A Study of Tracheostomy in Neuro- ICU Patients

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Abstract:

Background - Tracheostomy is the creation of a stoma at the skin surface that leads into the tracheal lumen. It has been observed that tracheostomy is commonly indicated in patients in neuro ICU who require prolonged ventilation.

Objective - Objective is to study the indications of tracheostomy in patients, timing of tracheostomy, its complications and outcomes.

Material and methods - A retrospective observational study was conducted on 204 patients with pre-existing neurological conditions and patients admitted in Neuro-ICU, who had undergone tracheostomy at Tertiary care centre from the year 2019 to 2023. The patients were analysed for the indications, timing, and outcome of the tracheostomy. The outcomes were assessed based on indication of tracheostomy, mortality, discharge, decannulation, complications as parameters.

Results - Out of 204 tracheostomized patients, the male-female ratio is 1.83:1, the most common indication is prolonged ventilation and most of tracheostomies 94.1 % were planned tracheostomy, 56 patients were successfully decannulated and 108 patients were discharged with home tracheostomy. Mortality rate was 19.1%.

Discussion - Prolonged intubation is the most common indication for planned tracheostomy and recurrent Endotracheal tube blockage with significant drop of oxygen saturation were mainly the indications of emergency tracheostomy. Early tracheostomy is associated with favourable outcomes in terms of decreased mortality, low incidence of VAP, and thus, better weaning.Prolonged ventilation is the commonest cause and early tracheostomy within 7 days is more beneficial for the patient.

Key Message: In terms of indication prolonged ventilation is the commonest cause and in terms of timing of tracheostomy early tracheostomy which is within 7 days is more beneficial for the patient.

INTRODUCTION

Tracheostomy is one of the earliest surgical procedures recorded, with illustrations depicting it as early as 3600 B.C. in ancient Egypt.[(1)]

Tracheostomy is the surgical procedure in which an opening is made into anterior wall of trachea and through which a tube is inserted to facilitate breathing.[(2)] The indications for tracheostomy in neuro ICU patients are[(3)]:

- To prevent mucosal damage due to prolonged oral intubation.
- To prevent aspiration of oral secretions in neuromuscular disorder.
- For prolonged mechanical ventilation or oxygen support in respiratory muscle insufficiency.
- For removal of secretions from lower respiratory tract.

Conventionally, tracheostomies performed in the first week are classified as early, while tracheostomies later than 7 days are defined as late. Tracheostomy can help in long-term ventilated patients and can short the duration of mechanical ventilation and ICU stay. Tracheostomy is useful to remove secretions from lower respiratory tract and it decreases the occurrence of ventilator-associated pneumonia.

As tracheostomy is a surgical procedure, various complications can occur, during tracheostomy and after tracheostomy. During tracheostomy most common complication is bleeding due to injury to adjacent vessels, other complications include hypoxia, cardiac arrest etc. Intermediate complications include surgical emphysema, pneumothorax, pneumomediastinum, local site infection, recurrent tube blockage and late are tracheoesophageal fistula, difficult decannulation, narrowing at stoma site etc.

The purpose of the study is to highlight our clinical experience of tracheostomy indications, timing of tracheostomy, length of ICU stay, complications, decannulation and other factors related to tracheostomy.

AIMS AND OBJECTIVE:

- To study the indications of tracheostomy.
- To determine timing of tracheostomy
- To study the complications and outcome.

MATERIALS AND METHODOLOGY:

This study data was collected from 204 patients admitted in neuro ICU setup of our hospital from 2019 to 2023. Tracheostomy is a routine ICU procedure performed for long term respiratory care of the patients.All the information was retrieved from patients' medical record as per standard guidelines and ethical standards. No experimental or pilot study was performed. Consent for inclusion in study was taken from the relatives of the patients. Patients having neurological conditions like epilepsy, cerebral stroke, Intraventricular haemorrhage, guillain barre syndrome, tetanus, myasthenia gravis, bulbar paralysis as well as post operative patients with neurosurgical intervention were included. Patients who underwent tracheostomy before admitted in ICU, patient lost in follow up were excluded from the study. The patients were taken in follow up uptill1 year post procedure.

