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The Pediatric Tracheostomy Practice During COVID-19 Pandemic at a PICU

COVID-19 Pandemi Sürecinde Çocuk Yoğun Bakımda Pediyatrik Trakeostomi Deneyimi

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Abstract

Introduction: To evaluate pediatric tracheostomies performed at a tertiary care pediatric intensive care unit (PICU) before and after the Coronavirus disease-2019 (COVID-19) pandemic.

Methods: A total of 57 pediatric tracheostomy patients performed at a tertiary care PICU were included. Prognostic scores including pediatric risk of mortality 2, pediatric index of mortality 2 and pediatric logistic organ dysfunction scores, the family education process and time to home discharge were evaluated according to time of tracheostomy (pre-pandemic vs. after pandemic) and responsible surgeon (pediatric surgeon vs. otolaryngologist). MedCalc® Statistical Software version 19.7.2 (MedCalc Software Ltd, Ostend, Belgium; https: //www.medcalc.org; 2021) was used for statistical analysis.

Results: A non-significant tendency for higher rate of pediatric surgery-based tracheostomies was noted after the pandemic (76.0 vs. 24.0%, p=0.134). No significant difference was noted between tracheostomies performed before vs. after the COVID-19 pandemic and those performed by otolaryngologists vs. pediatric surgeons in terms of prognostic scores and time to home discharge.

Conclusion: Our findings emphasize the maintenance of high quality patient care for pediatric tracheostomy patients in accordance with standardized tracheostomy protocols and policies during the pandemic period with no significant difference between tracheostomies performed before and after the COVID-19 pandemic and those performed by pediatric surgeons vs. otolaryngologists in terms of prognostic scores and time to home discharge.

Keywords: Pediatric tracheostomy, pediatric surgeons, otolaryngologists, PICU, COVID-19

Öz

Giriş: Koronavirüs hastalığı-2019 (COVID-19) pandemisi öncesi ve sonrası çocuk yoğun bakım (ÇYB) ünitesinde trakeostomi durumunu değerlendirmek amaçlandı.

Yöntemler: Üçüncü basamak ÇYB ünitesindeki toplam 57 çocuk trakeostomili hasta geriye dönük olarak değerlendirildi. Çocuk mortalite riski 2, çocuk mortalite indeksi ve çocuk lojistik organ disfonksiyonu skorlarını içeren prognostik skorlar, trakeostomi açılma endikasyonları, aile eğitimi süreci, eve taburcu edilme süreçleri ve trakeostomiyi uygulayan sorumlu cerrahın taburculuk sürecine etkileri değerlendirildi. İstatistik analiz için MedCalc® Statistical Software version 19.7.2 (MedCalc Software Ltd, Ostend, Belgium; https: //www.medcalc.org; 2021) kullanıldı.

Bulgular: Kurumumuzda pandemi sürecinde pediyatrik cerrahların trakeostomi açma eğilimi daha yüksek oranda; ancak anlamlı olmayan bir eğilim göstermiştir (76,0 vs %24,0, p=0,134). COVID-19 pandemisinden önce ve sonra; otolaringologlar ve pediyatrik cerrahlar tarafından uygulanan trakeostomiler arasında prognostik skorlar, eve taburcu olma süreleri açısından istatistiksel anlamlı fark bulunamadı. İstatistiksel anlamlı olmamakla birlikte pandemi sürecinde hastaların ebeveynlerinin (tek kişi eğitimi tercih edildi) eğitim süreleri ve hastaların eve verilme süreçleri daha kısa olarak saptandı.

Sonuç: Bulgularımız, pandemi koşullarına rağmen çocuk trakeostomi hastaları için standart protokollere uygun, ebeveyn eğitimi için izole alan eğitimine uygun, yüksek kaliteli hasta bakımının; COVID-19 pandemisinden önce ve sonra, otolaringolog ve pediyatrik cerrahlar tarafından açılan trakeostomiler arasında prognostik skorlar, eve verilme süreleri arasında anlamlı fark olmaksızın sürdürülebildiğini vurgulamaktadır.

