CASE REPORT

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Tracheostomy on COVID-19 Pediatric Patients

COVID-19 Enfeksiyonu Olan Çocuk Hastalarda Trakeostomi

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Abstract

This article reports four cases of pediatric patients who underwent tracheostomy after Coronavirus disease-2019 (COVID-19) infection. The common feature of these patients was not only prolonged intubation but also the presence of significant comorbidities. Tracheostomy was well tolerated by all patients and resulted in improved outcomes. Although tracheostomy is an old surgical procedure, there is not enough experience on COVID-19 patients in terms of indications, technique, and actual timing. We presented a single-center experience and discussed the management of COVID-19 pediatric patients with preexisting comorbidities who were candidates for a surgical tracheostomy.

Keywords: COVID-19, pediatric, tracheostomy

Öz

Makalemizde Koronavirüs hastalığı-2019 (COVID-19) enfeksiyonundan sonra trakeostomi uygulanan dört çocuk hasta bildirilmektedir. Bu hastaların ortak özelliği sadece uzun süreli entübasyon değil, aynı zamanda önemli komorbiditelerin olmasıdır. Trakeostomi tüm hastalar tarafından iyi tolere edildi ve sağkalımla sonuçlandı. Trakeostomi çok eski bir cerrahi prosedür olmasına rağmen endikasyon, teknik ve zamanlama açısından COVID-19'lu çocuk hastalarda yeterli deneyim bulunmamaktadır. Tek merkez deneyimimizi sunarak, cerrahi trakeostomi adayı olan, önceden mevcut komorbiditeleri olan COVID-19'lu çocuk hastalarda trakeostomi yönetimini tartıştık.

Anahtar kelimeler: COVID-19, pediatrik, trakeostomi

Introduction

Children infected with the severe acute respiratory syndrome-coronavirus-2 (SARS-CoV-2), which causes the Coronavirus disease-2019 (COVID-19), have usually fewer clinical manifestations and less hospitalization when compared with adults. According to the American Academy of Pediatrics, 14.1% of all cases were children indicating an overall 5.307 cases per 100,000 children in the general population. Children constitute 1.4-3.2% of total reported hospitalizations. In the pediatric age group, 0.1-1.9% of COVID-19 patients require hospitalization (1). The increased number of COVID-19 patients with acute respiratory distress syndrome (ARDS) for prolonged ventilation, compromised airway required intubation with a ventilator. The most common indication for pediatric tracheostomy includes prolonged ventilation and obstruction of the airway (2).

During the COVID-19 pandemic, the timing of tracheostomy is controversial. The benefit of a tracheostomy is not clear. Besides, tracheostomy is an aerosol-generating procedure that carries a transmission risk for healthcare workers (3). The decision of tracheostomy should be made with a multidisciplinary approach during the COVID-19 pandemic, especially in the pediatric age group. Indications and stages of the surgical procedure should be reconsidered, as the tracheostomy procedure is a droplet-spreading procedure,

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causes a significant amount of aerosol formation, and provides a basis for the spread both during surgery and in the postoperative period.

Our pediatric intensive care unit (PICU) interned 35 COVID-19 infected patients. The polymerase chain reaction (PCR) tests of all patients were positive. All children had a family history of infection contact. Four of our patients (11%) who were treated in 35 pediatric intensive care units required tracheostomy. Considering the indications for tracheostomy in the PICU, the COVID-19 disease did not change the indications much, but only the COVID-19 infection of the patients with additional comorbidities increased the length of the stay in the intensive care unit. Although tracheostomy indications did not change with COVID-19 infections, the recovery of severe ARDS in children and the necessity of tracheostomy under general anesthesia extended our time. Moreover, additional morbidity (there was pontocerebellar dysplasia in Case 1 and bronchopulmonary dysplasia in Case 2) also extended timing. We discussed our single-center experiences of the management of patients with COVID-19 who underwent surgical tracheostomy in light of the literature.

Since all of our patients did not have emergency indications, we discussed with the intensive care doctors and waited for the PCR results to become negative, then patients underwent to the operation.