METHODOLOGY:

- Before the tracheostomy procedure, general condition of the patients, assessment of the patient, vitals, viral markers, coagulation profile, complete blood counts were checked.
- If any alteration was observed, it was corrected, if possible, prior to the procedure.
- If patients were on anticoagulant therapy, then it was advised to stop anticoagulant for at least 48 hours before tracheostomy, If possible.
- All patients were already intubated and were on mechanical support and tracheostomy was done at bedside in neuro ICU setup as Shifting the patient to operation theatre for tracheostomy carries risk due to need for constant ventilatory support.
- Majority of the tracheostomies were elective, emergency tracheostomy was performed in case of recurrent tube blockage/ fall in oxygen saturation.

Procedure:

- Rose position given. (Sandbag below the shoulder to extend the neck).
- Anatomic landmarks such as the thyroid notch, cricoid cartilage, and sternal notch are palpated and marked.
- After painting and draping and lignocaine + adrenaline (1:200000 dilution) was injected into the skin of the anterior neck that is, site of the incision, 1-2 cm below the cricoid cartilage above suprasternal notch.
- Midline vertical skin incision (2- 2.5 cm long) was kept through skin, subcutaneous tissue to expose the strap muscles. Strap muscles were retracted and blunt dissection continued till trachea was reached.
- The thyroid isthmus retracted superiorly, pretracheal fascia was incised exposing the 2^{nd} and 4^{th} tracheal rings (mid tracheostomy), cruciate incision was kept.
- Tracheal opening was dilated with tracheal dilator and appropriate sized cuffed tracheostomy was inserted.
- Air patency and bilateral air entry was checked and tube was tied to the patient's neck.
- All the patients were carefully monitored and observed for Bleeding/breathing pattern/oxygen saturation/surgical emphysema.

Postoperative care:

- Vitals and oxygen saturation were monitored.
- Regular suction and daily dressing were done.
- Cleaning of the tube via instilling diluted sodium bicarbonate drops if required to avoid blockage.

Follow up care:

- Patients who decannulated or discharged with tracheostomy- home tracheostomy care was explained and they were called for regular follow up.

Data collected was evaluated for parameters like demographic data, duration of mechanical ventilation, ventilatory associated pneumonia, LOS in hospital, LOS in ICU, complications, mortality, outcomes etc.Furthermore, comparative analysis was done with other relevant studies.

RESULT

Total 204 number of tracheostomized patients included in our study who were admitted in neuro-intensive care unit. this study includes various patients having neurological conditions as well as post operative patients of neurosurgery department. 64.7% patients are male and 35.3% patients are femalewith male:female ratio of 1.83:1 (Chart 2). The patients' age were ranging from 9 to 89 years of age. The median age was 55 years (Chart 1). We have considered tracheostomy within 7 days of endotracheal intubation (≤7 days) as an 'Early tracheostomy' (ET) and after 7 days (>7 days) as a 'Late tracheostomy'(LT). There was no proper definition in any literature to define early and late tracheostomy. Various studies have mentioned various definition for early and late tracheostomy. 67.6% of the patients have undergone ET and 32.4% patients in LT.

In our study, maximum cases of 50 were seen in 51-60 years of age group f/b 36 patients in 61-70 years of age group (Chart 1). Total 56.4% patients were having neurological conditions and rest 43.6% patients were having neurosurgical intervention (Chart 3). Out of which, 94.1% tracheostomies were planned and 5.9% tracheostomies were done in cases of emergencies (Chart 4). Recurrent endotracheal tube blockage due to high peak pressure in ventilator and persistent drop of oxygen saturation were mainly the indications of emergency tracheostomy.