Anahtar Kelimeler: Pediyatrik trakeostomi, pediatrik cerrahi, otolaringolog, ÇYB, COVID-19

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Introduction

The coronavirus disease-2019 (COVID-19), has become a rapidly spreading pandemic associated with increasing burden on the healthcare system and a drastic change in healthcare delivery since its first emergence in Wuhan, China, at the end of 2019.[1,2]

Most health workers have deviated toward COVID care delivery along with postponing of elective and non-essential services, while the otolaryngology surgical volume of tracheostomy has considerably increased given the prolonged intubation need among adult COVID-19 patients with severe acute respiratory distress syndrome (ARDS).[3-6]

Along with significant changes in the management of critically ill children and consideration of prolonged mechanical ventilation (MV) as the primary indication for tracheostomy, tracheostomy has become an increasingly performed procedure in pediatric patients as an important option for earlier transition of children from the pediatric intensive care unit (PICU) and earlier home discharge.[7-10]

This seems notable given that tracheostomy, similar to several procedures in the otolaryngology practice, is an aerosol generating procedure that poses a high risk of exposure to COVID-19, while in the pediatric otolaryngology practice another difficulty is the examining and operating within a potentially asymptomatic population affected by COVID-19.[5,6,11-13]

Hence, in addition to ongoing controversies regarding the optimal timing, technique and home care for pediatric tracheostomy in routine PICU clinical practice,[9,10] management of patients with tracheostomy in COVID-19 pandemic is also considered challenging in terms of continued provision of quality of care in the presence of patient-specific factors, transmission risks and clinical environment.[13]

During the pandemic, pediatric COVID-19 patients were accepted to our PICU and 2 of 8 beds served these patients. No change occurred in the number of beds and adult COVID-19 patients were not accepted at out PICU during the pandemic, while family visitation was limited to specified cases and elective surgeries were delayed as per the standard policy of the institution. Besides, in our hospital, pediatric tracheostomies are performed not only by the otolaryngologists but also by the pediatric surgeons. Hence, given the likelihood of prolonged PICU stay and increase in related complications in patients with tracheostomy indication due to postponing of elective surgeries in pandemic conditions in our hospital, this study presented our clinical experience with pediatric tracheostomies performed at a tertiary care PICU within a 2-year period extending from 2018 to early outbreak period in 2020 and to evaluate potential changes in tracheostomy patient care before and after the COVID-19 pandemic.

Materials and Methods

Study population

A total of 57 pediatric tracheostomies (mean age: 66.5, ranged 2 to 204 months, 66.7% were boys) performed at a tertiary care PICU between May 2018 and May 2020 were included in this retrospective study. The tracheostomies were divided into two groups based on the time of intervention, including pre-pandemic (n=32) and after-pandemic (n=25) tracheostomies.

The study was conducted in accordance with the ethical principles stated in the "Declaration of Helsinki" and approved by the Celal Bayar University Faculty of Medicine Health Sciences Ethics Committee along with the permission for the use of patient data for publication purposes (date of approval: 10/02/2021 reference number/protocol no: 20.478.486/748).

Assessments

Data on patient demographics, primary diagnosis, presence of chronic disease, responsible surgeon (pediatric surgeon, otolaryngologist), prognostic scores including Pediatric Risk of Mortality 2 (PRISM 2), the pediatric index of mortality 2 (PIM 2) and pediatric logistic organ dysfunction (PELOD) scores, duration of family education and time to home discharge from tracheostomy were recorded in each patient. Study parameters were evaluated according to the time of tracheostomy (pre-pandemic vs. after pandemic) and responsible surgeon (pediatric surgeon vs. otolaryngologist).

Tracheostomy indications and the timing of tracheostomy were determined by the treating PICU physician and the surgeon. After confirmation of COVID-19 negativity via two successive real-time reverse transcription-polymerase chain reaction (RT-PCR) analyses, all tracheostomies were performed electively under general anesthesia using the same surgical procedure by the same group of otolaryngologists/pediatric surgeons.