Case Reports

Case 1

A 10-year-old boy previously diagnosed with pontocerebellar hypoplasia presented with respiratory distress after 2 days of fever. He had been transferred to our PICU from another center due to his worsening dyspnea/hypoxia. He underwent tracheal intubation. His chest computed tomography (CT) showed both-side diffuse ground-glass opacity, peripheral zone consolidations (Figure 1A). On the 20th day of intubation, tracheostomy was planned in accordance with the consensus of PICU specialists and ear nose throat (ENT) specialists because the patient had been intubated for three weeks and it was not anticipated that he would be extubated in the near future. Open surgical tracheostomy was performed in operating room conditions. After the tracheostomy procedure, he was discharged with home-type mechanical ventilation (MV). The patient had severe ARDS. It was difficult for us to make a clear judgment about whether the neurological sequelae due to pontocerebellar hypoplasia, with which he was diagnosed within the neonatal period, worsened the clinical picture of the patient.

Case 2

A 6-month-old boy previously diagnosed with bronchopulmonary dysplasia presented with persistent fever, dyspnea, tachypnea, intercostal and subcostal retractions. He was admitted to the PICU for non-invasive MV due to acute hypoxemic respiratory failure while the chest X-ray showed bilateral interstitial consolidations of the lung parenchyma (Figure 1B). On day 22, he could not be tolerated weaning for a non-invasive MV, chest CT and bronchoscopy showed signs of tracheal stenosis. In the light of the bronchoscopy report and recommendations of the pediatric chest specialist, we planned to open a tracheostomy for the child and decided to wait for the surgical decision for stenosis until the age of 2 years. On day 28, a tracheostomy was performed.

Case 3

A 4-year-old previously healthy girl presented with pediatric acute respiratory distress associated with SARS-CoV-2. She had been transferred to our PICU from another center due to hypoxia and her oxygen saturation levels were not improving. Her chest CT showed both-side diffuse ground-glass opacity and consolidation (Figure 1C). On day 30, tracheostomy was performed to reduce the sedation and by this way to allow a neurological assessment and reduce the MV support. The reason for the delay in the tracheostomy procedure is that the general condition of the patient was expected to be suitable for transport to the operating room and to receive general anesthesia. After tracheostomy, she was still under high peep on invasive MV and had high oxygen requirement. The patient could be discharged on the 142nd day without being decannulated due to the development of multi-organ failure and the continued need for MV.

Case 4

A 6-year-old boy presented with symmetric ascending paralysis progressed over a 4-day course and 2 days of fever. He had bilateral lower and upper limb flaccid weakness of 1/5 with absent deep tendon reflexes. He had severe respiratory muscle weakness requiring invasive MV. On admission, SARS-CoV-2 turned as positive by real-time PCR on a nasopharyngeal swab. He was diagnosed with Guillain-Barre syndrome (GBS) associated with SARS-CoV-2 infection. He was admitted to the PICU for severe respiratory muscle weakness requiring invasive MV. He underwent tracheal intubation despite his chest X-ray being

