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Retrospective Evaluation of Patients Who Underwent Bronchoscopy in a Tertiary Pediatric Intensive Care Unit

Üçüncü Basamak Bir Çocuk Yoğun Bakım Ünitesinde Bronkoskopi Yapılan Hastaların Geriye Dönük Olarak Değerlendirilmesi

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Abstract

Introduction: This study aims to evaluate bronchoscopy's indications and clinical results in patients who underwent bronchoscopy during their stay in the pediatric intensive care unit (PICU).

Methods: This study was carried out retrospectively in PICU between April 2019, and October 2021. The diagnoses of the patients, the reasons for bronchoscopy, where and by whom bronchoscopy was performed, complications related to bronchoscopy, and the contribution of bronchoscopy to diagnosis and treatment were determined.

Results: Thirty-seven patients underwent bronchoscopy. The median age was 20 (7-126) months. The children comprised 17 females (45.9%). We performed bronchoscopy in 17 (45.9%) patients in the PICU and in 20 (54.1%) patients in the operating room. Pediatric intensive care physicians, 13 (35.1%) performed fifteen (40.5%) of bronchoscopy procedures pediatric pulmonologists and 9 (24.3%) pediatric surgeons. Nine patients underwent rigid bronchoscopy, 28 patients underwent flexible bronchoscopy. The median bronchoscopy time was 10 minutes (7.5-15). Bronchomalacia was found in 5 of the patients and tracheomalacia in 2 of them. Three patients (8.1%) had extraluminal airway compression. Bronchoscopy was performed in six patients due to foreign body aspiration. In 13 patients, peak inspiratory pressure and positive end-expiratory pressure of mechanical ventilation were decreased after the bronchoscopy procedure. During the bronchoscopy procedure, desaturation showed in 19 patients, bleeding in 4 patients, bradycardia in 4 patients, and short-term cardiac arrest in 3 patients.

Öz

Giriş: Hava yolu bronkoskopisi, çocuk hasta grubunda çeşitli hava yolu bozukluklarının tedavisinin yanı sıra trakea ve bronşların görüntülenmesine izin veren önemli bir prosedürdür. Bu çalışmanın amacı çocuk yoğun bakım ünitesinde (ÇYBÜ) yatışı sırasında bronkoskopi işlemi yapılan hastalarda bronkoskopi endikasyonlarını ve klinik sonuçlarını değerlendirmektir.

Yöntemler: Bu çalışma geriye dönük olarak 1 Nisan 2019-1 Ekim 2021 tarihleri arasında ÇYBÜ'de gerçekleştirildi. Hastaların tanıları, bronkoskopi yapılma nedenleri, bronkoskopinin nerede ve kim tarafından yapıldığı, bronkoskopi ile ilişkili komplikasyonlar, bronkoskopinin tanı ve tedaviye katkısı belirlendi.

Bulgular: Otuz yedi hastaya bronkoskopi yapıldı. Olguların ortanca yaş değeri 20 (7-126) ay idi. Olguların %45,9'u kız (n=17) idi. Hastaların 17'sine (%45,9) ÇYBÜ'de, 20 (%54,1) hastaya ameliyathanede bronkoskopi işlemi yapıldı. Bronkoskopi işlemlerinin 15'i (%40,5) çocuk yoğun bakım doktoru, 13'ü (%35,1) çocuk göğüs hastalıkları doktoru ve 9'u (%24,3) çocuk cerrahi doktorları tarafından yapıldı. Dokuz hastaya rijit bronkoskopi 28 hastaya fleksibl bronkoskopi yapıldı. Ortalama bronkoskopi süresi 10 dk (7,5-15) idi. Hastaların 5'inde bronkomalazi, 2'sinde trakeomalazi saptandı. Üç hastada (%8,1) ekstraluminal hava yolu kompresyonu mevcuttu. Altı hastaya yabancı cisim aspirasyonu nedeniyle bronkoskopi yapıldı. On üç hastada bronkoskopi işlemi sonrası mekanik ventilasyonun inspiratuvar tepe basıncı ve-veya pozitif end-ekspiratuvar basınç azaltıldı. Bronkoskopi işleminde 19 hastada desaturasyon, 4 hastada kanama, 4 hastada bradikardi, 3 hastada kısa süreli kardiyak arrest

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Three patients with cardiac arrest were patients who underwent rigid bronchoscopy. The median PICU length of stay was 52 days. There were no bronchoscopy-related deaths, but 9 patients died due to their primary disease.

Conclusion: Bronchoscopy is a method that can be performed in PICU, both at the bedside and the operating room, to identify pathological changes in the airway in critical patients and to remove foreign bodies and life-threatening plugs in the airway. Its use for emergency or diagnostic purposes is increasing in PICUs.

Keywords: Bronchoscopy, pediatric intensive care, airway

gelişti. Kardiyak arrest olan 3 hasta da rijit bronkoskopi yapılan hastalardı. Hastaların ortanca yatış gün sayısı 52 (9-119) gün idi. Bronkoskopi ilişkili ölüm olmadı ancak 9 hasta primer hastalıkları nedeniyle kaybedildi.

