites of injury. Mean age was 48±21 years, and mean Injury Severity Score was 29±10. Multivariable logistic regression of significant independent variables, which were defined as P -value ≤ 0.10 in univariate logistic regression, showed that Shock Index (SI) during ED stay < 0.5 was associated with higher likelihood for tracheostomy (Odd Ratio [OR] 11, 95% Confidence Interval [CI] 1.4–87, $P=0.022$) (Table 1). Among factors at admission to the trauma center, being transferred from trauma-designated

EDs (OR 7.6; 95% CI 1.1–51 [$P=0.036$]) and Glasgow Coma Scale at hospital day 5 (HD5GCS) ≤ 8 (OR 10; 95% CI 5.4–53 [$P<0.001$]) were significantly associated with higher likelihood for needs of tracheostomy.

Our finding is consistent with a previous study which suggested that low HD5GCS was associated with higher likelihood of tracheostomy. Ahmadinegad et al^[2] found that 85.7% of patients with HD5GCS < 9 required tracheostomy. However, it is also possible in our study that trauma intensivists may be inclined to perform tracheostomy early with patients with HD5GCS ≤ 8, rather than repeatedly attempt to wean them off the ventilator.

Our study might provide information for trauma intensivists at referral tertiary trauma centers, supporting their communications with referring emergency physicians to improve patient outcomes. Previous study of trauma patients suggested that Shock Index, defined as ratio of heart rate and systolic blood pressure, increasing more than 0.3 was associated with higher mortality.^[3] Our data also suggested that emergency physicians should maintain TBI patients' heart rate and systolic blood pressure within normal range, to prevent rising SI, which is harmful as previously suggested^[3] and to avoid lowering Shock Index to less than 0.5, which was associated with increased needs for tracheostomy. Emergency physicians should pay special attention during the peri-intubation period, which is associated

Table 1. Multivariable logistic regressions for association of clinical factors and tracheostomy among patients with severe TBI

Variables	Univariate analysis			Multivariable analysis		
	ORs	95% CI	P-value	ORs	95% CI	P-value
ED clinical factors ^a						
ED SI < 0.5 [*]	0.31	0.02–6.1	0.44	11	1.4–87	0.022
Trauma designation - Yes	8.3	1.80–36	0.005	7.6	1.1–51	0.036
Gender	0.235	0.04–1.2	0.09	0.19	0.05–2.6	0.14
Age	0.18	0.53–1.06	0.10	0.78	0.44–1.4	0.41
Triage GCS	1.7	1.04–2.7	0.03	1.3	0.0–3.5	0.46
Worsening GCS at ICU arrival	0.67	0.05–1.01	0.05	0.31	0.0–2.8	0.30
ED mechanical ventilation	2.7	0.80–9.0	0.10	0.01	<0.01–100+	0.65
ED highest FiO ₂	3.8	0.78–19	0.10	14	<0.01–100+	0.69
STC clinical factors ^b						
HD5GCS ≤ 8	13	5.70–28	0.001	10	5.4–53	<0.001
History of DM	3.6	1.60–8.5	0.003	1.1	0.19–9.3	0.91
Admission GCS	0.90	0.85–0.96	0.001	2.7	0.4–1.1	0.12
Admission SI ^{**}	1.8	0.65–4.9	0.25	2.7	0.3–22	0.36
Admission RR ^{**}	0.99	0.96–1.02	0.73	0.96	0.9–1.04	0.34
Admission PF ratio	0.7	0.58–0.89	0.002	0.70	0.4–1.1	0.12
ISS	1.1	1.02–1.09	0.001	1.0	0.9–1.1	0.89
Receiving EVD	4.8	2.70–8.9	0.001	2.9	0.9–9.3	0.19
Marshall CT score	1.4	1.10–1.8	0.004	0.88	0.5–3.1	0.06
Lung injury score	1.6	1.03–2.3	0.029	1.1	0.5–2.8	0.62

OR: odds ratios; CI: confidence intervals; ED: emergency department; SI: shock index; GCS: Glasgow Coma Scale; ICU: intensive care unit; FiO₂: fraction of inspired oxygen; STC: regional trauma center; HD5GCS: Glasgow Coma Scale on hospital day 5; DM: diabetes mellitus; ISS: Injury Severity Score; EVD: extraventricular drain; CT: computer tomography; ^a: Hosmer-Lemeshow test, χ^2 value=5.73, P-value=0.68; ^b: Hosmer-Lemeshow test, χ^2 value=3.45, P-value=0.90; ^{*}: clinically significant factor; ^{**}: clinical factors with P-value ≤ 0.10 in bivariate analyses.

with an increased likelihood of severe cardiovascular collapse,^[4] which will affect SI, particularly among patients with severe TBI, to avoid secondary brain injury.

Further study is needed to confirm our findings that, patients with severe traumatic brain injury while having a SI < 0.5 in the ED, or Glasgow Coma Scale score on hospital day 5 ≤ 8, were associated with increased likelihood of requiring tracheostomy.

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