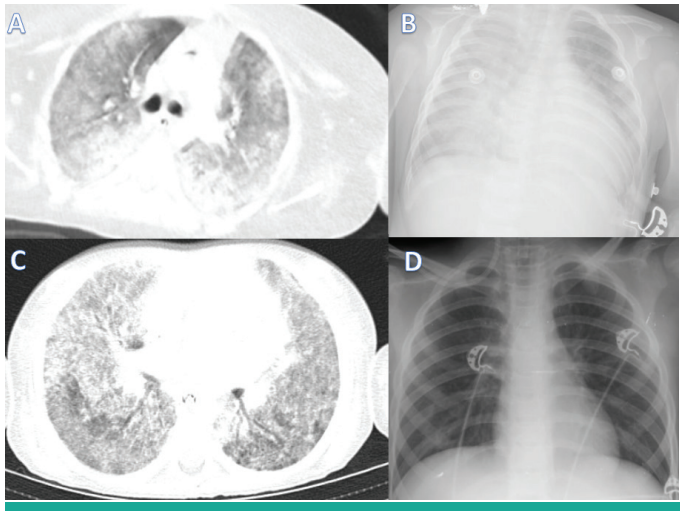

Figure 1. A) A 10-year-old boy's chest CT showed both-side diffuse ground-glass opacity, peripheral zone consolidation, B) A 6-month-old boy' tchest X-ray showed bilateral interstitial consolidation of the lung parenchyma, C) A 4-year-old girl's chest CT showed both-side diffuse ground-glass opacity and consolidation, D) A 6-year-old boy's chest X-ray was normal

CT: Computed tomography

normal (Figure 1D). We hypothesize that there is a causal relationship between GBS and SARS-CoV-2 infection, but there is no evidence of direct invasion of nerves or nerve roots by a virus. On day 30, a tracheostomy was performed due to ongoing respiratory muscle weakness with respiratory failure and bulbar involvement. The patient's need for MV continued due to bulbar involvement, and decannulation was not considered. This case was reported as a case report in another journal (4).

Technical Details About Tracheostomy

Here, we gave the details of tracheostomy procedure during the COVID-19 pandemic period. During the pandemic process, requirement of the tracheostomy started to develop, we prepared our patients according to the guideline review in the literature (5,6). Intensive care unit physicians and ENT physicians consulted on the appropriateness of tracheostomy in a COVID-19 infected patient. One day before the procedure, the anesthesia team and the ENT team hold a meeting to evaluate all the steps of the procedure. We preferred an open surgical procedure in a negative pressure operating room. The most experienced physicians and allied health personnel were involved to ensure that the procedure was accurate, fast, and safe. A few team members and personnel were employed, and the number of unnecessary team members was reduced. The use of appropriate personal protective equipment was required for all staff. Surgical team members wore Dräger X-plore® 8000 powered air-purifying respirator before the procedure. Cuffed and non-fenestrated tracheostomy cannula were used, and the robustness of the cuff was checked before starting the procedure. The syringe which the cuff would be inflated was attached to the cannula. The patients were fully curated during the procedure. For children who needed a tracheostomy, a vertical incision was made in the midline of the skin. After dissection, the thyroidal isthmus was retracted and tracheal rings were identified. A tracheal incision was performed between rings 3 and 5 in the vertical incision. The tracheal wall was sutured with 0 polypropylene suture material to the skin and a patent tracheostomy was performed. The appropriate diameter tracheostomy tube was inserted. The tube was secured with stay sutures. No tracheal ring was removed and no horizontal incision was used.

After the operation, all patients were reconnected to the ventilator and transferred back to the PICU by the transport team. Fourteen days after the tracheostomy, all participating medical staff members were healthy and asymptomatic and we also had no complications with the tracheostomy.

All patients' clinical situations and outcomes before and after tracheostomy are shown in Table 1. MV parameters and oxygen requirement of all of our patients decreased after tracheostomy which enabled us to make a better neurologic evaluation and helped to decrease in sedation dosage. Written informed consent for publication was obtained from the parents on behalf of the patients.

Discussion

We reported 4 cases of pediatric patients with or without comorbidities who developed respiratory failure due to COVID-19 infection and performed tracheostomy after long-term MV support.

The COVID-19 pandemic has presented health care systems with critical respiratory illness. During surgical tracheostomy, there is a high risk of spreading the aerosols to the surrounding health care providers. Therefore, two negative PCR tests in 24 h before performing a surgical tracheostomy on COVID-19 patients are required. A minimal number of staff in the operating room and adequate sedation should be provided to eliminate the risk of coughing during the procedure, even though the child is paralyzed (7). In all our patients, we had two negative PCR tests in 48 h.

