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Research Article

The Assessment of Mortality Risk after Bedside Tracheostomy in Pediatric Intensive Care Unit

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Abstract:

Objective: This study was conducted to assess the mortality risk after Bedside tracheostomy in the pediatric Intensive Care Unit.

Methods: the retrospective study included 78 pediatric patients who underwent tracheostomy in a bedridden state at the time of tracheostomy and were admitted to the PICU at Al Azhar University Hospitals from April 2022 to October 2024.

Results: a total of 78 patients were included in this study, 27 of the patients had an early tracheostomy and 51 patients had a late tracheostomy, MV duration before tracheostomy was significantly higher among patients with early tracheostomy (14.37±4.76), than late. The time from tracheostomy to discharge/day was significantly lower among patients with early tracheostomy (25.72± 7.45) than late, and the number of tracheostomy-related complications was more common among patients with late tracheostomy (94%) than early. Meanwhile, the PICU stay/day, and hospital stay/day, showed no significant difference among patients with early and late tracheostomy (P≥0.05). Mortality rates after tracheostomy were found in 27 patients (34.62%), 9 patients with early tracheostomy (33.33%), and 18 patients with late tracheostomy (66.67%). Cox-regression analysis indicated that the most significant independent factors associated with high risk were age at tracheostomy, GCS score at PICU admission, central venous access, airway obstruction duration before tracheostomy, and PICU stay (p<0.05). Kaplan-Meier curves analysis, the estimation of mean survivor rate based on the time from tracheostomy to discharge in patients who underwent tracheostomy was significantly higher among pediatric patients with early tracheostomy compared to those patients with late tracheostomy (log-rank test=21.548, Wilcoxon=10.279, Tarone-Ware=15.117, P≤0.001).

Conclusions: Tracheostomy is one of the most used procedures nowadays in the PICU. The indication for tracheostomy has changed from emergency to more of an elective one. The most common indication for tracheostomy in the present study was prolonged mechanical ventilation. The mortality rates after tracheostomy were found in patients 34.62%, 33.33% of with early tracheostomy, and 66.67% with late tracheostomy. Tracheostomy can be performed safely at the bedside in a pediatric intensive care unit, but the patient selection should be made carefully.

Keywords: bedside tracheostomy; complications; pediatrics; picu; mortality risk

Introduction

Tracheostomy is a common surgical procedure in critically ill children **(Jain et al., 2021)**. Children may require tracheostomy for various reasons, both as an emergency measure and a planned procedure. **(Pacheco and Leopold, 2021)**. Pediatric tracheostomy is more complex than adult tracheostomy due to the smaller, more flexible trachea, limited surgical field, and increased risks associated with anesthesia **(Sharma, 2023)**. Consequently, the rates of morbidity and mortality are significantly higher in pediatric patients compared to adults **(Swain et al., 2018)**.

Tracheostomy is a life-saving procedure, but it also carries potential risks and complications **(Chavan et al., 2019)**. Over the years, the indications for tracheostomy have evolved **(Fuller et al., 2021)**. In the past, inflammatory conditions leading to upper airway obstruction were the primary reasons for tracheostomy **(Kissi, 2018)**. However, in today's pediatric and neonatal populations, tracheostomy is often required to address congenital or acquired airway abnormalities, facilitate long-term ventilation, or aid in airway clearance **(Sachdev et al., 2021)**.

While strict contraindications to tracheostomy are rare, **(Fuller et al., 2021)**. relative contraindications may include neck masses, severe medical instability, a high-riding innominate artery, or a very poor prognosis. **(Phanthok et al., 2022)**. Despite these considerations, tracheostomy can offer significant benefits, such as reducing the need for sedation, enabling wakeful interaction with caregivers, and potentially serving as a palliative measure in children with poor prognoses who require long-term ventilation **(Fuller et al., 2021, (Yan et al., 2021)**.

For those patients with an expected intubation period longer than two weeks, tracheostomy is preferred, not only to limit the risk of possible intubation-related laryngeal trauma (resulting in glottic and subglottic stenosis) but also to decrease the length of hospital stay, the need for sedation as well as the number of health care workers required to take care of the patient **(Ertugrul et al., 2016)**. It is known that pediatric patients tolerate intubation for a longer period than adults do **(Watters, 2017)**. Since there is no certain time for tracheostomy for children after prolonged intubation ,there are no established criteria for children, so each patient must be evaluated individually **(Pacheco and Leopold, 2021)**.

The high morbidity and mortality associated with pediatric tracheostomy are well documented **(Newton et al., 2022)**. Tracheostomy performed on a neonate, infant, or child is more technically demanding than adult tracheostomy because of the smaller, more pliable trachea and a confined operating field **(Watters, 2017; Madgar et al., 2024)**. This study was conducted to assess the mortality risk after Bedside tracheostomy in the pediatric Intensive Care Unit.

