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Cost-effectiveness and Clinical Outcomes of Early Tracheostomy in the Patients of Isolated Head Injury: A Retrospective Study

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ABSTRACT

Introduction: Early tracheostomy (ET) proved to be effective in the intensive care unit (ICU) in patients who face difficulty in weaning off of mechanical ventilators easily. Tracheostomy is a common procedure applied in mechanically ventilated patients. It aims at reduction of complications and improvement of comfort of the patient. However, the benefits of the tracheostomy must be evaluated against the risks of the tracheostomy before its placement. Variables which are needed to be considered before performing a tracheostomy are the timing of the procedure, absence or presence of TBI, and severity of the injuries.

Aim: To assess the cost-effectiveness and clinical outcomes of early tracheostomy in the patients of isolated head injury

Methodology: A total of 212 patients were included in the study. All the patients had isolated severe traumatic brain injury (TBI) and required mechanical ventilation. Tracheostomy was done within seven days of retaining TBI. Prolonged endotracheal intubation (EI) was defined as intubation more than seven days after TBI. A total of 103 (48.58%) patients underwent early tracheostomy (ET). A total of 109 (51.42%) patients underwent prolonged (EI). The patients were assessed according to the occurrence of ventilator associated pneumonia (VAP), Glasgow Outcome Score (GOS), and ICU stay.

Results: The occurrence of VAP was 133 (62.74%) in the EI group which was higher compared to that of the ET group in which 79 (37.26%) had presented with VAP. The duration of need for a ventilator in the ET group was 10 days compared to 13 days of the prolonged EI group. Similarly, the need for ICU stay was 11 days in the ET group which was lesser than 13 days of the EI group. The complication rate in the ET group was 14% and in the EI group, it was 18%. The rate of mortality in the ET group was 7.77% and it was 16.51% in the EI group. The GCS of the ET group was better than the EI group. Moreover, the cost of the EI group was more than the ET group.

Conclusion: ET reduces the total duration of ICU stay and ventilation in patients with severe TBI. The frequency of VAP is also lesser in the patients given ET. Hence, ET should be given in patients with severe head injuries that require prolonged support of mechanical ventilation.

Key Words: Mechanical ventilation, Early tracheostomy, Severe traumatic brain injury, Prolonged endotracheal intubation, EI group, ET group

INTRODUCTION

Early tracheostomy (ET) proved to be effective in the intensive care unit (ICU) in patients who face difficulty in weaning off of mechanical ventilators easily. Tracheostomy is a common procedure applied in mechanically ventilated patients.[1] It aims at reduction of complications and improvement of comfort of the patient. However, the benefits of the tracheostomy must be evaluated against the risks of the tracheostomy before its placement. Variables which are needed to be considered before performing a tracheostomy are the timing of the procedure, absence or presence of TBI, and severity of the injuries. The definition of early and late tracheostomy is different in different health care setups. Most

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of the patients present with TBI in critical condition need to have a tracheostomy. It has also been proved that the patients given ET have less rate of morbidity, more days free from the ventilator, and have to stay for a shorter duration in the hospital as compared to those patients that are given prolonged EI. Hospital mortality, duration of stay in the ICU, and pneumonia are also less likely to be seen in such patients.[2]

TBI is a complex brain injury that involves direct as well as indirect damage to the neurons of the brain. It ultimately results in consequences such as temporary physical impairment, permanent physical impairment, psychosocial impairment, and cognitive impairment. The common sources of such an injury are violence, falls, and road traffic accidents.[3] The incidence rate of TBI on the global level is 939 in 100,000 people. The rate is higher in Europe and North America.[4] The economic burden and epidemiology can be demonstrated by this incidence rate. Hence, for the maintenance of financial viability and patient care, ET can be helpful. Tracheostomy is a reliable alternative for critically ill patients in case of prolonged mechanical ventilation (MV).

Some of the other benefits of ET are improved comfort of the patients, the lesser need for sedatives, lower exertion of the respiratory system, improved safety of the patient, oral intake is feasible, and can speak earlier. On the other hand, the physician should also expect certain complications including bleeding, desaturation, loss of airway, infection, tracheal ring fracture, pneumothorax, hypotension, esophageal injury, false placement, and even death. Long-term complications of the tracheostomy are tracheal narrowing, granulation tissue, vascular erosion, disfiguring scar, vocal injury, and tracheomalacia.[5] However, the benefits of the ET outgrow its complications. The present study aims at evaluating the benefits and clinical outcomes of early tracheostomy in patients of TBI.