Chart - 1 Age group distribution

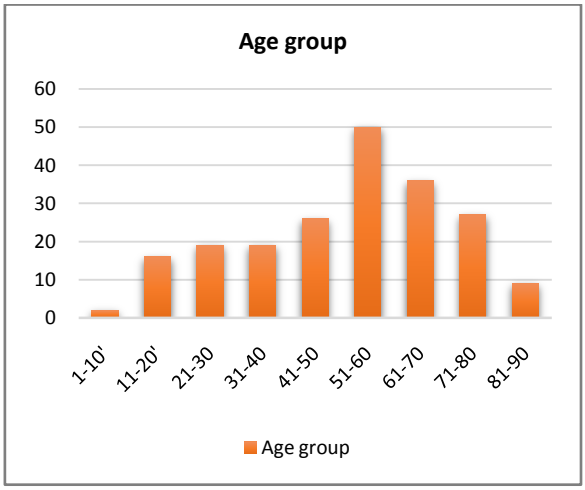

Chart -2 Gender distribution

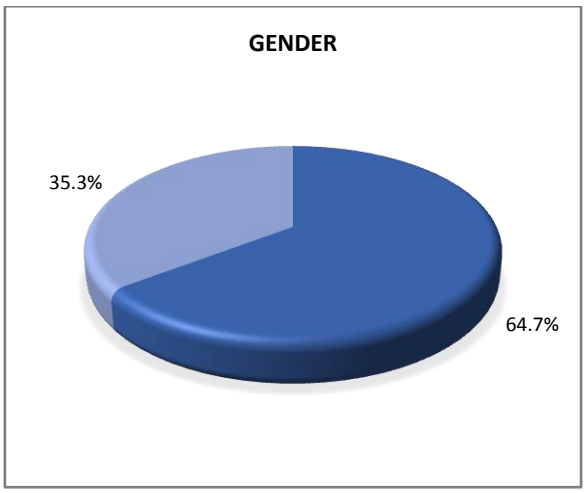

Chart -3 Neuromedicine/ Neurosurgery

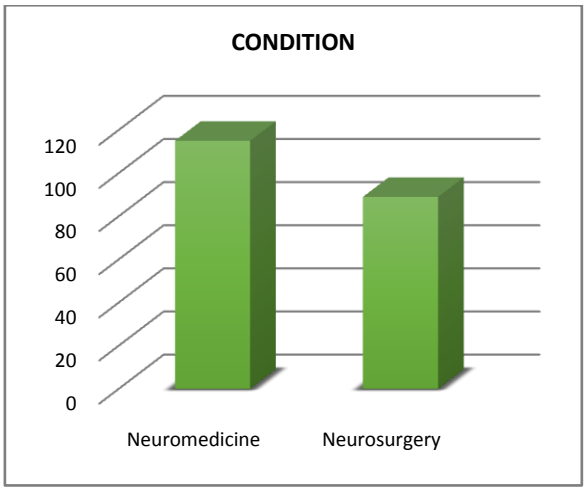

Chart -4 Emergency/ Planned tracheostomy

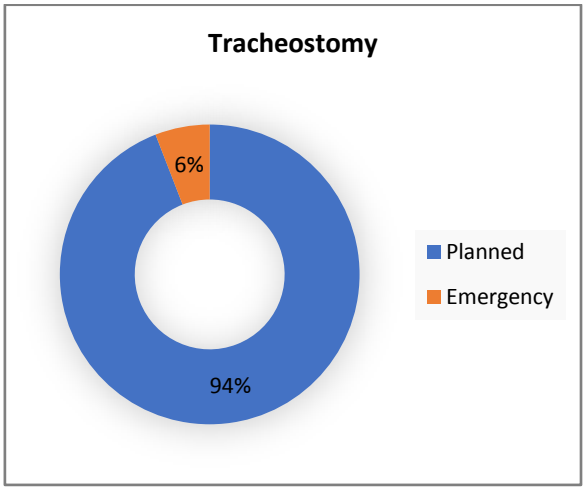

Table -1

	Duration of Mechanical ventilation (Mean No. of days)	Ventilatory associated pneumonia (VAP)	LOS in ICU (Mean No. of days)	LOS in Hospital (Mean No. of days)
ET	5.6	5.8%	8.3	12.7
LT	11.5	33.3%	15.2	21.5

According to our data, mean no. of days for required mechanical ventilation is 5.6 and 11.5, occurrence of VAP was 5.8% and 33.3%, LOS in ICU was 8.3 and 15.2, LOS in Hospital was 12.7 and 21.5 days in ET and LT group respectively.

Every surgical procedure has its complications. But with proper equipment and setup it can be minimised. Tracheostomy related complications during hospital stay presented that there was no significance in ET & LT group. Various complications observed, during the procedure and after the procedure, are listed in the table no. 2

Table- 2

Complications		Percentage
Early	Bleeding	4.9%
	Subcutaneous emphysema	2.45%
	Pneumothorax	1.47%
	Pneumomediastinum	0.98%
Late	Stoma infection	1.96%
	Tracheocutaneous fistula	1.47%
	Tracheoesophageal fistula	0.49%

Out of 204 tracheostomised patients, 56 patients were successfully decannulated and 108 patients were discharged with home tracheostomy. Mortality rate was 19.1% only, it was because of pre-existing medical condition and not due to tracheostomy.