Patients And Methods

Study design

A retrospective study included 78 pediatric patients who underwent tracheostomy in a bedridden state at the time of tracheostomy and were admitted to the PICU at Al Azhar University Hospitals from April 2022 to October 2024.

Patients' selection criteria

We included only patients with neurological impairments who were bedridden at the time of tracheostomy. We excluded patients without neurological impairments upon PICU admission, those who had a tracheostomy before PICU admission or emergently, and those who did not require invasive ventilation before tracheostomy.

Patients diagnoses

We diagnosed the studied children admitted to the PICU who underwent tracheostomy based on the criteria for tracheostomy and the procedure site (bedside ICU or OR). Bedside tracheostomy candidates met the following criteria: low ventilator settings (low PEEP, peak airway pressure, and FiO2), no anticipated need for additional diagnostic procedures (e.g., bronchoscopy or direct laryngoscopy), and easily palpable laryngeal anatomy suitable for flexion-extension positioning. Tracheostomies performed within 14 days of mechanical ventilation were classified as early tracheostomies, while those performed after 14 days were classified as late tracheostomies. As there are no definitive guidelines for the optimal timing of tracheostomy in prolonged pediatric mechanical ventilation, we adopted a 14-day threshold based on previous clinical studies **(Holloway et al. 2015, Lee et al. 2016).**

All patients were subjected to the following:

Full history datils included the history of age, sex, weight at the time of tracheostomy, sex, underlying disease, indication for tracheostomy (e.g., lung tissue disease; disordered control of breathing (neurological and neuromuscular diseases); cardiovascular disease; and airway obstruction).

The primary reason for PICU admission was divided into 9 categories: respiratory; neurological; cardiovascular; metabolic; trauma; oncological; post-operative (cardiac surgery); post-operative (other); and others.

Glasgow coma scale (GCS) score on PICU admission, presence of central venous access devices and gastrostomy at the time of tracheostomy, use of inotropes at the time of tracheostomy, presence of kyphoscoliosis, failure to thrive (FTT) at the time of tracheostomy, tracheostomy-related complications, and mortality.

Tracheostomy-related complications were classified as early (within 1–7 days) or late (> 7 days). FTT was defined as a body weight less than the 3rd percentile for age. The duration of the hospital and PICU stay and time from the procedure to discharge were calculated.

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.

Bedside Tracheostomy

Before the procedure, the patient's caregivers were informed about the necessity, safety, and potential complications of tracheostomy. Bedside tracheostomies were performed by the surgical team with the assistance of intensivists for sedation and paralysis. The patient's airway was secured with an endotracheal tube, and the neck was positioned for optimal exposure. Standard sterile techniques were followed, and local anesthesia was avoided to maintain clear anatomical landmarks.

Decannulation was considered once the patient was hemodynamically stable, off oxygen and inotropes. Laryngoscopy was used only if decannulation was difficult. The frequency of tracheostomy tube downsizing depended on the patient's age and the initial tube size. During the procedure, vital signs were closely monitored. Patients remained in the PICU until they were stable and then transferred to the general ward. Caregivers receive training on tracheostomy care before discharge. Post-discharge follow-up appointments were scheduled with pediatric and otolaryngology departments for regular monitoring and assessment.

Outcomes of the study

The outcomes of the current study encompassed the length of PICU stay, length of hospital stay, time from tracheostomy to discharge, complications thought to be associated with the procedure itself, and Mortality rate after tracheostomy.

Ethics approval and consent to participate.

Parental and caregiver participants who chose to take part in the experiment were provided with information regarding the benefits and potential hazards. Upon obtaining clearance from the local ethics committee, they proceeded to sign an informed consent form. All procedures were carried out following the 1964 Declaration of Helsinki and its later revisions, including the ethical principles set by national and institutional research committees and comparable norms. The study protocol received approval from the ethical committee of Al Azhar University Hospitals (RESERACH/AZ.AST./9/210/12/2024).

Sample size estimation

A cluster sample size was estimated based on the number of pediatric patients who underwent tracheostomy and were admitted to the PICU at Al Azhar University Hospitals from April 2022 to October 2024.

Statistical analysis

A statistical analysis was conducted on the tabulated results using Microsoft Excel 2019 and SPSS v. 25 (SPSS Inc., Chicago, IL, USA). Statistical measures of relative frequency are employed to represent categorical variables, including the independent t-test (t), Mann-Whitney U test (U), and the Chi-square test (Fisher or Monte Carlo), COX-regression analysis and Kaplan–Meier survival analysis to estimate means and medians of survival times. The statistical significance level is defined as $p<0.05$.