Study design: A retrospective study

Place and Duration: This study was conducted at People's University of Medical and Health Sciences for Women Nawabshah Pakistan from June 2020 to June 2021.

METHODOLOGY

The present study included a total of 212 patients. Permission was taken from the ethical review committee of the institute. A review of the data collected on the mentioned dates was collected prospectively. All the patients included in the study fulfilled the inclusion criteria. Pediatric TBI patients were not included in the study as the intensive care team for the adult patients and pediatric patients is separate in the health care setup. Moreover, patients with polytrauma and systemic injuries were also excluded as they required a mechanical ventilator.

According to the inclusion criteria, the patients with TBI of Glasgow Coma Scale (GCS) less than or equal to 8 were considered for endotracheal intubation (EI). The remaining patients were not managed with intubation. Intracranial pressure monitoring was not done in the healthcare setup for TBI patients. Patients with extradural hematoma or subdural hematoma were considered for decompressive surgery. The replacement of the bone was done according to the case and intraoperative findings. Patients not having an obvious mass lesion, intracranial hypertension and low GCS underwent ventilation. They were treated according to the Lund protocol. They underwent neurological examination, CT scan, and MRI scan.

Patients included in the study had isolated and severe TBI with a GC lower than 8. All the patients needed ventilation and airway control. In the present study, ET was defined as the tracheostomy which was performed in 7 days of intubation. On the other hand, prolonged EI was defined as intubation after 7 days of receiving translaryngeal intubation on a ventilator. The choice of opting for one of both procedures was taken by the Neurosurgeon present on the call, on the basis of the presentation and condition of the patient. However, the institutional data depicts that an abnormal response of the pupils, preoperative condition if worse, preexisting comorbidities and delay in the arrival of more than 1.5 hours are definitive indications of tracheostomy in TBI patients. Moreover, low GCS in addition to these factors along with prolonged intubation were also considered strongly in each patient. The duration of ventilation, intubation, stay in ICU, and incidence of mortality was recorded for each group. The intraoperative complication and postoperative complications were also noted and recorded. Both the EI and ET groups were seen for acute respiratory distress syndrome (ARDS) and VAP for a comparison. The GCS of patients in both groups was set as a parameter to assess the clinical outcomes of the procedures.

The cost of both treatments was assessed during the hospital stay. The cost included was of hospital stay, time of stay in the emergency room, special care cost, ICU bed occupancy cost, ward bed cost, laboratory tests, imaging studies, and the neurosurgical procedure cost. Data regarding the cost of the treatment was acquired from the billing department of the hospital. Data regarding the research was recorded and analyzed IBM SPSS version 26. For the comparison of both the groups, a Student t-test was used. A p-value less than 0.05 was considered significant.

RESULT

This review of the data included a total of 212 patients. All the patients had a severe head injury that required tracheostomy and mechanical ventilation. A total of 103 (48.58%)

patients underwent ET and 109 (51.42%) underwent prolonged EI. Both the groups were compared in terms of gender, age, and GCS on arrival in the emergency room. The mean duration of need of ventilator in the ET group was 10 days compared to 13 days of prolonged EI group. The occurrence of VAP was 133 (62.74%) in the EI group which was higher compared to that of the ET group in which 79 (37.26%) had presented with VAP. The most frequent pathogens isolated in the tracheal culture of VAP patients were Gran-negative bacilli, Pseudomonas, and Acinetobacter. The patient treated with ET were shifted in the ward out of ICU earlier than those treated with EI. Tracheal stenosis was not noted in any of the cases. Stomal bleeding was noted in four patients and stomal infections were seen in six of the patients in the ET group. In the prolonged EI group, tongue laceration and labial laceration were seen. Accidental extubations happened in 4 patients of the EI group. On the other hand, the total duration of hospital stay and ICU stay was longer in the ET group. The duration is shown in Table 1.

The assessment of the clinical outcomes was made on the basis of the GCS score. The clinical outcomes of the ET group were better than that of the EI group. A comparison of the clinical outcomes has been demonstrated in Table 2. The rate of mortality was seen higher in the prolonged EI group because of a longer stay in ICU and raised VAP incidence. In the ET group, sepsis and intracranial hypertension were the cause of death. On the other hand, the causes of death in the EI group were sepsis and ARDS. The comparison of causes in both groups has been demonstrated in table 3. The rate of mortality in the ET group was 7.77% and it was 16.51% in the EI group.