Table 1. Clinical characteristics and outcomes in four patients with COVID-19

	Case 1	Case 2	Case 3	Case 4
Age/gender	10 years old/male	6 months old/male	4 years old/female	6 years old/male
Comorbidity	Pontocerebellar hypoplasia	Bronchopulmonary dysplasia	No	No
Concomitant illness	No	Yes	Yes	Yes
SARS-CoV-2 PCR	Positive	Positive	Positive	Positive
Symptoms	Fever, respiratory distress	Fever, dyspnea, tachypnea, intercostal and subcostal retraction	Fever, respiratory distress, shock	Fever, symmetric ascending paralysis
Presentations	PARDS	PARDS	PARDS	GBS
Vital signs				
SpO_2 (%)	79	85	91	92
Pulse rate (per min)	142	174	84	102
Blood pressure (mmHg)	82/53	86/51	89/56	95/64
Respiratory rate (per min)	25	55	25	35
Body temperature (°C)	39	38.9	37	39.6
PELOD-2 score (%)	10 (71)	4 (58.9)	10 (79.7)	15 (90.7)
PRISM-3 score (%)	22 (32)	12 (8.8)	34 (87.9)	20 (26.1)
PIM-2 %	45	6.8	99.8	4.3
Intubation duration	33 days	11 days	40 days	30 days
Mechanical ventilator settings before tracheostomy	SIMV PC+PS PIP: 20, PEEP: 7, VR: 20, FiO_2: 50	NIV IPAP: 12, EPAP: 6, VR: 20 FiO_2: 50	PC PIP: 35 PEEP: 15 VR: 30 FiO_2: 100	SIMV PC + PS PIP: 20, PEEP: 5, VR: 10, FiO_2: 40
Tracheostomy time	20th day	28th day	30th day	30th day
Tracheostomy technique	Surgical	Surgical	Surgical	Surgical
Tracheostomy cannula size	5.5 cuffed	4 cuffed	6 cuffed	5.5 cuffed
Complication	No	No	No	No
Mechanical ventilator settings after tracheostomy	SIMV PC + PS PIP: 15, PEEP: 5, VR: 20, FiO_2: 30	Only O_2 supplement	SIMV PC + PS PIP: 30, PEEP: 10, VR: 20, FiO_2: 80	SIMV PC + PS PIP: 15, PEEP: 5, VR: 10, FiO_2: 30
Discharge	55. day with home MV	38. day without MV	142. day with home MV	50. day with home MV

COVID-19: Coronavirus disease-2019, PARDS: Pediatric acute respiratory distress syndrome, GBS: Guillain-Barre syndrome, SARS-CoV-2: Severe acute respiratory syndrome-coronavirus-2, PCR: Polymerase chain reaction, PELOD-2: Pediatric logistic organ dysfunction-2 score, PRISM-3: Pediatric risk of mortality-3, PIM-2: Pediatric index of mortality, SIMV PC + PS: Synchronized intermittent mandatory ventilation with pressure controlled and supported breath, NIV: Non-invasive ventilation, PC: Pressure control, PIP: Peak inspiratory pressure, PEEP: Positive end-expiratory pressure, VR: Ventilation rate, FiO_2: Fractional concentration of oxygen in inspired air, IPAP: Inspiratory positive airway pressure, EPAP: Expiratory positive airway pressure

Tang et al. reported a retrospective study about tracheostomy in COVID-19 patients. This study showed most tracheotomies were performed by ICU physicians and using percutaneous techniques at the ICU bedside. The most common complication was stoma bleeding. Percutaneous tracheostomy is more likely to cause aerosol formation compared to surgical approaches. Therefore, surgical tracheostomies should generally be preferred to percutaneous tracheostomies during the COVID-19 pandemic (8). Our patients' tracheostomies were performed by ENT specialists and using surgical techniques. The timing of tracheostomy is important and remains one of the issues discussed during the pandemic process. Tracheostomy should be avoided or delayed even beyond 2 weeks because of the exposed high viral load during the procedure and subsequent tracheostomy care (9). Early tracheostomy should be avoided in the COVID-19 patients because of the higher viral load. Early tracheostomy is not related to less ICU stay and improved mortality (10). In all of the study cases, tracheostomies were done after at least 14 days of orotracheal intubation. Our approximate tracheostomy time is longer than adult cases, with an average of 21 days. To be suitable both for the transportation of the general condition of the

patients to the operating room and for receiving general anesthesia.

