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Outcome of early vs. late tracheostomy in traumatic brain injury patients admitted to neurosurgery ICU

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Abstract

Introduction: Tracheostomy is one of the most commonly done procedures in patients with severe head injury. The study was carried out to evaluate the role of early tracheostomy and outcomes in patients with severe traumatic brain injury (TBI).

Method: This study compared early and late tracheostomy in TBI patients in neurosurgical ICU at Chitwan Medical College, Nepal, from Apr 2019 to Jul 2022. Data were extracted from medical records. Tracheostomy at admission or mortality <3 days of admission were excluded. Ethical approval was taken. Tracheostomies done ≤7 days of admission were considered early tracheostomies (ET), and >7 days late (LT). Length of ICU stay, hospital stay, injury types, admission GCS, diagnosis and outcome between ET and LT were compared. Continuous variables presented as mean±SD were analysed using t-tests, while categorical variables summarised as frequency percentages were analysed with X^2 tests. The IBM SPSS 26.0 was used for analysis, and p≤0.05 was considered statistically significant.

Result: Out of 76 patients with TBI admitted to neurosurgical ICU who underwent tracheostomies, 50(65.8%) were ET and 26(34.2%) LT. The ET was associated with shorter ICU stay (p<0.013). Mortality and other outcomes had no significant difference between ET and LT groups.

Conclusion: Early tracheostomy was beneficial in terms of a significant decrease in ICU stays compared to late tracheostomy. Timing of tracheostomy did not significantly affect other outcomes.

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Introduction

About 2-11% patients admitted to intensive care unit (ICU) with mechanical ventilation require tracheostomy during hospitalisation for a prolonged definitive airway.[1] Over 3000 years, tracheostomy has developed from the sword for choking soldiers on the battlefield, to now aseptic insertion of a curved tube with a low-pressure cuff in an anaesthetised intubated patient.[2]

Mostly patients with traumatic brain injuries and pulmonary injuries require tracheostomy.[3] It benefits by lowering respiratory tract resistance, reducing irritation of airway, increasing pulmonary toileting, and better communication with patients without sedation. Complications include stomal haemorrhage, site infections, tracheoesophageal fistula, pneumomediastinum and arterial fistula.[4] Ideally, tracheostomy should be performed by an experienced surgeon with an anaesthesiologist in an operating room or an equipped critical care setting.[5]

American College of Chest Physicians and the American College of Critical Care Medicine have no specific recommendations for the timing of tracheostomy, but it is done if patients require prolonged assisted Ventilation.[1] In 1998, the Europeans came to consensus, like Americans, that tracheostomy is preferred if >21 days of artificial airway is anticipated.[6]

Studies have shown that early tracheostomy (ET) in patients (within 5-7 days of intubation) has a shorter length of ICU stay compared to extubation trials before tracheostomy, the late tracheostomy (LT).[7] The ET is beneficial in reducing the incidence of pneumonia, days on mechanical ventilation, and ICU stay, but no difference in both groups in terms of survival.[1,8-10]

This study analysed the outcome and clinicodemographic characteristics of patients with brain injury with timing of tracheostomy.

Method

This study compared outcomes between early and late tracheostomy in a cohort of traumatic brain injury patients admitted to the neurosurgical ICU at Chitwan Medical College Teaching Hospital (CMCTH), Department of Surgery, Neurosurgery unit, Nepal, from Apr 2019 to Jul 2022. Data were extracted from electronic medical records and patients' record files at CMCTH. Patients with solid organ injury, who underwent tracheostomy at admission or died within 3 days after admission were excluded. Ethical approval for the study was taken from the Institutional Review Committee (Ref: CMC-IRC 081/082/117).

Patients were categorised into two groups, early tracheostomy (performed ≤7 days of intubation and mechanical ventilation) vs late (>7 days), based on timing documented in the medical record. Extubation was considered on the basis of improvement in GCS score.

Indications for early tracheostomy included GCS at admission <8, early intubation <12 hours of admission, CT DAI grade ≥3, and reintubation <48 hours of extubation. Tracheostomies were done using the standard technique according to hospital protocol.

Study variables included clinicodemographic details like age, diagnosis, procedure, day of tracheostomy after admission, ICU and hospital stay, and Glasgow outcome scale. The samples with incomplete records were excluded from the study.