All patients were cases with failed extubation before tracheostomy and were discharged home with long-term ventilator. The parents and/or formal caregivers of patients were educated prior to home discharge of the patient about the stoma care, suctioning, changing the tracheostomy tube, the equipment required for emergency situations, and routine care.

Statistical Analysis

Statistical analysis was made using MedCalc® Statistical Software version 19.7.2 (MedCalc Software Ltd, Ostend,

Belgium; https://www.medcalc.org; 2021). Chi-square test and Yates Continuity Correction were used for analysis of categorical data, while Mann-Whitney U test was used for analysis of the parametric variables. Data were expressed as mean (standard deviation), median (minimum-maximum) and percent (%) where appropriate. P<0.05 was considered statistically significant.

Results

Baseline characteristics

Overall, mean patient age was 66.5 months (range, 2 to 204 months) and 66.7% of patients were boys. Primary diagnosis was neurological disease in 61.4% of patients, and chronic disease was evident in 78.9% (Table 1).

No significant difference was noted between pre-pandemic and post-pandemic tracheostomy patients in terms of age, primary diagnosis or presence of chronic disease (Table 1).

Tracheostomy indications and the responsible surgeon

The prolonged MV was the major tracheostomy indication overall (89.5%) and in both pre-pandemic (87.5%) and post-pandemic (92.0%) operations, being related to neurological problems in most of patients (42.9% overall, 40.6% pre-pandemic and 44.0% after pandemic) (Table 1).

Tracheostomies were performed by pediatric surgeons in 63.2% of cases and by otolaryngologists in 36.8%. Although not statistically significant, a tendency for higher rate of pediatric surgery-based tracheostomies was noted after the pandemic (76.0 vs. 24.0%, p=0.134) (Table 1).

Prognostic scores, timing of tracheostomy, family education and home discharge

Overall, the median PRISM 2, PIM 2 and PELOD scores were 16.0 (range, 3 to 41), 36.0 (range, 4 to 93) and 12.0 (range, 2 to 46), respectively. Median duration of tracheostomy timing was 30 days (range, 0 to 300) before pandemic and 35 days (range, 12 to 150) after pandemic period. Median duration of family education was 7 days (range, 4 to 25) and time to home discharge was 61 days (range, 19 to 362 days) (Table 2).

No significant difference was noted between tracheostomies performed before and after pandemic in terms of prognostic scores and time to home discharge, while the duration of family education was significantly shorter in tracheostomies performed after pandemic than in those performed before the pandemic (median 6 vs. 8 days, p=0.007) (Table 2, Figure 1).

Prognostic scores, and home discharge according to the responsible surgeon

No significant difference was noted between tracheostomies performed by otolaryngologists vs. pediatric surgeons in terms of prognostic scores, length of PICU stay (before and after tracheostomy) and time to home discharge (Table 3, Figure 2).

Table 1. Baseline characteristics, tracheostomy indications and the responsible surgeon

		Total (n=57)	Pre-pandemic (n=32)	After-pandemic (n=25)
Age (year)	Mean (SD)	66.5 (68.8)	74.4 (69.7)	56.5 (67.6)
	Median (min-max)	36 (2-204)	48 (2-204)	24 (3-204)
Primary diagnosis, n (%)				
Neurological disease		35 (61.4)	17 (53.1)	18 (72.0)
Respiratory disease		12 (21.1)	8 (25.0)	4 (16.0)
Trauma		5 (8.8)	3 (9.4)	2 (8.0)
Cardiovascular disease		3 (5.3)	3 (9.4)	0 (0.0)
Infection		2 (3.5)	1 (3.1)	1 (4.0)
Chronic disease, n (%)				
Yes		45 (78.9)	25 (43.9)	20 (35.0)
No		12 (21.1)	7 (12.2)	5 (8.9)
Tracheostomy indication, n (%)				
Prolonged MV		51 (89.5)	28 (87.5)	23 (92.0)
Neurological problems		24 (42.9)	13 (40.6)	11 (44.0)
Neuromuscular problems		16 (28.6)	7 (21.9)	9 (36.0)
Pulmonary problems		11 (19.6)	8 (25.0)	3 (12.0)
Upper airway obstruction		6 (10.5)	4 (12.5)	2 (8.0)
Responsible surgeon, n (%)				
Pediatric surgeon		36 (63.2)	17 (53.1)	19 (76.0)*
Otolaryngologist		21 (36.8)	15 (46.9)	6 (24.0)