The results were further analysed to draw a comparison using the same parameters as above to Understand the effect of timing of tracheostomy on Outcome of tracheostomy.

DISCUSSION

Overall, it is commonly accepted that mechanically assisted ventilation is essentially required in critically ill neurological patients when they are unconscious or have poor brain function. These pernicious neurological diseases often require prolonged mechanical ventilation. Many a times Endotracheal intubation and controlled ventilation are often established early to secure an adequate airway and tissue oxygenation while preventing hypercarbia and acidosis. This significantly increases the chances of recurrent pulmonary infections. But Tracheostomy has been decremental for its incidence. Tracheostomy is one of the most important and standard routine procedures for airway management in intensive care units. But it has its own merits and demerits. The present study was conducted with aim to define the role of tracheostomy in this group of patients. In our study, we observed a male preponderance and most of the patients belonging to the age group of 51-60 years.

In older age group neurological condition is more common than neurosurgical condition. In younger age group (<50 years) neurological condition and neurosurgical condition have almost equal occurrence. Neurosurgical conditions include majorly head injury including intracranial haemorrhage due to road traffic accident. Since older age group population is less engage in outdoor activities, occurrence of head injury is less common compared to younger population. Because of males being the bread winners for the family and their more involvement in outdoor activities males are more affected. And also, may be because of male predominance in the society. Other than that, various neurological conditions like epilepsy, cerebral stroke, Gullain-Barre syndrome are more common in male.

We analysed that the patients who had associated comorbidities like Chronic heart failure, Chronic respiratory failure, liver disease, chronic renal failure, and Immunodeficient status had shown slower weaning from mechanical ventilation and worsened the prognosis.

We observed a linear relationship between the timing of tracheostomy and various patient outcomes, including mortality. In present study we found that early tracheostomy was beneficial in all groups of patients which is consistent with other studies. [9]

It was studied that patients with severe brain injury presenting with a GCS score < 8, early tracheostomy had favourable outcomes compared to late tracheostomy (12% vs. 36%). [9]

Prolonged ventilation with endotracheal tube was associated with turbulent airflow, inspissated secretions, extrinsic tube compression and tube angulations through the upper airway which limits the airflow and weaning efforts in patients.[8] Early tracheostomy can diminish these problems and augment the weaning by decreasing the dead space volume.

In comparison to LT group, ET group showed lesser mechanical ventilation requirement, occurrence of VAP, LOS in ICU, LOS in Hospital and mortality. Our findings are comparable with the studies Bosel 2013[4], Catalino 2018[5], Gessler 2015[6], Villwock 2014[7].

Table 3

	Timing of tracheostomy		Duration of mechanical ventilation (Mean No. of days)		Ventilatory associated pneumonia		LOS in ICU (Mean No. of days)		LOS in Hospital (Mean No. of days)	
	ET	LT	ET	LT	ET	LT	ET	LT	ET	LT
Our study	<=7	>7	5.6	11.5	5.8%	33.3%	8.3	15.2	12.7	21.5

Bosel 2013[4]	<=3	>=7	13.93	12	NA	NA	14.35	17.42	NA	NA
Catalino 2018[5]	<=10	>10	7.3	15.2	6 (40%)	12 (36.36%)	20.1	31.5	28.5	44.4
Gessler 2015[6]	<=7	>7	17.4	22.3	11 (28.2%)	15 (13.8%)	NA	NA	NA	NA
Villwock 2014[7]	<=10	>10	NA	NA	346 (6.1%)	644 (8.5%)	NA	NA	29.1	36.8

Duration of mechanical ventilation is almost less in ET group and it is also observed in Catalino 2018[5] and Gessler 2015[6] studies. Bosel 2013[4] study shown a slightly more mean no. of days in ET group. It was observed that early tracheostomy can help in weaning of the patient from mechanical ventilation than late tracheostomy. For Endotracheally intubated patients, sedation is required to prevent discomfort and irritation that caused by Endotracheal tube. While tracheostomy can reduce above issues by improved comfort, motility and oral hygiene of patient. Poor GCS score(<8) in tracheostomized patients was one of the important predictor for prolonged ventilation and extubation. Poor neurological status leaded to more ventilator dependency and failed extubation causing complication like VAP.

For VAP only Villwock 2014[7] study favours our results while Gessler 2015[6] and Catalino 2018[5] don't.