Results

In our study, Figure 1 depicts a flowchart of 89 pediatric patients who underwent tracheostomy. 11 patients were excluded from the research because did not complete their files. Out of the 78 pediatric patients who were allocated in the current retrospective study, **(Figure 1).**

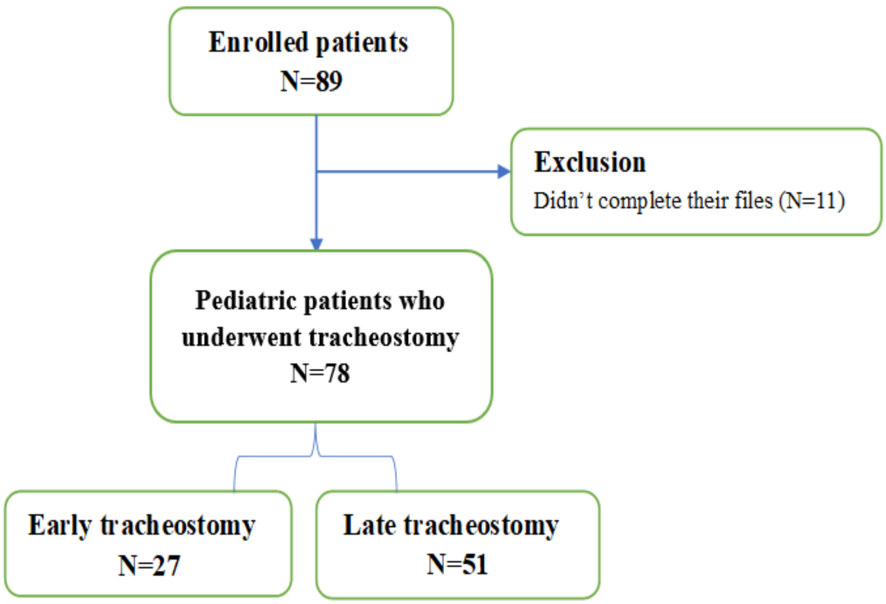

Figure 1. Flowchart of the studied pediatric patients.

In our study, a total of 78 patients were included in this study, 27 of the patients had an early tracheostomy and 51 patients had a late tracheostomy, there was no significant difference among them regarding age, weight, and sex ($P\geq0.05$), **(Table 1).**

Variable	Tracheostomy		*Significant test*	
	Early (n=27)	Late (n=51)	*t*	*P-value*
Age at tracheostomy Mean ± SD	6.39±3.69	7.06±1.52	0.903	0.373
Weight at tracheostomy Mean ± SD	14.12±5.16	14.65± 2.83	0.494	0.624
Sex, n (%) Male Female	14(51.85%) 13(48.15%)	31(60.78%) 20(39.22%)	X^2= 0.577	0.447

Independent t-test (t), Chi-square test (X^2)

Table 1: Demographic data among patients with early and late tracheostomy.

In our study, GCS score at PICU admission, Prolonged mechanical ventilation, MV before tracheostomy, airway obstruction, gastrostomy, kyphoscoliosis, failure to thrive, central venous access and inotrope use showed no significant difference among patients with early and late tracheostomy ($P\geq0.05$), while MV duration before tracheostomy was significantly higher among patients with early tracheostomy (14.37±4.76), than late. **(Table 2).**

Variables	Tracheostomy		Significant test	
	Early (n=27) Mean ± SD	Late (n=51)	t	P-value
GCS score at PICU admission	9.89 ±2.75	9.87± 1.17	Z=0.03	0.974
MV duration before tracheostomy/day	14.37±4.76	11.9± 2.38	2.530	0.016*
Prolonged mechanical ventilation	22 (81%)	41 (80%)	0.01	0.91
MV before tracheostomy	23 (85%)	47 (92%)	0.93	0.33
Airway obstruction	2 (7%)	5 (10%)	FE=0.12	0.73
Gastrostomy	9 (33%)	18 (35%)	0.03	0.86
Kyphoscoliosis	16 (59%)	22 (43%)	1.84	0.18
Failure to thrive	9 (33%)	22 (43%)	0.71	0.40
Central venous access	18 (67%)	39 (76%)	0.86	0.35
Inotrope use	7 (26%)	17 (33%)	0.46	0.50

*FTT, failure to thrive; GCS, MV, mechanical ventilation, Glasgow Coma Scale; PICU, pediatric intensive care unit, Chi-square test (X^2), Fisher exact test (FE), *Significant, Independent t-test (t), Chi-square test (X^2), *Significant*

Table 2. Tracheostomy indications among patients with early and late tracheostomy.

