



# Tracheostomy in Pediatric Intensive Care Unit: Experience from Eastern India

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Received: 22 April 2020 / Accepted: 24 September 2020 / Published online: 14 October 2020  
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## Abstract

**Objective** Tracheostomy is one of the most commonly used surgical intervention in sick children in the intensive care unit. The literature in the pediatric population is limited, therefore, we conducted this study to evaluate the indications, timing, complications, and outcomes of tracheostomy among the children at our center.

**Methods** This retrospective study was conducted from January 2016 through December 2019. Data was collected from the patients' records and analyzed.

**Results** During this study period, 283 children were ventilated, of which 26 (9.1%) required tracheostomy. Among this 73% were boys. The median age of the children who underwent tracheostomy was 6.32 y. The most common indication for tracheostomy was prolonged mechanical ventilation [24 cases (92%)] followed by upper airway obstruction [2 cases (8%)]. The average time of tracheostomy was 11.65 d, range (1–21 d). Complications were seen in 14 patients (55%). The most common complications were accidental decannulation, occlusion, pneumothorax, and granulation tissue. Twenty one (80%) patients were successfully discharged, out of which 16 (61%) patients were discharged after decannulation and 5 (21%) were sent home with a tracheostomy tube in situ. Overall mortality in present study was 11.5%; none was directly related to tracheostomy.

**Conclusions** The indication for tracheostomy has been changed from emergency to more elective one. Prolonged mechanical ventilation is the most common indication for tracheostomy. Although the timing of tracheostomy is not fixed, two weeks time is reasonable and it can be done safely at the bedside in pediatric intensive care.

**Keywords** Children · Intensive care unit · Indication · Mechanical ventilation · Tracheostomy

## Introduction

Tracheostomy is one of the most commonly used surgical intervention in critically sick children in the intensive care unit. Children need a tracheostomy for various reasons, either as an emergency or an elective procedure. Pediatric tracheostomy is more challenging because of the small, pliable trachea, limited extension of the surgical field and the risk of anesthesia. The morbidity and mortality for Pediatric tracheostomy are around two to three times more than for adult patients [1–4].

The indication for tracheostomy has been significantly changed over the last few decades from upper airway obstructions following infections to prolonged mechanical ventilation

[5]. With the advent of vaccination against *Haemophilus influenzae* type B and *Corynebacterium diphtheria* and improvement in the pediatric intensive care, the number of tracheostomies for upper airway disease has been reduced [1]. Now-a-days Pediatric tracheostomy is commonly done for prolonged ventilation, upper airway obstruction, trauma and neurological diseases [6]. In contrary to adults, there is no consensus guideline for the timing of tracheostomy in children [7].

The literature in the pediatric population is limited. Therefore, this study was conducted to analyze the indications, complications and outcomes of tracheostomy at a tertiary care pediatric intensive care unit in Eastern India.

## Material and Methods

This retrospective study was conducted from January 2016 through December 2019. A total of 26 tracheostomies were performed during this period. Data regarding demography,

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indication, timing, complications, and the outcome of tracheostomy was collected and analyzed. After discharge, the patients were followed up at the hospital every 2 mo for at least 6 mo.

All the tracheostomies were carried out by otolaryngologists in the presence of an anesthetist and a pediatric intensivist either in the pediatric intensive care unit (PICU) or in the operation theatre. A standard procedure for tracheostomy was used in all cases. The indication and timing of tracheostomy were decided by the pediatric intensivist. The decannulation protocol of authors' institution includes cannula downsizing and then its gradual occlusion. The decision for the decannulation was combinedly taken but mainly by the treating physicians. Once the child is hemodynamically stable, on minimal or no oxygen, off inotropes then authors planned for the decannulation. A laryngoscopy is performed only when there was difficulty in the decannulation process. The frequency of downsizing depends on the age of the patient and type of tracheostomy tube used initially.

Parents and caregivers were involved in the care of the tracheostomy patient. They were taught about the routine care of the tracheostomy, including suctioning and changing of tubes by demonstration. They were also educated about various equipments like suction catheter, suction machine, pressure set up before discharge etc.

## Results

During the study period, 283 children were ventilated, out of which 26 (9.1%) required a tracheostomy. Among this 73% were boys. The median age of the children who underwent tracheostomy was 6.32 y. The youngest child was 4-mo-old and the eldest was 16 y. Seven children were  $\leq 1$  y. In 19 (73%) patients tracheostomy was performed at the bedside in the pediatric intensive care unit.

The most common indication for tracheostomy in present study was prolonged mechanical ventilation secondary to neuromuscular problems – 24 cases (92%) followed by upper airway obstruction (UAO) – 2 cases (8%). The prolonged mechanical ventilation group was further divided into four subgroups as neuromuscular (7 children), neurological (10 children), traumatic brain injury due to road traffic accidents (5 children) and respiratory (2 children) (Table 1).

The average timing of tracheostomy was 11.65 d, range (1–21 d). In 18 (70%) children it was done within 2 wk and only in 8 (30%) cases after 2 wk. In authors' experience, this delay was because of parental anxiety, stress, and fear about the care of tracheostomy. In 2 cases of upper airway obstruction (UAO), an emergency tracheostomy was performed in the operation theatre.

