ORIGINAL ARTICLE

Secondary Brain Injury in Early and Late Tracheostomy in Severe Head Injury Patients

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ABSTRACT

Objective: *To determine the risk of secondary brain injury during tracheostomy in severe head injury patients.*

Material and Methods: *The study was carried on 180 patients of severe head injury admitted to Neuro ICU in Lady Reading hospital, Peshawar from March 2015 to March 2017. Early tracheostomy was performed in 95 and late tracheostomy in 85 patients. Patients on ventilator with spontaneous breathing and vitally stable were included and those with no spontaneous breathing, vitally unstable or had already tracheostomy been excluded.*

Results: *From a total of 180 patients, 95 (53%) and 85(47%) patients went under early and late tracheostomy group respectively. In the early group, 35 (37%) patients dropped GCS and 60 (63%) were static or improved. Further, patients who dropped GCS in early group, 32(91%) died while 3 (9%) improved or static. Even patients who improved in early group, 10 (17%) died while 50 (83%) improved or static. While in the late group, 9 (11%) dropped GCS more than 2 points and 76 (89%) were static or improved. Further, patients who dropped GCS in late group, 7 (78%) died while 2 (22%) improved or static. Even patients who improved in late group, 6(8%) died while 70 (92%) improved or static. Overall results of the study show that morbidity and mortality is high among early tracheostomy group than late group.*

Conclusion: *It is concluded that there is risk of secondary brain injury during tracheostomy.*

Key Words: *Tracheostomy, Head injury, Secondary brain injury, GCS.*

INTRODUCTION

The term tracheostomy, referring to an opening in the trachea with skin attachment. A tracheotomy is just an opening in the trachea. A tracheostomy is a permanent exteriorization of trachea or permanent tracheostomy.[1] Tracheostomy is common and effective procedure in patients with severe brain injury for improving patient comfort, reducing need for sedation, lowering airway resistance, allowing for easier airway care and weaning from ventilator.[2]

The duration of tracheostomy can be divided into early (within 7 days) and late (after 7 days). The indications, timing, and patients selection for tracheostomy is controversial among different centers.[1] Indications for tracheostomy in severe brain injured patient consist of air way obstruction due to decreased consciousness, difficult to wean from mechanical ventilation and extensive secretions.[3,4] The common reason for tracheostomy in the ICU is difficulty in weaning from ventilation. Different studies shows that ~10% of mechanically ventilated patients need tracheostomy, but there is variation with respect to timing, indication and patient selection.[5] The appropriate timing for endotracheal intubation in severe brain injury is well defined that all patients with GCS less than 8/15 or with extensive facial or oropharyngeal trauma should have ETT passed in emergency and must be mechanically ventilated. However, there is no data that give adequate timing as to when convert an ETT tube to a tracheostomy.[6] In a multi-institutional retrospective cohort study 685 trauma subjects was analyzed who had tracheostomy. This study also classified tracheostomy into early, intermediate and late post trauma. This study concluded that Early tracheostomy patients had decreased ICU stay, hospital stay, total ventilator days, and rates of pneumonia. Among these patient's

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mortality was low in late tracheostomy group but there was significantly high mortality in early tracheostomy group.[6]

Complications of tracheostomy procedure can be divided into three categories: immediate, early, and late.[7] Complication associated with tracheostomy can be divided into three categories immediate, intermediate and late. Immediate complications consist of False placement of cannula, pneumothorax, injury to surrounding anatomical structures, hemorrhage, hoarseness, air way obstruction, surgical emphysema. Intermediate complications are infection, hemorrhage due to Tracheoinnominate fistula, tracheal ring rupture and late complications are Tracheal stenosis, Tracheoesophageal fistula, Tracheocutaneous fistula after decannulation and Tracheomalacia.[4]

MATERIALS AND METHODS

The 180 patients of severe head injury admitted to Neuro ICU in Lady Reading hospital, Peshawar Pakistan from March 2015 to March 2017 represent our experience about the risk of secondary brain injury during tracheostomy. Retrospective observational study carried out from March 2015 to March 2017. GCS score were used to define the severity of brain injury. Their clinical, radiological and lab findings were documented on a designed proforma before and after tracheostomy. Tracheostomy was performed within 7 days in 120 patients and late tracheostomy that is after 7 days of being intubated in 60 patients. All those patients with severe head injury who were on ventilator with spontaneous breathing and vitally stable were included. Those patients with no spontaneous breathing, vitally unstable and not willing or had already tracheostomy been excluded from study. The study was approved by Institute of Research in Ethics and Biomedicine (IREB).

Tracheostomy Procedure

There are two methods of tracheostomy open and percutaneous technique. But we performed open tracheostomy in all patients.