Ventilatory associated pneumonia is a lung infection that develops in a person who is on a ventilator. According to our previous data ET decreases the duration of mechanical ventilation required mean days so it can decrease the chances of ventilatory associated pneumonia, and in LT group duration of mechanical ventilation is almost double so chances of ventilatory associated pneumonia is extremely high and it is also observed in LT group. LOS in ICU and LOS in Hospital is less in ET group and more in LT group and it is comparable in all the above-mentioned studies. Patient is kept in ICU whoever requires constant monitoring and observation. In our study it is observed that ET group reduces that duration of mechanical ventilation required and occurrence of ventilatory associated pneumonia, so ICU requirement is less in this group. ET group has less LOS in ICU because of early weaning from mechanical ventilation. So early discharged can be planned as per the clinical condition of the patients. Because of less LOS in ICU and hospital, total cost is also less in ET than LT.

Various surgical complications observed in above mentioned table no. 2

Bleeding is the most common complication in our study. Because in most of the patient of neurosurgically managed, anticoagulant and antiplatelet drugs are given to prevent thrombosis so coagulation profile is altered in these patients. Other intra operative complications can be avoided with experienced surgeons. Post operative complications like stoma infections can be reduced with proper stoma care.

Table 4: Mortality

	In our study	Bosel 2013[4]	Gessler 2015[6]	Villwock 2014[7]	Catalino 2018[5]
ET	9 (6.5%)	3 (10%)	3 (7.7%)	699(12.5%)	5 (33.3%)
LT	31 (46.9%)	14(46.6%)	8 (0.7%)	894(11.8%)	2 (6.1%)

In our study, 6.5% mortality is from ET group and 46.9% mortality is from LT group and it is comparable to Bosel 2013[4] study. But not comparable to Gessler 2015[x], Villwock 2014[7] and Catalino 2018[5] studies. According to our study data ET reduces the duration of mechanical

ventilation, LOS in ICU, LOS in Hospital as well as VAP occurrence, because of this various hospital acquired infections and other complications can be minimized so mortality is less.

CONCLUSION

Anticipation of prolonged ventilation is the most common indication of tracheostomy in neuro ICU patients. Early tracheostomy is very useful with favourable outcomes in terms of low complications rates, less VAP incidence, reduced overall stay in hospital and cost, increased survival and better chances of weaning.

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REFERENCES

1. Olszewski J, Miłoński J. Historia tracheotomii. Otolaryngologia Polska 2007; 61(3):349-52
2. Pracy P. Tracheostomy. In: Gleeson M, Browning G, Burton M, editors. Scott Brown's Otolaryngology and Head-Neck Surgery. 7th ed. London: Hodder Arnold; 2008 pp. 2292-304
3. Durbin CG Jr. Tracheostomy: why, when, and how? Respir Care. 2010 Aug;55(8):1056-68.
4. Bösel J, Schiller P, Hook Y, Andes M, Neumann JO, Poli S, et al. Stroke-related Early Tracheostomy versus Prolonged Orotracheal Intubation in Neurocritical Care Trial (SETPOINT): a randomized pilot trial. Stroke. 2013 Jan;44(1):21-8.
5. Catalino MP, Lin FC, Davis N, Anderson K, Olm-Shipman C, Jordan JD. Early versus late tracheostomy after decompressive craniectomy for stroke. J Intensive Care. 2018 Jan 4;6:1.
6. Gessler Florisan, Mutlak Haitham, Lamb Stefan, Hartwich Michael, Adelmann Michael, Platz Johannes, et al. The Impact of Tracheostomy Timing on Clinical Outcome and Adverse Events in Poor-Grade Subarachnoid Hemorrhage. Survey of Anesthesiology August 2016; 60(4):p 145.
7. Jennifer A. Villwock, Mark R. Villwock, Eric M. Deshaies. Tracheostomy Timing Affects Stroke Recovery. Journal of Stroke and Cerebrovascular Diseases. 2014; 23(5): 1069-72.
8. Koh WY, Lew TW, Chin NM, Wong MF. Tracheostomy in a neuro-intensive care setting: indications and timing. Anaesth Intensive Care. 1997 Aug;25(4):365-8.
9. Tanaka A, Uchiyama A, Kitamura T, Sakaguchi R, Komukai S, Matsuyama T, et al. Association between early tracheostomy and patient outcomes in critically ill patients on mechanical ventilation: a multicenter cohort study. J Intensive Care. 2022 Apr 11;10(1):19.