Emergency tracheostomy was performed in one child in the pediatric intensive care unit due to severe respiratory distress after decannulation (Table 1).

Complications from tracheostomy were seen in 14 patients (55%). Out of 14, 2 patients had accidental decannulation, 2 had tube occlusion, 1 patient had a cardiac arrest, 2 patients developed pneumothorax, 3 developed granulation tissue, 1 patient had maggots and infection at home, another patient died at home due to occlusion and 1 patient each developed stromal site infection and subglottic stenosis.

Twenty one (80%) patients were successfully discharged, of which 16 (61%) patients were discharged after decannulation and 5 (21%) were sent home with a tracheostomy tube in situ. Out of those 5, 2 patients were decannulated on follow-up, 1 child died due to tube occlusion at home, 2 are remaining on tracheostomy for more than 1 y. Three patients got discharged against medical advice, out of which one died on the way home, one died at home after 2 wk due to tube occlusion and one patient was lost to follow-up. Overall mortality in present study was 11.5% (Fig. 1 and Table 1).

## Discussion

Now-a-days tracheostomy is one of the most commonly performed surgical procedures in the pediatric intensive care unit. Over the last 50 y, the indication for tracheostomy has been changed from acute inflammatory airway obstructions to prolonged mechanical ventilation. This change is because of the introduction of new vaccines and improvement in neonatal and pediatric intensive care [1, 5].

In the present study, the rate of tracheostomy was 9.1%, which is almost similar to a study by Kamit Can et al. [8]. The tracheostomy rate of units varies from 2 to 7%, but the rate with different co-morbidities is not clear [9–11]. The most common indication for tracheostomy in present study was prolonged mechanical ventilation (92%) followed by UAO (8%), which is similar to many recent studies [8–11]. Douglas et al. reported 111 children who underwent tracheostomy and found that the most common indication was prolonged mechanical ventilation (32%) followed by craniofacial anomaly causing UAO (18%) and subglottic stenosis (14%) [12]. Contrary to present study, Schweiger et al. found that the most common indication for tracheostomy is upper airway obstruction [13]. Mahadevan et al. from New Zealand also reported that UAO accounts for the majority of tracheostomies [14].

The average timing of the tracheostomy in present study was 11.65 d, range (1–21 d). As per the unit's protocol, any child who required ventilation for  $> 1$  wk, was evaluated for tracheostomy. In the United States, studies have demonstrated that the time for insertion

**Table 1** Demographic characteristics, indications, timings and outcomes of patients with tracheostomy

Subgroup	Serial no.	Age/ Sex	Indication	Timing of tracheostomy	Duration of tracheostomy	Outcome
1. Neuromuscular (7)	1	5 y/F	GBS	10 d	16 d	Discharged
	2	4 mo/M	CM	21 d	> 100 d	LAMA, Died
	3	4 y/M	GBS	7 d	65 d	Discharged
	4	7 y/M	GBS	10 d	48 d	Discharged
	5	12 y/F	GBS	9 d	85 d	Discharged
	6	12 y/M	GBS	5 d	Not yet closed	Discharged <sup>a</sup>
	7	7 y/F	GBS	15 d	40 d	Discharged
2. Neurological (10)	1	9 y/M	CP/ Seizure	15 d	In situ	Discharged <sup>b</sup>
	2	1 y/M	Encephalitis	20 d	17 d	Discharged
	3	9 y/M	AIE	18 d	34 d	Discharged
	4	1 y/M	Encephalitis	20 d	75 d	Discharged
	5	1 y/M	JE	13 d	15 d	Discharged
	6	3 y/M	AIE	14 d	35 d	Discharged
	7	2 y/M	JE	10 d	65 d	Discharged
	8	1 y/F	Encephalitis	10 d	No data	LAMA
	9	7 y/F	AIE	10 d	60 d	Discharged <sup>a</sup>
	10	13 y/M	Encephalitis	6 d	25 d	Discharged
3. TBI due to road traffic accidents (5)	1	14 y/M	RTA /TBI	12 d	Not yet closed	Admitted
	2	5 y/M	RTA/SRSE	20 d	Not yet closed	Admitted
	3	5 y/F	RTA (DAI)	17 d	Not yet closed	Discharged <sup>a</sup>
	4	7 y/M	RTA (DAI)	7 d	6 mo 5 d	Discharged <sup>a</sup>
	5	7 y/M	RTA (DAI)	5 d	32 d	Discharged
4. Respiratory (4)	1	16 y/M	Sepsis, pneumonia	7 d	39 d	LAMA
	2	6 mo/M	Sepsis, pneumonia	13 d	43 d	Discharged
	3	5 y/F	Laryngeal papilloma	Emergency	60 d	Discharged
	4	1 y/M	Foreign body	Emergency	5 d	Discharged

*AIE* Auto immune encephalitis; *CM* Compressive myelopathy; *CP* Cerebral palsy; *DAI* Diffuse axonal injury; *GBS* Guillain barre syndrome; *JE* Japanese encephalitis; *LAMA* Left against medical advise; *RTA* Road traffic accidents; *SRSE* Super refractory status epilepticus; *TBI* Traumatic brain injury