In our study, the time from tracheostomy to discharge/day was significantly lower among patients with early tracheostomy (25.72± 7.45) than late, and the number of tracheostomy-related complications was more common among patients with late tracheostomy (94%) than early. Meanwhile, the PICU stay/day, and hospital stay/day, showed no significant difference among patients with early and late tracheostomy (P≥0.05), **(Table 3).**

Variables	Tracheostomy		Significant test	
	Early (n=27) Mean ± SD	Late (n=51) Mean ± SD	t	P-value
Time from tracheostomy to discharge/day	19.97± 3.14	25.72± 7.45	3.833	**0.001***
PICU stay/day	30.4 ±2.38	38.95 ±43.55	1.019	0.318
Hospital stay/day	38.13± 7.65	40.28± 3.51	-1.382	0.177
Number of tracheostomy-related complications	9 (33%)	48 (94%)	X^2=33.15	**0.001***

*FPICU, pediatric intensive care unit, Chi-square test (X^2), *Significant, Independent t-test (t), Chi-square test (X^2), *Significant*

Table 3. Mortality outcomes among patients with early and late tracheostomy.

In the current study, mortality rates after tracheostomy were found in 27 patients (34.62%), 9 patients with early tracheostomy (33.33%), and 18 patients with late tracheostomy (66.67%), with p-value 0.86, **(Figure 2).**

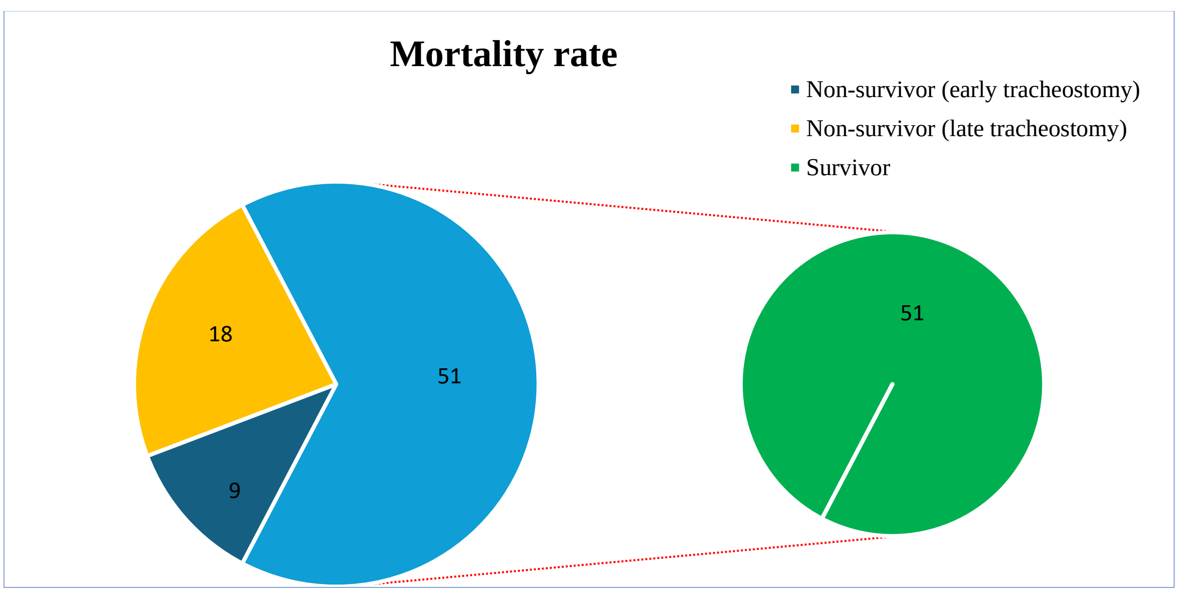

Figure 2. Mortality rate distribution among the studied pediatric patients.

In our study, a total of 78 patients were included in this study, 27 of the patients had an early tracheostomy and 51 patients had a late tracheostomy, there was no significant relation between mortality after tracheostomy regarding age, weight, and sex (P≥0.05), **(Table 4).**

Early Tracheostomy (n=27)	**Mortality after tracheostomy**		***Significant test***	
	Yes	**No**	**t**	***P-value***
Age at tracheostomy, Mean ± SD	6.38±3.90	6.40±3.70	-.011	.992
Weight at tracheostomy, Mean ± SD	16.21±5.54	13.07±4.77	1.44	.169
Sex Male Female	 5(55.56%) 4(44.44%)	 9 (50.00%) 9 (50.00%)	0.07	.785
Late Tracheostomy (n=51)				
Age at tracheostomy, Mean ± SD.	7.02±1.54	7.09±1.54	-.0-.16	.870
Weight at tracheostomy, Mean ± SD.	14.62±3.07	14.66±2.75	-.053	.958
Sex Male Female	 11(61.11%) 7 (38.89%)	 20 (60.61%) 13 (39.39%)	.001	.972

Table 4. Mortality after tracheostomy concerning demographic data.