Continuous data were assessed for normality. Normally distributed data presented as mean±SD were analysed with t-tests; skewed data as median (IQR) with Mann-Whitney U tests. Categorical data were presented as frequency and percentage and analysed using X^2 or Fisher's exact tests (cell counts <5). The IBM SPSS v-26 was used for analysis, with $p \leq 0.05$ considered statistically significant.

Result

Out 76 patients, 50(65.8%) had ET and 26(34.2%) LT. Mean age was 46.30±16.91, males 58(76.3%), and admission GCS 7.28±2.70. The cause of brain injury was a road traffic accident (RTA) in 39(51.3%), hypertensive brain injury in 28(36.8%), and a fall in 9(11.8%).

Basal ganglia and thalamic haemorrhage were seen in 18(23.7%), followed by subdural hematoma in 16(21.1%), brain contusion in 12(15.8%) and diffuse axonal injury in 10(13.2%). The rest of the patients had epidural hematoma, subarachnoid haemorrhage, cerebral and cerebellar infarction, intracranial infection/abscess, ischemic stroke, hydrocephalus, and brain stem bleed.

Craniotomy was performed in majority 49(64.5%) patients, while 23(30.3%) had supportive ICU care only and, EVD in 2(2.6%) patients, burr hole in 1(1.3%) patient and VP shunt in 1(1.3%) patient, Table 1.

Total ICU days were greatly reduced in ET group (14.14±4.82) vs LT group (17.46±6.44), which was statistically significant (p-value 0.013), while the total hospital days were more in ET group (46.36±37.33) vs LT group (42.81±37.33). Five patients out of 50 died during the hospital stay in ET group, while 6 out of 26 in LT group. Majority of the patients had moderate disability in both groups 19(38.0%) in ET vs 11(42.3%) in LT, severe disability was more in ET group18(36%) than 2(7.7%) LT groups.

Table 1. Characteristics of traumatic brain injury (TBI) patients admitted to neurosurgery ICU who underwent early tracheostomy (ET) vs. late tracheostomy (LT), n=76

Variables	n	ET (50), n(%)	LT (26), n(%)	p-value
Age (Mean±SD)	76	45.12±16.63	48.58±17.53	0.401
Gender				
Male	58	40(69.0%)	18(31.0%)	0.295
Female	18	10(55.6%)	8(44.4%)	
Mechanism of Injury				
RTA	39	28(71.8%)	11(28.2%)	
Fall	9	6(66.7%)	3(33.3%)	0.459
HTN	28	16(57.1%)	12(42.9%)	
Admission GCS				
Severe TBI	55	36(65.5%)	19(34.5%)	
Moderate TBI	19	13(68.4%)	6(31.6%)	1.0
Mild TBI	2	1(50.0%)	1(50.0%)	
Diagnosis				
Diffuse axonal injury	10	9(90.0%)	1(10.0%)	
Subdural hematoma	16	11(68.8%)	5(31.3%)	
Brain contusion	12	7(58.3%)	5(41.7%)	
Basal ganglia/ thalamic haemorrhage	18	12(66.7%)	6(33.3%)	
Cerebral/ cerebellar infarction	2	0(0.0%)	2(100.0%)	0.273
Intracranial infection/ abscess	2	2(100.0%)	0(0.0%)	
Epidural hematoma	8	6(75.0%)	2(25.0%)	
Sub arachnoid haemorrhage	4	2(50.0%)	2(50.0%)	
Hydrocephalus	1	0(0.0%)	1(100.0%)	
Ischemic stroke	2	1(50.0%)	1(50.0%)	

RTA- road traffic accident, HTN- hypertension, ICU- intensive care unit

Table 2. Outcome of traumatic brain injury patients admitted to neurosurgery ICU who underwent early ET) vs. LT, n=76

Variables	n	ET, n=50 n(%)	LT, n=26 n(%)	p-value
ICU stays in day (Mean±SD)		14.14±4.82	17.46±6.44	0.013
Hospital stays in day (Mean±SD)		46.36±37.33	42.81±37.33	0.695
Glasgow outcome scale (GOS), X^2 /Fisher				
Good recovery	13	7(14.0%)	6(46.2%)	
Moderate disability	30	19(38.0%)	11(42.3%)	
Severe disability	20	18(36.0%)	2(7.7%)	0.081
Vegetative state	2	1(2.0%)	1(3.8%)	
Mortality	11	5(10.0%)	6(23.1%)	

Discussion

We found that total ICU days were less in ET group (14.14±4.82) vs LT group (17.46±6.44), which was statistically significant (p=0.013). There were no significant differences in total hospital stays or functional outcomes (GOS) between groups. Thus, ET may expedite ICU discharge, but may not affect recovery overall outcomes in severe TBI.