Open tracheostomy requires a 3-cm vertical skin incision initiated below the inferior cricoid cartilage. The strap muscles are retracted laterally. The thyroid isthmus is retracted superiorly. An inverted 'U' shape incision is given in second and third tracheal ring for insertion of tracheostomy tube shown in Figure 1.[1]

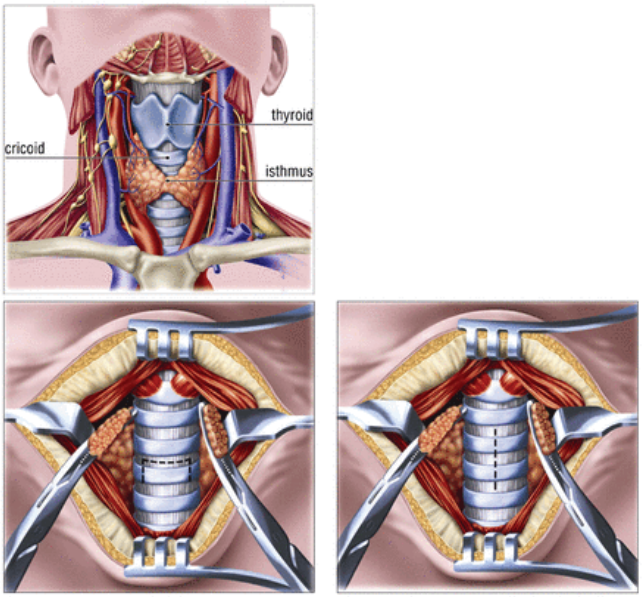

Fig. 1: *Pre-tracheal region anatomy and inverted u shape incision in tracheal rings vs. straight incision.*

RESULTS

Patients in this study were in the age range of 10years to 55years. Mean age was 26.5years. Among patients, nine had GCS 8/15. Ninety patients were with GCS 7/15. Thirty one patients were with GCS 5-6/15. Twenty five patients had GCS 04/15. Fifteen patients had GCS 3/15 at admission. All these patients had spontaneous breathing on mechanical ventilation and was maintaining vitals without inotropic support.

From a total of 180 patients of the study, 95 (53%) patients went under early tracheostomy and 85(47%) patients were in late tracheostomy group. In the early tracheostomy group, 35 (37%) patients dropped GCS and 60 (63%) patients were static or improved. Further, patients who dropped GCS in early tracheostomy group, 32 (91%) were expired while 3 (9%) were improved or static. Even patients who improved in early tracheostomy group, 10 (17%) were expired while 50 (83%) were improved or static.

While in the late tracheostomy group, 9 (11%) patients dropped GCS more than two points and 76 (89%) patients were static or improved. Further, patients who dropped GCS in late tracheostomy group, 7 (78%) were expired while 2 (22%) were improved or static. Even patients who improved in late tracheostomy group, 6 (8%) were expired while 70 (92%) were improved or static. Overall results of the study show that the risk of secondary brain injury is associated with tracheostomy but morbidity and mortality

Table 1: *Demographic Profile of Patients (n = 180).*

Age	
Mean	26.5 years
Range	10 to 55 years

is high among early tracheostomy group than late tracheostomy group. Details of results are depicted in Table 1 and 2.

Table 2: *Results of the Study Groups.*

Total No of Patients N = 180 (100%)							
Early Tracheostomy Group n = 95 (53%)				**Late Tracheostomy group n = 85 (47%)**			
Dropped GCS n = 35 (37%)		**Improved or Static n = 60 (63%)**		**Dropped GCS n = 9 (11%)**		**Improved or Static n = 76 (89%)**	
Expired n = 32 (91%)	Improved or Static n = 3 (9%)	Expired n = 10 (17%)	Improved or Static n = 50 (83%)	Expired n = 7 (78%)	Improved or Static n = 2 (22%)	Expired n = 6 (8%)	Improved or Static n = 70 (92%)

Table 3: *Comparison of Results in Early Tracheostomy Group and Late Tracheostomy Group (%).*

Total No of Patients N = 180 (100%)							
Dropped GCS Rate				**Improved or Static Rate**			
Dropped GCS patients in early tracheostomy group n = 35 (37%)		Dropped GCS patients in late tracheostomy group n = 9 (11%)		Improved or Static patients in early tracheostomy group n = 60 (63%)		Improved or Static patients in late tracheostomy group n = 76 (89%)	
Expiry Rate				**Improved or Static rate**			
Expiry rate in Dropped GCS Cases		**Expiry rate in Improved or Static Cases**		**Improved or Static Rate in Dropped GCS Cases**		**Improved or Static rate in Improved or Static Cases**	
Expired in late Early tracheostomy group (91%)	Expired in late tracheostomy group (78%)	Expired in early tracheostomy group (17%)	Expired in late tracheostomy group (8%)	Improved or static in early tracheostomy group (9%)	Improved or static in early tracheostomy group (22%)	Improved or static in early trachea-stomy group (83%)	Improved or static in early tracheostomy group (92%)