MV: Mechanical ventilation, SD: Standard deviation, Yates Continuity correction, *p=0.134

Table 2. Prognostic scores, timing of tracheostomy, family education and home discharge according to time of tracheostomy

		Total (n=57)	Pre-pandemic (n=32)	After-pandemic (n=25)	p
PRISM 2	Mean (SD)	18.2 (10.1)	18.7 (9.7)	17.5 (10.8)	0.606
	Median (min-max)	16.0 (3-41)	18.0 (5-41)	13.0 (3-39)	
PIM 2	Mean (SD)	38.4 (24.7)	35.1 (26.1)	42.6 (22.8)	0.145
	Median (min-max)	36.0 (4-93)	33 (4-93)	40.0 (10-88)	
PELOD	Mean (SD)	16.6 (12.1)	16.7 (13.8)	16.4 (9.6)	0.591
	Median (min-max)	12.0 (2-46)	11.0 (2-46)	20 (2-33)	
Timing of tracheostomy (day)	Mean (SD) Median (min-max)	43.0 (44.1) 31 (0-300)	44.7 (53.4) 30 (0-300)	40.8 (29.1) 35 (12-150)	0.742
Duration of family education (day)	Mean (SD)	8.5 (4.7)	10.2 (5.5)	6.3 (2.2)	0.007
	Median (min-max)	7.0 (3-25)	8.0 (4-25)	6.0 (3-10)	
Time to home discharge (day)	Mean (SD)	85.3 (74.8)	90.3 (77.3)	79.0 (73.1)	0.769
	Median (min-max)	61.0 (19-362)	52.5 (20-320)	67.0 (19-362)	

PRISM 2: Pediatric risk of mortality 2, SD: Standard deviation, PIM 2: Pediatric index of mortality 2, PELOD: Pediatric logistic organ dysfunction, Mann-Whitney U test

Discussion

Our findings regarding the 2-year experience of pediatric tracheostomies in a tertiary care PICU revealed that most of tracheostomies were performed due to prolonged MV related to neurological problems and were performed by pediatric surgeons rather than otolaryngologist, particularly during the pandemic period. A shorter duration of family education was noted in tracheostomies performed in the post-pandemic vs. pre-pandemic period. During the pre-post pandemic, caregivers of the patients with tracheostomy were educated by the pediatric intensive care nurse and the responsible physician. No significant difference was noted between the tracheostomies performed before vs. after pandemic or by pediatric surgeon vs. otolaryngologist in terms of prognostic scores or time to home discharge.

During COVID-19 pandemic, early tracheostomy to wean intubation in certain patients with severe ARDS and thus to allow them to be transferred to a ventilatory weaning unit has become a strategy adopted by many ICUs, to free up all possible ICU beds for new patients.[3-5]

Notably, in a past study on the impact of the COVID-19 pandemic on the surgical volume of otolaryngology