The shorter ICU stay in the ET group in the present study is also supported by a study with a well-balanced propensity-matched cohort of 1,154 patients in which ET was associated with a significantly shorter duration of mechanical ventilation, ICU stays, and hospital stays p<0.0001.[11]

In a retrospective review of a 2-year period including 185 surgical ICU patients with acute injuries requiring mechanical ventilation and tracheostomy, there was a significant decrease in the incidence of ventilator associated pneumonia (VAP), less ventilator time, and lower ICU stays when tracheostomy was performed <7 days after admission to the ICU.[7]

A study of 66 patients with tracheostomies, 16(24.2%) ET and 50(75.8%) LT, the length of ICU stay was significantly shorter in the ET group (p<0.001).[1] Similarly, another study reported ET had a lower hospital stays (46.4 vs 38.6 day, p=0.048) and ICU stays (34.9 vs 26.7 day, p=0.003).[12]

Our study differs from studies reporting improved hospital stays or pneumonia rates.[11] This discrepancy may be due to heterogeneity of hospital policy and care pathways, like delayed transfers from ICU and case selection, like our ET group had higher rates of severe disability (36% vs. 7.7%), possibly due to severe injuries. On the contrary, our study was associated with longer hospital stays in ET group (46.36±37.33) vs LT group (42.81±37.33).

In our study, ET was associated with fewer in-hospital deaths 5(10.0%) than 6(23.1%) in LT group. However, this was statistically not significant.

The statistically non-significant difference in GOS outcomes between groups shows neurological recovery depends primarily on injury severity and not tracheostomy timing alone.

Tracheostomy is a common surgical procedure performed in critically ill patients who require long-term airway access. The benefits of tracheostomy, compared to prolonged laryngeal intubation, include improved patient comfort, more effective airway suctioning, decreased airway resistance, enhanced patient mobility, increased opportunities for articulated speech, ability to eat orally, and a more secure airway.[13]

Though the exact timing of tracheostomy is still debatable, many researchers and surgeons have attempted to clarify the timing of tracheostomy.[4,7]

There are controversies regarding the specific indications, techniques and timing of tracheostomy. Not only the optimal timing of specific methods, but also the actual clinical value (benefit/risk ratio) of tracheostomy is debated. In addition, the duration of mechanical ventilation is not easy to predict. For these reasons, using or withholding tracheostomy is often based on a physician's opinion.[14] Late tracheostomy significantly increases the incidence of procedure related complications (pneumonia, tracheostomy site hematoma, subcutaneous emphysema and stromal infection) in comparison to early tracheostomy.[15]

Present study focused on tracheostomy timing in patients with severe head injury and may help physicians make a decision on the timing of tracheostomy for patients with severe head injury.

Some of the limitations of present study is a single-centre design with a limited sample. Subgroup analysis for types of injuries was underpowered. Strategies for sedation and ventilator practice or comorbidities like pulmonary disease could influence outcomes. Despite prospective comparison, data relied on the accuracy of chart documentation. Further studies in larger cohorts with analysis of comorbidities and confounding factors for tracheostomy timing and outcomes, together with the timing of tracheostomy, consideration

of care and rehabilitation pathways, long-term functional outcomes, and costs of ICU vs. total hospitalisation, ventilation weaning practices seem necessary for analysis on overall outcome and economic impact.

Conclusion

Early tracheostomy was beneficial in severe head injury patients in terms of decreased length of ICU stay. Age and admission GCS were associated with the need for tracheostomy. There were no significant differences in total hospital stay or functional outcomes between groups, suggesting that while early tracheostomy may expedite ICU discharge, it does not independently improve recovery trajectories in severe TBI. The primary brain injury severity remains the dominant factor for neurological outcomes.

Author contribution

Concept design: GA, AS, BKD; Literature search: GA, AS, BKD; Data collection: GA, AS, BKD; Data analysis GA, AS, BKD; Draft manuscript GA, AS, BKD; Final manuscript and accountability: All

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Conflict of interest

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Supplementary material

The data and supplementary material that support the findings of this study are available from the corresponding author upon reasonable request.

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