DISCUSSION

The results of our study show that the risk of secondary brain injury is associated with tracheostomy but morbidity and mortality is high among early tracheostomy group than late tracheostomy group. This is in accordance with many studies like in a small randomized trial cohort sizes, retrospective studies performed and showed that hospital mortality is increased with early tracheostomy in severe head injured patients. So, all these results indicate that early tracheostomy should not be performed in severe head injury patients. Tracheostomy during the first week after severe brain injury should only be performed in selected patients and under controlled conditions. Three different randomized controlled trials were suggestive of no reduction in ventilator associated pneumonia after early tracheostomy. However, duration of ICU stay was decreased in patients with early tracheostomy. But these, randomized trials indicated that mortality is significantly increased with early tracheostomy.[8]

In our study, we concluded that tracheostomy procedure carries the risk of secondary brain injury which is more in early tracheostomy group. Although it is very effective procedure for patients with severe brain

injury who were on mechanical ventilation for long time which is in accordance with many studies.[9] In a study, early tracheostomy was compared with late tracheostomy and found the benefit of easy weaning from mechanical ventilation and shorter stay in ICU. But there was no difference in term of mortality and morbidity which contradict our study.[10]In another study, there was no difference in mortality but in one study out of 4 found a decrease in ventilator time after early tracheostomy.[11]

In our study, we found deterioration of patients who had early tracheostomy after severe brain injury that is within 7 days of head injury and especially in those patients who had some chest trauma or developed ARDS after head injury while on mechanical ventilation. The patients who needs high PEEP or having associated lung trauma should not undergo tracheostomy because after tracheostomy PEEP will not be maintained in these patients and these patients are also at high risk of hypoxic secondary brain injury during procedure.

Many studies have showed deterioration of patient due to increases in intracranial pressure with early tracheostomy in acute brain injured patients. It is established fact that increase intracranial pressure in head injury adversely affect outcome. Stocchetti and Kocaeli have mentioned in their studies that during tracheostomy procedure intracranial pressure increases even in those patients who had well controlled intracranial pressure before.[12-14] Some studies demonstrated an increase in intracranial pressure above 20 mmHg which is a significant increase. One study on cerebral perfusion pressure and arterial carbon dioxide levels during tracheostomy procedure showed significant changes which can adversely affect outcome.[13] Even during percutaneous tracheostomy continuous bronchoscopy can lead to hypoventilation, respiratory acidosis and hypercarbia which can lead to raised ICP and secondary brain injury.[15] Tracheostomy both early and late is contraindicated if there is raised ICP.[12,13] Stocchetti and Kocaeli recommend that during tracheostomy in severe brain injured patients intracranial pressure should be closely monitored and changes in ICP should be prevented.[13,14]

Tracheostomy during first seven days of severe head injury should be avoided because of risk of increase in morbidity and mortality. Those patients with severe brain injury associated with hypotension, hyperthermia, extreme of ages, intracranial hypertension, respiratory problems and other associated conditions like diabetes mellitus, renal, cardiac problems and hepatitis caries high rate of mortality during tracheostomy. Hypotension that is systolic blood pressure less than 90 mmHg or hypoxia with PaO_2 of less than 60 in blood gases doubles mortality, and the combination of both triples mortality and lead to worse outcome. Hypotension in these patients cause decreased cerebral blood flow as these patients have lost cerebral autoregulation so any change in blood pressure is directly transmitted to brain tissue. Another risk of secondary brain injury during tracheostomy is the use of sedatives and paralytics in a combative patient can be helpful for transport and tracheostomy procedure but it interferes with neurological examination. After tracheostomy, prophylactic hyperventilation and decrease in $PaCO_2$ can also cause ischemic brain injury.[16]There is chance of hyperventilation before or after tracheostomy as manual ambo bagging is usually used before or after tracheostomy and there is risk of hypoventilation during tracheostomy. Hyperventilation with $PaCO_2$ of less than 25 mmHg is associated with increased risk of ischemic brain injury while hypoventilation with $PaCO_2$ more than 50mmHg is associated with intracranial hemorrhage.[16]

GCS at admission is a strong predictor of outcome that is GCS less than 6/15 carries worse prognosis.[17] Looking into all these factors tracheostomy should be considered in severe brain injury after 7 days and only in those patients who are vitally as well as biochemically stable and maintaining SpO2 of more than 95 at FiO_2 of less than 40% and does not need high peep (more than 5) for maintaining SpO_2.

CONCLUSION

From this study, we concluded that there is risk of secondary brain injury during tracheostomy. Although tracheostomy is very useful for weaning of patient from mechanical ventilation, suction of secretions, maintenance of patent airway but it is not free of risk especially if performed within 7 days of head injury or in patients with hemodynamic instability.

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