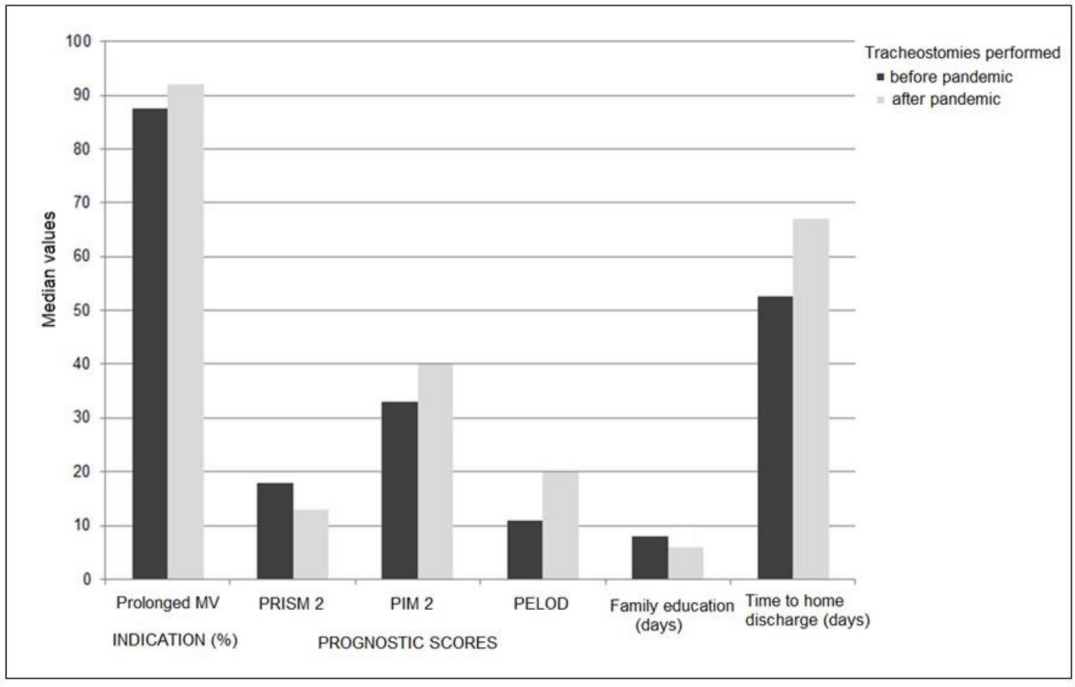

Figure 1. Comparison of tracheostomies performed before vs. after the COVID-19 pandemic
COVID-19: Coronavirus disease-2019, MV: Mechanical ventilation, PRISM 2: Pediatric risk of mortality 2, PIM 2: Pediatric index of mortality 2, PELOD: Pediatric logistic organ dysfunction

Table 3. Prognostic scores, length of PICU stay and home discharge according to responsible surgeon

	Total (n=57)	Responsible surgeon		
		Pediatric surgeon (n=36)	Otolaryngologist (n=21)	p
Prognostic scores, median (min-max)				
PRISM 2	16.0 (3-41)	18.0 (3-39)	13.0 (5-41)	0.188
PIM 2	36.0 (4-93)	41.0 (6.5-93)	29.0 (4-89)	0.132
PELOD	12.0 (2-46)	12.0 (2-46)	12.0 (2-42)	0.431
Length of PICU stay (day), median (min-max)				
Before tracheostomy	31 (0-300)	29 (0-150)	35 (10-300)	0.085
After tracheostomy	23 (2-670)	29.5 (2-670)	22 (8-90)	0.456
Time to home discharge (day), median (min-max)	61 (19-362)	56 (19-362)	64 (20-320)	0.535

PRISM 2: Pediatric risk of mortality 2, PIM 2: Pediatric index of mortality 2, PELOD: Pediatric logistic organ dysfunction, PICU: Pediatric intensive care unit, Mann-Whitney U test

departments in France, the authors reported that while the number of functional otolaryngology surgeries decreased by 84% during the first month of the COVID-19 epidemic, the number of planned tracheostomies increased.[5] Hence, the decrease in the pediatric tracheostomies performed by otolaryngologists in our hospital during COVID-19 pandemic may be explained by the increased otolaryngology surgical volume of tracheostomy for adult COVID-19 patients, given that patients with COVID-19-related ARDS may require prolonged intubation, justifying tracheostomy and otolaryngologists were logically asked to perform this procedure.[5,14]

In this regard, our findings emphasize the likelihood of an increased participation of pediatric surgeons in implementation of pediatric tracheostomies during the COVID-19 pandemic in our hospital to enable the continued routine tracheostomy care with no delay or deviation from the standard protocol during the pandemic period. Also, there were no significant differences in prognostic scores, length of PICU stay and time to home discharge in pediatric tracheostomies performed before vs. after pandemic or by pediatric surgeons vs. otolaryngologists.