<sup>a</sup> discharged with tube in situ

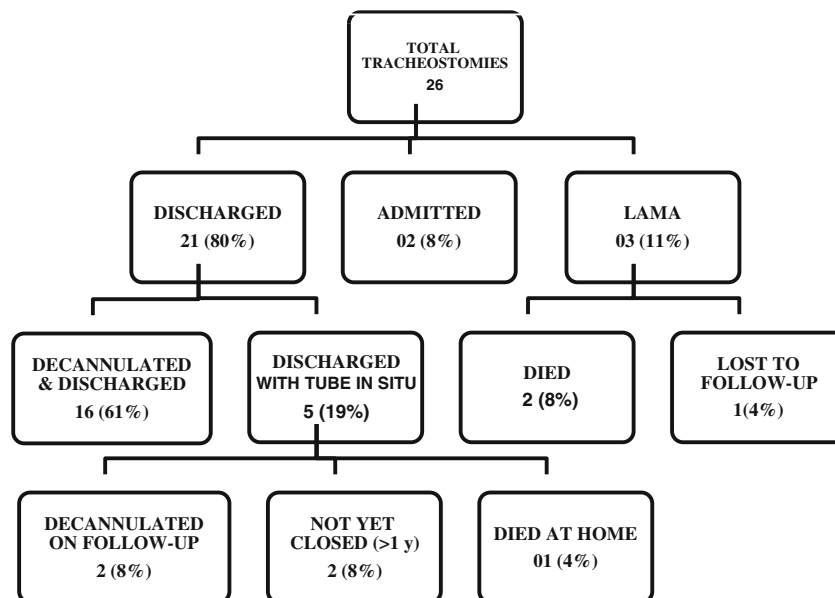
<sup>b</sup> discharged and died at home

of a tracheostomy tube is on average, 14.4 d, although it varies significantly in units from 4.3 to 30.4 d [9, 15]. Holloway et al. analyzed 73 subjects with a median of 22 d of ventilation before tracheostomy, and suggested that prolonged mechanical ventilation is associated with increased ICU morbidities and stay and recommended early tracheostomy within 14 d [16]. Although there is a consensus that tracheostomy should be performed in 1 or 2 wk of ventilation in adult patients, no established criteria currently exists regarding the time of tracheostomy in children, and timing of tracheostomy should be individualized for each patient [7, 17]. It is known that the pediatric patients tolerate intubation for a longer period than do adults; however, early tracheostomy not only reduces the work of breathing, ventilator-

associated complications, sedation requirements, the length of ICU stay and cost but also improves quality care and patient comfort [17].

The complications of tracheostomy were seen in 14 patients (55%). Pneumothorax and minor bleeding were two important perioperative complications. Early postoperative complications were occlusion of the tube, accidental decannulation whereas subglottic stenosis and granulation tissue were late complications. One child on tracheostomy had blocked tubes at home and died. Mortality was 11.5%; none was because of a tracheostomy. Kamit Can et al. found that the complication rate was 25.3% in the pediatric intensive care unit and 11.1% at home; no patients died of tracheostomy-related complications, which shows that performing a

**Fig. 1** Outcome of tracheostomy.  
LAMA Left against medical  
advise



tracheostomy is a relatively safe intervention in the pediatric ICU [8]. The study by Mahadevan et al. found a complication rate of 51% [14].

The average length of tracheostomy in present study was 48 d (5–180 d). In four patients, tracheostomies could not be closed to date: 3 severe traumatic brain injury (TBI) and 1 Guillain barre syndrome (GBS) patients are still on the tube. A study by Schweiger et al. had shown decannulation time ranged from less than one mo to 7 y (median of 5 mo) [13].

The rate of successful decannulation in present study was 18 (69%) and 2 patients are still waiting for closure and 2 patients need tracheal reconstruction surgery. Studies show that decannulation rates vary around 35–75% [1, 2, 12, 14, 18]. A study by Sharma and Vinayak showed the rate of decannulation was 82% [19]. The mortality rate of tracheostomy patients is relatively high, between 14 and 19% [2, 6, 14]; in the present study, it is 11.5%. Schweiger et al. showed mortality of 32%, which is because of an underlying disease rather than due to tracheotomy [13].

## Conclusions

Tracheostomy is one of the most commonly used procedure now-a-days in the PICU. The indication for tracheostomy has changed from emergency to more of elective one. The most common indication for tracheostomy in present study was prolonged mechanical ventilation. Although the timing of tracheostomy is individualized for each patient, two weeks seems to be reasonable enough. Tracheostomy can be performed safely at the bedside in pediatric intensive care unit, but the patient selection should be made carefully.

**Authors' Contributions** MKJ, SP and BS: Concept designing, analysis of data, drafting, critical revision and final approval of the manuscript; RM and JRB: Concept designing, analysis of data and final approval of the manuscript. Dr. Natabar Swain, Professor & HOD, Department of Pediatrics will act as guarantor for this paper.

## Compliance with Ethical Standards

**Conflict of Interest** None.

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