In our study, GCS score at PICU admission ,MV duration before tracheostomy/day, prolonged mechanical ventilation, MV before tracheostomy, airway obstruction, gastrostomy, kyphoscoliosis, failure to thrive, central venous access and Inotrope use ware showed no significant relation with mortality after tracheostomy. (**Table 5).**

Early Tracheostomy (n=27)	**Mortality after tracheostomy**		***Significant test***	
	Yes	**No**	**t**	***P-value***
GCS score at PICU admission	9.70±3.20	9.99±2.59	-.240	.814
MV duration before tracheostomy/day	13.31±4.21	14.91±5.04	-.870	.395
Prolonged mechanical ventilation	7 (77.78)	15 (83.33%)	0.12	0.73
MV before tracheostomy	8 (88.89)	15 (83.33%)	0.15	0.70
Airway obstruction	0 (0.00%)	2 (11.11%)	*FE*=1.08	0.30
Gastrostomy	2 (22.22%)	7 (38.89%)	*FE*=0.75	0.39
Kyphoscoliosis	4 (44.44%)	12 (66.67%)	*FE*=1.23	0.27
Failure to thrive	5 (55.55%)	4 (22.22%)	*FE*=3.00	0.08
Central venous access	5 (55.55%)	13 (72.22%)	0.75	0.39
Inotrope use	3 (33.33%)	4 (22.22%)	*FE*=0.39	0.54
Late Tracheostomy (n=27)				
GCS score at PICU admission	10.05±1.30	9.78±1.11	.766	.447
MV duration before tracheostomy/day	12.04±2.19	11.83±2.51	.295	.769
Prolonged mechanical ventilation	15 (83.33%)	26 (78.79%)	.15	.696
MV before tracheostomy	18 (100.00%)	29 (87.88%)	2.36	.124
Airway obstruction	3 (16.67%)	2 (6.06%)	*FE*=1.48	.224
Gastrostomy	5 (27.78%)	13 (39.39%)	.68	.407
Kyphoscoliosis	11 (61.11%)	11(33.33%)	3.66	.056
Failure to thrive	8 (44.44%)	14 (42.42%)	.019	.889
Central venous access	12 (66.67%)	27 (81.82%)	1.48	.223
Inotrope use	6 (33.33%)	11 (33.33%)	.000	1.00

Table 5. Mortality after tracheostomy concerning Tracheostomy indications.

In our study, time from tracheostomy to discharge/day, PICU stay/day, hospital stay/day, and number of tracheostomy-related complications ware showed no significant relation with mortality after tracheostomy **(Table 6).**

Early Tracheostomy (n=27)	Mortality after tracheostomy		Significant test	
	Yes	No	t	*P-value*
Time from tracheostomy to discharge/day	23.30±8.01	26.93±7.07	1.156	.266
PICU stay/day	44.80±52.69	27.26±5.61	11.397	**.018***
Hospital stay/day	39.86±7.91	34.68±6.08	1.883	.074
Number of tracheostomy-related complications	2 (22.22%)	7 (38.89%)	0.75	0.39
Late Tracheostomy (n=27)				
Time from tracheostomy to discharge/day	20.71±3.27	19.57±3.05	1.22	.225
PICU stay/day	29.82±2.13	30.72±2.49	1.29	.202
Hospital stay/day	40.98±3.30	39.90±3.61	1.05	.297
Number of tracheostomy-related complications	16 (88.89%)	32 (96.97%)	1.37	.241

Table 6. Mortality after tracheostomy concerning outcomes of the study.

In the current study, Cox-regression analysis indicated that the most significant independent factors associated with high risk were age at tracheostomy, GCS score at PICU admission, central venous access, airway obstruction duration before tracheostomy, and PICU stay (p<0.05), **(Table 7).**

	B	SE	Wald	Sig.	Exp(B)	95.0% CI for Exp(B)	
						Lower	Upper
Age at tracheostomy	-.158	.066	5.789	.016*	.854	.751	.971
Sex	.483	.289	2.805	.094	1.622	.921	2.856
Weight at tracheostomy	.041	.039	1.086	.297	1.042	.965	1.125
Gastrostomy	-.353	.284	1.551	.213	.702	.403	1.225
Kyphoscoliosis	-.233	.281	.686	.407	.792	.457	1.374
GCS score at PICU admission	-.206	.095	4.661	.031*	.814	.675	.981
FTT	.125	.265	.223	.637	1.133	.674	1.905
Central venous access	.866	.411	4.449	.035*	2.377	1.063	5.316
Inotrope use	-.248	.290	.736	.391	.780	.442	1.376
Prolonged mechanical ventilation	-.161	.388	.172	.679	.852	.398	1.822
MV before tracheostomy	.652	.457	2.034	.154	1.919	.784	4.700
Airway obstruction	1.126	.569	3.920	.048*	3.084	1.011	9.403
MV duration before tracheostomy	-.103	.046	5.139	.023*	.902	.825	.986
Time from tracheostomy to discharge	-.021	.037	.333	.564	.979	.911	1.052
Number of tracheostomy-related complications	-.027	.379	.005	.943	.973	.463	2.048
PICU stay	.014	.006	5.255	.022*	1.014	1.002	1.025

Table 7. Cox-regression analysis of pre-tracheostomy factors associated with hazard rate.