Hence, our findings indicate a favorable outcome in pediatric tracheostomy interventions performed during the pandemic conditions, indicating a maintained provision of high-quality healthcare delivery to non-COVID patients. This seems notable given that in a past study regarding the experience of a surgeon at the emergency department during COVID-19 pandemic, the authors indicated a worrying change in indications of tracheostomies performed during the pandemic (i.e., chronic suppurative otitis media and retropharyngeal abscess) which were preventable in normal circumstances.[6]

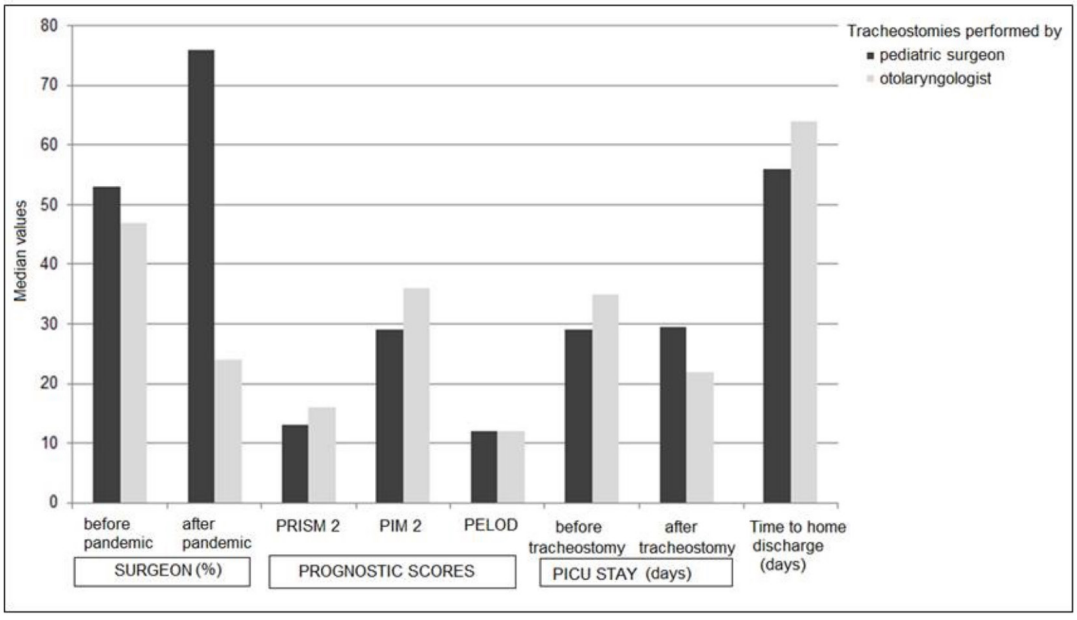

Figure 2. Comparison of tracheostomies performed by pediatric surgeons vs. otolaryngologists
PRISM 2: Pediatric risk of mortality 2, PIM 2: Pediatric index of mortality 2, PELOD: Pediatric logistic organ dysfunction, PICU: Pediatric intensive care unit

Notably, in a study providing data on a South African tertiary center experience on COVID-19 and pediatric lung disease as of September 2020, the authors reported that while the children with tracheostomies are generally considered to be at increased risk of lower respiratory tract infections, severe COVID-19 was not observed in their patient cohort.[15] The authors also noted that pandemic-related limitations in caregiver support as well as hospital regulations restricting the movement of caregivers in and out of hospital have had significant impact on family dynamics, especially in families with children who required prolonged hospitalization for training in tracheostomy care.[15] In this regard, it should be noted that the only difference between tracheostomies performed before and after pandemic period in the current study was a shorter course of patient education provided by the pediatric surgeons after the COVID-19 pandemic. Indeed, family involvement and broad staff education are considered amongst the key factors in improving the quality of care for pediatric tracheostomy patients in addition to contribution of multidisciplinary tracheostomy care teams and the use of standardized tracheostomy protocols and policies.[7]

