Early Versus Late Tracheostomy in Outcome of Patients Admitted in Neurosurgical Intensive Care Unit.

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Background: Tracheostomy is a commonly performed procedure in neurosurgical Intensive Care Units (ICU). The primary indications of tracheostomy in such set up is the protection of the airway in moderate to severe craniofacial injuries, to protect the airway from aspiration injuries seen in many neurological conditions and as an aid in pulmonary toiletting and securing airway in cases requiring prolonged mechanical ventilation. There has been no clear consensus in the timing of tracheostomy so far.¹⁻³ In deciding for the timing of tracheostomy one has to be very careful that early tracheostomy might lead to unnecessary surgery in some cases whereas late tracheostomy might lead to prolonged endotracheal intubation and its disadvantages leading to potentially prolonged weaning from mechanical ventilation. In this study we tried to see the effect of early tracheostomy in various patient outcomes like hospital and ICU stay; mortality; total tracheostomy and ventilation days; and ventilator-associated pneumonia (VAP) over late tracheostomy.

Methods and Materials:
A retrospective study was carried out in all cases undergoing tracheostomy in the neurosurgery intensive care unit (ICU) of Manipal Teaching Hospital, Pokhara, Nepal from Jan 2018 to June 2019. Patients were divided into two groups; those who had undergone tracheostomy within 4 days of endotracheal intubation were allotted to the early tracheostomy group (ET) and those who had undergone tracheostomy after 4 days of intubation were allotted in late tracheostomy (LT) group. The
The objective of the study was to evaluate the outcome of patients in terms of hospital stay, ICU stay, duration of mechanical ventilation, mortality, time to removal of tracheostomy tube and ventilator assisted pneumonia (VAP) in between early and late tracheostomy group. There is no definite consensus in literature for a fixed cutoff of timing determining early and late tracheostomy. Our neurosurgical ICU protocol defines early tracheostomy as 4 days from endotracheal intubation which has been followed in this study.

Patient having decreased level of consciousness or risk of aspiration due to various neurological insults requiring prolonged ventilator support, those requiring active pulmonary hygiene care for copious secretions, pulmonary infiltrates, etc. were the commonest reasons for tracheostomy in our ICU. The decision for tracheostomy was taken by the team of treating neurosurgeons and an open tracheostomy was carried out in operation theatre under general anesthesia by neurosurgeons, ENT surgeons, or resident under supervision. Sputum was usually sent at intubation, during tracheostomy and every seven days till the culture was negative. Tracheostomy care was done as per the guidelines by trained ICU nurses. The tracheostomy tube was first changed after the 7th day and every 5 days thereafter. The patient who had been successfully weaned off the ventilator was shifted out of ICU to a high dependency ward as per neurosurgeon’s assessment. Patients were followed up for 90 days from admission for any complications or adverse events.

Data of patients undergoing tracheostomy were collected from operative records and ICU charts. Patients of all age groups and both sex were included. Those having incomplete records left against advice without completing the treatment and admitted to the ICU with pre-existing tracheostomy tube received from other wards or hospitals were excluded from the study. Records were retrieved from the Medical records Department (MRD) and data were tabulated and evaluated statistically using IBM SPSS 20.0. Continuous variables were compared using student's t-test and discrete variables were compared using Chi-square or Fischer's exact test and a p-value of 0.05 or less was considered significant.

Results:

During the study duration, 89 patients had undergone tracheostomy under our care. Out of these 17 patients left against advice without completion of treatment and 5 patients had either incomplete or lost records. Thus, 67 patients who fulfilled our study criteria were included in our study out of which 27 (40.3%) comprised of the early tracheostomy group and 40 (59.7%) comprised of the late tracheostomy group.

The mean age of the study population was 43.67±21.27 years; that of the early tracheostomy group was 47.26±19.89 years and the late tracheostomy group was 41.25±22.09 years. There were 47 (70.1%) males and 20 (29.9%) females in the study with M:F ratio of 2.35. The diagnosis of these patients on admission to ICU is depicted in Figure 1.

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mean hospital stay was 35.78±13.04 days (16-86 days), the mean duration of mechanical ventilation was 14.37±5.74 days (6-32 days) and the mean duration of tracheostomy in situ for these patients were26.93±9.44 days (12-60 days). The endpoints of these patients were studied as to their discharge, death, or referral to other rehabilitation centers. The total number of patients discharged after recovery was 46 (68.65%), mortality was seen in 16 (23.88%) cases and 5 (7.46%) patients were referred to other centers on patient request or for rehabilitation. Ventilator-associated pneumonia (VAP) was seen in 49 (73.1%) cases and the organisms grown in them are shown in Figure 2. The commonest organisms seen in our study population were Acinetobacter (19, 28.4%) and Pseudomonas (16, 23.9%), and multiple bacterial colonization was seen in 31 (46.3%) cases Fig 2.