Based on Kaplan-Meier curves analysis, the estimation of mean survivor rate based on the time from tracheostomy to discharge in patients who underwent tracheostomy was significantly higher among pediatric patients with early tracheostomy compared to those patients with late tracheostomy (*log-rank test*=21.548, *Wilcoxon=10.279, Tarone-Ware=15.117,* P≤0.001), **(Table 8, Figure 3).**

Tracheostomy	**Mean**				**Median**			
	Estimate	Std. Error	95%CI		Estimate	Std. Error	95% CI	
			Lower Bound	Upper Bound			Lower Bound	Upper Bound
Early	25.726	1.434	22.916	28.536	25.100	2.769	19.672	30.528
Late	19.976	.441	19.112	20.841	19.800	.765	18.301	21.299
Overall	21.967	.648	20.696	23.237	21.000	.662	19.702	22.298
				Chi-square (X^2)		*P value*		
Log Rank (Mantel-Cox)				21.548		.0001*		
Breslow (Generalized Wilcoxon)				10.279		.001*		
Tarone-Ware				15.117		.0001*		

OR: Odds ratio, CI: confidence intervals, X^2: Chi-square test, *Significant

Table 8. Estimate means and medians of survival times using Kaplan–Meier survival analysis among the studied groups.

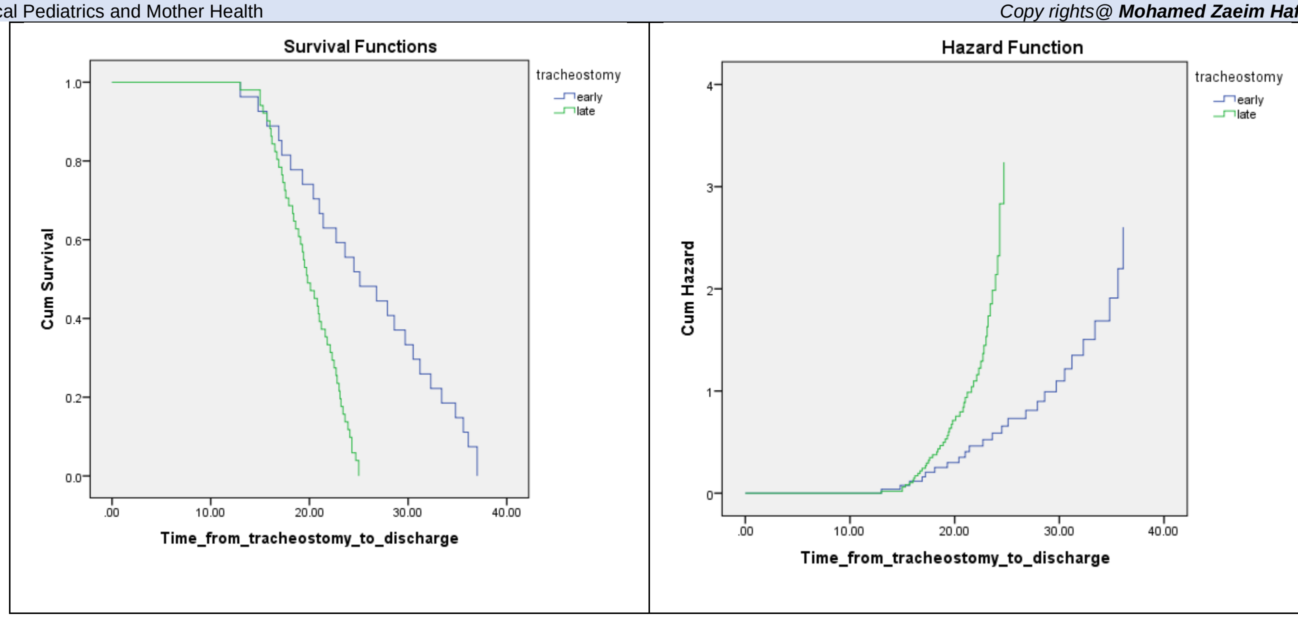

Figure 3. The survival function of intubation time using Kaplan–Meier analysis among the studied pediatric patients.