When we decided to perform this study, we aimed to evaluate the clinical profile and consequence of surgical tracheostomy on pediatric COVID-19 patients at the ICU, and we could find less study on pediatric COVID-19 related tracheostomy in the literature.

Our case series have limitations, such as that decannulation in PICU could not be performed because ventilatory support was required, cough/swallow was not adequate, and suctioning was not minimal. Although the sample size is small, the result of this study is an important message for other doctors and patients at the PICU.

Conclusion

For children with COVID-19 who were intubated and mechanically ventilated for long-term, tracheostomy performed earlier in the course of hospital admission may be associated with improved survival.

Ethics

Informed Consent: Written informed consent for publication was obtained from the parents on behalf of the patients.

Peer-review: Externally peer-reviewed.

Authorship Contributions

Concept: N.A., Z.M.Y., M.E.M., Desing: M.E.M., N.A., A.İ.S., Data Collection or Processing: İ.S., N.A., Z.M.Y., Drafting Manuscript: E.Ş., N.A., A.İ.S., Analysis or Interpretation: İ.S., N.A., Z.M.Y., Final Approval and Accountability: N.A., Z.M.Y., E.Ş., Critical Revision of Manuscript: Z.M.Y., İ.S., Supervision: E.Ş., İ.S.

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References

1. American Academy of Pediatrics Children and COVID-19: State-Level Data Report [Internet]. [cited 2021 May) https://services.aap.org/en/pages/2019-novel-coronavirus-covid-19-infections/children-and-covid-19-state-level-data-report/
2. Swain SK, Sahu A. Performing tracheostomy on COVID-19 pediatric patients at intensive care unit: Our experiences. Indian J Health Sci Biomed Res 2021;14:131-136.
3. Schultz MJ, Teng MS, Brenner MJ. Timing of Tracheostomy for Patients With COVID-19 in the ICU-Setting Precedent in Unprecedented Times. JAMA Otolaryngol Head Neck Surg 2020;146(10):887-888.
4. Akçay N, Menentoğlu ME, Bektaş G, Şevketoğlu E. Axonal Guillain-Barre syndrome associated with SARS-CoV-2 infection in a child. J Med Virol 2021;93:5599-5602.
5. David AP, Russell MD, El-Sayed IH, Russell MS. Tracheostomy guidelines developed at a large academic medical center during the COVID-19 pandemic. Head Neck 2020;42(6):1291-1296.
6. Tang Y, Wu Y, Zhu F, Yang X, Huang C, Hou G, et al. Tracheostomy in 80 COVID-19 Patients: A Multicenter, Retrospective, Observational Study. Front Med (Lausanne) 2020;7:615845.
7. McGrath BA, Ashby N, Birchall M, Dean P, Doherty C, Ferguson K, et al. Multidisciplinary guidance for safe tracheostomy care during the COVID-19 pandemic: the NHS National Patient Safety Improvement Programme (NatPatSIP). Anaesthesia 2020;75(12):1659-1670.
8. Tay JK, Khoo ML, Loh WS. Surgical Considerations for Tracheostomy During the COVID-19 Pandemic: Lessons Learned From the Severe Acute Respiratory Syndrome Outbreak. JAMA Otolaryngol Head Neck Surg 2020;146(6)517-518.
9. Framework for Open Tracheostomy in COVID-19 Patients. Available from: https://www.entuk.org/sites/default/files/COVID%20tracheostomy%20guidance_compressed. pdf. [Last accessed on 2020 Apr 15].
10. Young D, Harrison DA, Cuthbertson BH, Rowan K; TracMan Collaborators. Effect of early vs late tracheostomy placement on survival in patients receiving mechanical ventilation: The TracMan randomized trial. JAMA 2013;309:2121-2129.