Table 1: Various outcome measures against early vs Late tracheostomy group

| S. N | Parameters                          | Early Tracheostomy | Late Tracheostomy | P-value |
|------|------------------------------------|--------------------|-------------------|---------|
| 1    | ICU Stay                           | 14.63±3.54 days    | 20.20±5.75 days   | 0.00    |
| 2    | Hospital Stay                      | 31.30±10.51 days   | 38.30±13.81 days  | 0.20    |
| 3    | Tracheostomy in-situ               | 21.78±6.90 days    | 30.40±9.41 days   | 0.00    |
| 4    | Mechanical ventilation Duration    | 10.41±3.50 days    | 17.05±5.41 days   | 0.00    |
| 5    | Mortality                          | 4 (5.97%)          | 12 (17.91%)       | 0.15    |
| 6    | VAP                                | 16 (23.88%)        | 33 (49.25)        | 0.03    |

There were 13 (19.4%) cases having complications in our series of which 6 (9%) of cases were from the early tracheostomy group and 7 (10.4%) of the cases were from the late tracheostomy group (p=0.63). Hemorrhage and accidental decannulation of the tube while performing tracheostomy care were the commonest complications that were managed without any adverse events. Hemorrhage was mainly minor venous ooze which was managed with adrenaline-soaked gauze packing of the wound. None of the patients required re-exposure in the operation theatre. One patient who developed tracheoesophageal fistula did well with conservative management. The details of the complications are tabulated in Table 2.

Table 2: Complications of tracheostomy

| S. N | Complications                | Early Tracheostomy | Late Tracheostomy | Total No.67 |
|------|------------------------------|--------------------|-------------------|-------------|
| 1    | Hemorrhage                   | 2                  | 3                 | 5           |
|      | (7.5%)                       |                    | (2.9%)            |             |
| 2    | Surgical Site Infection      | 1                  | 1                 | 2           |
|      | (7.5%)                       |                    |                   |             |
| 3    | Accidental Decanulation      | 3                  | 2                 | 5           |
|      | (7.5%)                       |                    |                   |             |
| 4    | Tracheoesophageal fistula     | 0                  | 1                 | 1           |
|      | (1.5%)                       |                    |                   |             |

Discussion:

With the advancements in technologies of critical care, the survival of critical patients has increased and thus has the patients remaining dependent on a mechanical ventilator for a prolonged period. Endotracheal (ET) intubation for a prolonged...
period has its disadvantages of VAP due to bypassing and disabling the laryngeal protective mechanisms, increasing the chances of oropharyngeal contamination of the pulmonary system as well as having a higher chance of damage to the laryngeal and tracheal systems. Tracheostomy has been an effective substitute for prolonged ET intubation as it provides the benefit of easier handling of patients, easier pulmonary toileting, greater patient comfort, reduced need of sedation, the possibility of oral feeding, improved respiratory mechanics, reduced trauma to the oral cavity and lesser chances of VAP.\(^4\)^\(^6\)

Although the role of tracheostomy has been established in critical care in substitution to prolonged ET intubation, the timing of tracheostomy has been a topic of controversy in recent days. A consensus conference in 1989 suggested that tracheostomy is preferable when ventilator support is expected to exceed 21 days.\(^2\) However, the statement is controversial and depends upon the opinion of the treating specialist.

In the past few years, various studies have defined their cutoff for early and late tracheostomy. Literature search shows early tracheostomy defined as within 2-10 days of mechanical ventilation and late tracheostomy variously defined as any time outside early period within 7-28 days.\(^5\)-\(^13\)

With all these controversies, a question that stands to date is whether early tracheostomy imparts any benefit in the outcome of patients over late tracheostomy? Various small observational and cohort studies have shown variable outcome differences based on the timing of tracheostomy.\(^10,14\)-\(^17\) The difference seen was either beneficial or of no difference however none of the studies showed any detrimental effect of one over another. A Cochrane meta-analysis published in 2012 found no mortality difference between early (2-10days) and late (>10days) tracheostomy group. However, one of the four studies in the meta-analysis found that there was a decrease in ventilator time for early tracheostomy group.\(^18\) Two recent European randomized trials (Italian multicenter trails and TracMan UK multicenter trial) suggest earlier tracheostomy was not associated with improved survival and that clinicians cannot accurately predict which patient will require prolonged mechanical ventilation.\(^19,20\)

One way to explain these adverse outcomes of early tracheostomy could be the inclusion of patients with different diagnoses in such trails. The advantages of tracheostomy is not similar in various condition and indications of tracheostomy in various conditions like chronic obstructive pulmonary disease (COPD) are different than in neurological and neurosurgical conditions. This has not only been noticed in widespread clinical practice but also on studies of the timing of tracheostomy in various neurological conditions and craniocerebral trauma however larger randomized trials are yet to validate the findings.\(^21\)-\(^24\)

Our study also suggested a significant benefit of early tracheostomy in terms of length of ICU stay, mechanical ventilation, tracheostomy in situ duration, and VAP. There was no significant benefit on the survival of the patients over 90 days and length of hospital stay in the two groups.

Retrospective nature and small sample sizes were the main limitations of our study. Due to the retrospective design, the patients could not be randomized into early and late groups leading into selection bias although we tried to limit this by checking the homogeneity in between two groups in terms of demographics and neurological status (GCS score). A proper randomized study involving multiple centers to include a larger sample size may be a better option to answer and validate most of the findings of this study in the future.

**Conclusion:**

Early tracheostomy is beneficial in a neurosurgical patient in terms of a decrease in ICU stay, duration of mechanical ventilation, duration of tracheostomy in situ, and VAP. However, it does not impart any benefit over late tracheostomy in terms of mortality, complications of tracheostomy, and length of hospital stay.

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