Discussion

One of the most common surgical procedures in the pediatric intensive care unit these days is tracheostomy. In the past fifty years, sustained mechanical breathing has replaced acute inflammatory airway blockages as the reason for tracheostomy. New immunizations and advancements in pediatric and newborn critical care are to blame for this shift **(Wetmore et al. 1992, Kremer et al. 2002, Ang et al. 2005, Özmen et al. 2009, Dal'Astra et al. 2017, Jain et al. 2021).** Tracheostomy rates in the juvenile population ranged from 1.5 to 8.5%, with timing ranging from 4 to 32 days **(Principi et al. 2008, Wakeham et al. 2014, Can et al. 2018).**

It is unclear when tracheostomies are the best option for people who are very sick. To evaluate the mortality risk following bedside tracheostomy in a pediatric intensive care unit, the current retrospective study included 78 pediatric patients who were admitted to the PICU at Al Azhar University Hospitals between April 2022 and October 2024 and who had a tracheostomy while bedridden at the time of the procedure.

In our study, a total of 78 patients were included in this study, 27 of the patients had an early tracheostomy and 51 patients had a late tracheostomy, there was no significant difference among them regarding age, weight, and sex. In another study, age, gender, PIM3 score, necessity for a vasoactive medication, cause for PICU admission, and underlying disorders did not substantially differ between the early and late groups in the **Besci et al. (2023)** study. However, the early group had a considerably larger number of patients who had tracheostomies because of breathing disorders (p=0.004). The absence of demographic distinctions between the early and late tracheostomy groups emphasizes how clinical judgments about timing were unaffected by variables such as weight, sex, or age. This makes it possible to analyze clinical outcomes more precisely, which in turn can help inform evidence-based suggestions for the timing of tracheostomies.

In our study, GCS score at PICU admission, prolonged mechanical ventilation, mv before tracheostomy, airway obstruction, gastrostomy, kyphoscoliosis, failure to thrive, central venous access and inotrope use showed no significant difference among patients with early and late tracheostomy, while MV duration before tracheostomy was significantly higher among patients with early tracheostomy than late, which is similar to many recent studies **(Da Silva et al. 2005, Dursun and Ozel, 2011, Wood et al. 2012, Kamit Can et al. 2018).** In a study of 111 children who had tracheostomies, Douglas et al. (2015) discovered that the most frequent reason was extended mechanical breathing (32%), which was followed by a craniofacial abnormality that resulted in UAO (18%) and subglottic stenosis (14%). **Schweiger et al. (2017)** discovered that upper airway obstruction is the most frequent reason for tracheostomy, which is in contrast to the current study. UAO also explains the majority of tracheostomies, according to a 2007 study by Mahadevan et al. from New Zealand.

A recent study found no statistically significant difference in tracheostomy indications between the early and late groups (Holloway et al. 2015). This finding implies that to prevent tracheostomy operation difficulties, our team waits longer for effective extubation in patients with primary lung tissue diseases. Early tracheostomy may be beneficial for children who are anticipated to need extended mechanical breathing to lower the risk of endotracheal intubation problems, such as vocal cord injury and tracheal stenosis (Besci et al., 2023).

In our study, the time from tracheostomy to discharge/day was significantly lower among patients with early tracheostomy than late. The number of tracheostomy-related complications was more common among patients with late tracheostomy (94%) than early, while PICU stay/day, hospital stay/day, and mortality after tracheostomy showed no significant difference among patients with early and late tracheostomy. According to some research, early tracheostomy might result in shorter hospital stays, but this is not always the case (Pizza et al. 2017). A quicker recovery from the underlying ailment or a lower chance of complications like VAP could be the cause of this. According to a different study by Kamit Can et al. (2018), the tracheostomy procedure is a reasonably safe intervention in the pediatric intensive care unit. The complication rate was 25.3% in the pediatric ICU and 11.1% at home, and no patients passed away from tracheostomy-related issues.

According to Mahadevan et al. (2007), 51% of patients experienced complications. According to a number of studies, early tracheostomy was linked to less days spent in the intensive care unit and hospital, as well as fewer days spent on a mechanical ventilator (Holloway et al. 2015, Lee et al. 2016, Alkhatip et al. 2020). Patients in the early group in the Besci et al. (2023) trial experienced 27.5 fewer ICU days overall and 4.5 fewer post-tracheostomy ICU days. Age, CLABSI, VAP, tracheostomy indication, and tracheostomy timing were among the characteristics we assessed that affected ICU length of stay (LOS); tracheostomy timing and VAP were independently associated with ICU LOS.

After controlling for other variables, children with at least one VAP diagnosis had 13.7 more ICU days, while the late tracheostomy group had 10 more. A number of studies have shown that early tracheostomy in PICU is associated with shorter duration of mechanical ventilation, shorter ICU and hospital stays, and a lower rate of ventilator-associated pneumonia (VAP) (Holloway et al. 2015, Lee et al. 2016, Pizza et al. 2017). These studies have defined early tracheostomy as occurring 10 to 14 days after tracheal intubation.