Owing to the growing increase in the number of pediatric patients with chronic diseases who require prolonged ventilator assistance for survival and PICU discharge, prolonged MV has become the main indication for tracheostomy.[9,16-18] Accordingly, our findings support the data from previous studies indicated long-term ventilation as the most common indication for pediatric tracheostomy (range 20-61%), followed by subglottic stenosis (range 14-36.8%).[9,17-21]

When compared to our previous study regarding the retrospective review of pediatric tracheostomies from 2008 to 2014[9] findings in the current study period (2018-2020) revealed that the most common indication for tracheostomy continued to be the prolonged MV (85.7% in 2008-2014 period, 89.5% in the current study) due to neurologic, neuromuscular, muscular, or respiratory problems. Nonetheless, when compared to our earlier study[9] the current findings revealed higher PRISM 2 scores on admission (median 13.2 vs. 18.0) and a shorter PICU stay after tracheostomy (median 37 days vs. 23 days) along with similar rate of chronic diseases (81.0 vs. 78.9%) and similar duration of PICU stay before tracheostomy (median 32 days vs. 31 days).

The median duration of PICU stay in our study was also similar to other studies reported from Turkey.[22,23] Although the right time for tracheostomy in infants and children requiring long-term respiratory support is still controversial, most of the studies revealed the median duration of ventilation before pediatric tracheostomy to range from 4.3 to 30.4 days[7,16,24,25] while median time periods of up to 3 months before tracheostomy have also been reported.[26] Indeed, the potential benefits of early tracheostomy after 2 weeks of intubation in a child who is stable on the ventilator has been suggested, given the association of a longer duration of ventilation before tracheostomy with increased ICU morbidities and longer ICU stay.[7]

While the COVID-19 was ruled out via two successive PCR analyses before tracheostomy in our patients, given that examinations and interventions in the pediatric otolaryngology practice occur in anatomical locations with high possibility of aerosol generation and also in a potentially asymptomatic population affected by COVID-19, all pediatric patients undergoing urgent otolaryngology procedures is considered to be treated as suspected COVID-19 cases until proven otherwise.[11,12,27] Besides, given that not all patients requiring urgent tracheostomy will have been tested, tracheostomy necessitates the surgeon to pay meticulous attention for infection control to reduce the cross-contamination and their own risk for contracting the infection.[11,12,28]

Study Limitations

Certain limitations to this study should be considered. First, potential lack of generalizability is an important limitation due to single-center study design with relatively small sample size. Second, the lack of data on decannulation procedures, long-term post-discharge outcome and the potential risk factors in non-survivors is another limitation which otherwise would extend the knowledge achieved in the current study.

Conclusion

Our findings indicate the active participation of pediatric surgeons besides the otolaryngologists in implementation of pediatric tracheostomies at a tertiary care PICU, particularly after the emergence of COVID-19 pandemic. Accordingly, our findings indicate the maintenance of high quality patient care for pediatric tracheostomy patients in accordance with standardized tracheostomy protocols and policies during the pandemic period with no significant difference between tracheostomies performed before and after the COVID-19 pandemic and those performed by pediatric surgeons vs. otolaryngologists in terms of prognostic scores and time to home discharge.

Ethics

Ethics Committee Approval: The study was conducted in accordance with the ethical principles stated in the "Declaration of Helsinki" and approved by the Celal Bayar University Faculty of Medicine Health Sciences Ethics Committee along with the permission for the use of patient data for publication purposes (date of approval: 10/02/2021 reference number/ protocol no: 20.478.486/748).

Informed Consent: Retrospective study.

Peer-review: Externally peer-reviewed.

Authorship Contributions

Concept: N.Z., A.B., Design: N.Z., A.B., Data Collection or Processing: N.Z., A.B., O.O.C., H.İ.T., Analysis or Interpretation: N.Z., A.B., O.O.C., H.İ.T., Writing: N.Z., A.B., O.O.C., H.İ.T.

Conflict of Interest: No conflict of interest was declared by the authors.

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