The average time of follow-up was six months. Decannulation of the tracheostomy was done after 2 months of performing the tracheostomy. Delayed complications were absent. The comparison of the cost of both the treatments showed that the average cost of the ET group was USD $8065. While the average cost of the EI group was $9542. The duration of stay in ICU was shorter in the ET group compared to the EI group. The rate of complication in the ET group was 14% and 18% in the EI group. Moreover, the GOS of the ET group was better than that of the EI group.

Table 1: Comparison of characteristics of both groups

Variables	Early Tracheostomy n=103	Prolong endotracheal intubation n=109	p-value
Age (Years)	37.6±18.1	30.9±17.1	0.003
GCS on arrival	5.8±2.1	6.1±1.8	0.015
Duration of ventilation	10	13	0.035
Duration of stay in ICU	11	13	0.036
ARDS and VAP (Percentage)	37.26%	62.74%	0.093
Duration of hospital stay	28	24	0.298

Table 2: Comparison of the clinical outcomes in both the groups

Glasgow outcome score		Early Tracheostomy n=103	Prolong endotracheal intubation n=109
1	Good recovery	40	28
2	Moderate disability	22	20
3	Severe disability	20	24
4	Vegetative state	13	20
5	Death	8	17

Table 3: Comparison of causes of deaths in both the groups

Cause of death	Early Tracheostomy n=103	Prolong endotracheal intubation n=109
Raised intracranial pressure	4	2
Sepsis	4	6
ARDS and VAP	-	10

DISCUSSION

The prime focus of the ICU is the prevention of a secondary injury as it can lead to delayed recovery and cause more deterioration. The first 48 hours after a brain injury are quite critical because, after 48 hours of initial injury, the patients are at higher risk of development of morbidities as well as mortality related with longer duration of the ICU stay. [6]

The increased intracranial pressure and agitation are controlled by high sedation in such patients. These high doses of sedatives, a depressed mental status due to injury, and the use of narcotics can mandate the patency of airway in patients treated with EI. On the other hand, the endotracheal tube is noxious in comatose patients, hence, more sedation is given to control the anxiety and agitation of the patients. It can lead to more decline in the mental status of the patient.[7] Therefore, head trauma is a great challenge in the ICU even with the advancement in medical science and critical care. In

addition to the provision of protection to the airway, EI also provides ease in the mechanical ventilation and pulmonary toilet.[8] Most of the patients may not require it, however, tracheostomy is a viable alternative in this regard. It provides airway protection as well as prolonged support of mechanical ventilation.

The pooling of secretions in patients with translaryngeal ventilation leads to an increase in the frequency of aspiration in the airway. This leads to a higher risk of attaining ARDS or VAP. Biofilm is developed in the tube and it becomes colonized in most cases.[9] The ventilation and frequent suctioning lead to contamination of the secretions and they eventually disperse in the lungs. The inner cannula of the tracheostomy tube is extremely helpful in such a scenario. It can easily be removed and sterilized on the daily basis. Therefore, it is helpful in the prevention of building a biofilm. Moreover, it can be used for the pulmonary toilet. Patients can comfortably ambulate early due to a secure airway. Frequent chest therapy can help in the prevention of VAP.[10]

A similar study as that of the present study was conducted by Bouderka et al. The study aimed at the determination of a better procedure in TBI patients for airway maintenance. A total of 62 patients were divided into two groups. After a thorough comparison, it was shown that there was no significant difference between pneumonia and the rate of mortality in both groups. However, it was concluded by the researchers that early tracheostomy is extremely beneficial in terms of mechanical ventilation and its duration.The clinical outcomes shown by the patients were assessed in the present study based on GOS for a better understanding of the risks and benefits of ET.

CONCLUSION

ET decreases the duration of ICU stay and ventilation in an isolated and severe head injury. Tracheostomy is correlated with a decline in the VAP incidence. ET is highly considered in the TBI patient requiring ventilator support for a longer duration.

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Conflict of interest

The present study did not have any kind of conflicts of interest

Permission

Permission was asked and taken from the ethical committee of the institute

Author Contribution

All authors contributed equally towards the data collection, data analysis & compilations

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