The current study indicated that 18 patients had late tracheostomy (66.67%), 9 patients had early tracheostomy (33.33%), and 27 patients had post-tracheostomy death rates (34.62%). The percentage of decannulation was 82%, according to a study by Sharma and Vinayak (2018). According to Carron et al. (2000), Ang et al. (2005), and Mahadevan et al. (2007), the mortality rate for tracheostomy patients is between 14 and 19 percent; in this study, it is 11.5%. According to Schweiger et al., 32% of patients died as a result of an underlying illness rather than tracheotomy (Schweiger et al. 2017). Besci and associates (2023) The VAP rate following tracheostomy, effective decannulation, and death did not differ statistically significantly between the early and late groups.

Both the overall ICU-LOS (17.5 vs. 45 days, $p<0.001$) and the post-tracheostomy ICU length of stay (LOS) (8.5 vs. 13 days, $p=0.041$) were shorter in the early group. Tracheostomy timing was independently linked to ICU-LOS after adjusting for age, tracheostomy indication, central line-associated bloodstream infection, and VAP. There was a 10.7-day increase in ICU-LOS due to late tracheostomy scheduling.

In the current study, Cox regression analysis indicated that the most significant independent factors associated with high risk were age at tracheostomy, GCS score at PICU admission, central venous access, airway obstruction duration before tracheostomy, and PICU stay. Multiple studies have shown that patients who undergo early tracheostomy have a significantly lower risk of developing VAP compared to those who have late tracheostomy. This is likely due to the decreased risk of infection associated with bypassing the upper airway and the improved ability to clear secretions with a tracheostomy tube. Early tracheostomy was linked to a decreased risk of VAP, according to a study by Pizza et al. (2017), however there was no discernible difference in mortality, decannulation rate, or length of hospital stay. Ananda and Sony (2022) conducted a systematic evaluation of 17 studies with over 3,000 patients and discovered that early tracheostomy, which was done within seven days after mechanical breathing, decreased the incidence of VAP by around 40% when compared to late tracheostomy, which was done after eight days or not at all. Without influencing mortality, early tracheostomy also led to more days without a ventilator and shorter ICU stays**.** By removing the endotracheal tube sooner, early tracheostomy reduces airway inflammation and pathogen colonization, which is a major factor in reducing the incidence of VAP (Li et al. 2020).

Based on the Kaplan-Meier curves analysis, the estimation of the mean survivor rate was significantly higher among pediatric patients with early tracheostomy compared to those patients with late tracheostomy. Some studies have found that early tracheostomy may be associated with a lower mortality rate, while others have not found a significant difference. The small number of patients in some research or the various groups they looked at could be the cause of this. Morris et al. (2024), for example, showed that pediatric patients who underwent tracheostomy during the first seven days of mechanical ventilation experienced a decreased incidence of ventilator-associated pneumonia (VAP) and a lower ICU death rate. Early intervention greatly improved outcomes for children with severe respiratory failure, according to Mehta and Kochar (2020). Higher survival rates are indirectly supported by early tracheostomy, which has been linked to shorter intensive care unit stays, lower risk of secondary infections, and better overall recovery. Particularly in young children with narrower airways, early tracheostomy might result in procedural hazards such as hemorrhage, unintentional decannulation, and tracheal stenosis. Smith et al. (2016) pointed out that in certain situations, the procedural hazards could outweigh any possible survival advantages. The definitions of "early" and "late" tracheostomies differ throughout studies, according to Cheng et al. (2019), making direct comparisons challenging. Early tracheostomy is defined by some research as occurring within 7 days, whereas others extend it to 14 days or longer, which may have an impact on results. According to Nyp et al. (2018), the advantages of early tracheostomy can be particularly noticeable in subgroups, such as patients with neuromuscular disorders or severe trauma. Finally, early tracheostomy increases pediatric patients' survival rates, most likely as a result of fewer problems and improved airway control. Nevertheless, there is still controversy in the literature, mostly because of differences in patient demographics, classifications, and study methodologies. Additional high-quality research is necessary to firmly establish the role of early tracheostomy in pediatric treatment.

Conclusions

One of the most common operations performed in the PICU these days is tracheostomy. Tracheostomy is becoming more often used as an elective procedure rather than an emergency. Prolonged mechanical ventilation was the most frequent reason for tracheostomy in this study. Death rates following tracheostomy were 34.62% for patients who had an early tracheostomy, 33.33% for those who had a late tracheostomy, and 66.67% for those who had a late tracheostomy. A pediatric intensive care unit can safely conduct tracheostomy at the patient's bedside, but careful patient selection is necessary.

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