Sonuç: Bronkoskopi, çocuk yoğun bakım ünitelerinde hem yatak başında hem de ameliyathane şartlarında yapılabilen kritik hastalarda havayolundaki patolojik değişiklikleri tanımlamaya yarayan, yabancı cisim ve hava yolundaki yaşamsal tehdit eden tıkaçların çıkartılması amacıyla kullanılan bir yöntemdir. Çocuk yoğun bakımlarda acil müdahale veya tanı amaçlı kullanımı giderek artmaktadır.

Anahtar Kelimeler: Bronkoskopi, çocuk yoğun bakım, hava yolu

Introduction

Bronchoscopy in children is an important procedure that allows imaging of the trachea and bronchi as well as the treatment of various airway disorders.[1] Flexible bronchoscopy (FB), using modern ultra-thin fiberoptic technology, has revolutionized the study of neonatal and pediatric airway disorders over the past two decades.[2] FB is recognized as an important tool for diagnosing and treating pediatric pulmonary disorders.[3] Although the first published report on the use of FB in children was in 1978, rigid bronchoscopy applied by surgeons remained as the standard practice for many years due to instrument size limitations.[3,4] With the advent of smaller size bronchoscopes, the use of FB in pediatric and neonatal patients has increased.[3] FB is increasingly used in critically ill patients, resulting in a wider range of therapeutic applications.[2] FB has been used in pediatric intensive care units in recent years as a safe and valuable diagnostic tool for anatomical airway problems.[5] Thus, it provides the opportunity to perform bronchoscopy in the intensive care unit for patients receiving extracorporeal treatment.[6]

Therapeutic interventions with FB effectively alleviate airway problems, by highlighting the potential benefits of FB administration in children who cannot be extubated. Although the use of FB has been recommended in preterm infants with recurrent extubation failures, reports of bronchoscopic findings in children who cannot be extubated are rare.[5]

Foreign body aspiration (FBA) is one of the usage areas of bronchoscopy in patients hospitalized in the pediatric intensive care unit. The current preferred procedure for the removal of the aspirated foreign body is rigid bronchoscopy, with reported complications.[7] However, in adults and children, FB may also be used for the removal of inhaled foreign body.[7]

The aim of this study is to evaluate the indications and techniques of bronchoscopy in patients hospitalized in our pediatric intensive care unit, and its contribution to the diagnosis and solution of patients' problems.

Materials and Methods

This study was carried out retrospectively in our pediatric intensive care unit (PICU) between April 1, 2019 and October 1, 2021. There are 20 tertiary care beds in our unit. The population of children in the city where our hospital is located is approximately 1.3 million. There are approximately 600-700 hospitalizations per year. Inclusion criteria were determined as being patients between 1 month and 18 years of age, who underwent bronchoscopy while in or during hospitalization in the pediatric intensive care unit. Written permission was obtained from the Clinical Research Ethics Committee of Ankara University Faculty of Medicine for the study (decision no: 2021/406).

Demographic information and information about the disease course of the patients hospitalized in the PICU unit and undergoing bronchoscopy were recorded as given below.

Patients' age, gender, primary diagnosis, status of mechanical ventilator connection and MV mode if connected, tracheostomy status in patients receiving invasive MV support, whether the intubation tube was cuffed, and sedation treatments during bronchoscopy were retrospectively recorded from patient files. Regarding bronchoscopy, indication for bronchoscopy, department performing bronchoscopy, duration of bronchoscopy, blood gases taken before and after bronchoscopy and mechanical ventilator settings, bronchoscopy type, bronchoscopy complications, bronchoalveolar lavage results obtained during bronchoscopy were recorded.

A portable fiber optic bronchoscope (Karl Storz Endoscopy, Germany) was used in the PICU.

Fiberoptic bronchoscope (Karl Storz Endoscopy, Germany) was used in pediatric chest diseases.

Pediatric rigid bronchoscope (Karl Storz Endoscopy, Tuttlingen, Germany) was used in pediatric surgery and the patients were ventilated with 100% oxygen through the bronchoscope during the procedure.

Heart rate and rhythm, blood pressure and peripheral oxygen saturation were routinely monitored. Intravenous sedation and analgesia were administered for all bronchoscopic examinations and procedures. The flexible bronchoscope was inserted into the ventilator breathing circuit by using a "Y" shaped tube and the inspired oxygen concentration was increased to 100%, but no other ventilator settings were changed.

Statistical Analysis

Statistical analyses were performed by entering the data into SPSS 26.0 (Statistical Package for Social Sciences for MacOS, Inc., USA) software. The expression n (%) was used for categorical variables. For continuous variables, mean ± standard deviation values were used in case of conformity with normal distribution, and median (minimum-maximum limit) values were used in the absence of conformity with normal distribution. The mean and standard deviations were determined by using descriptive analyses of the demographic and clinical data of the cases.

In the presence of more than two categorical variables, the Kruskal-Wallis test was used when the parametric tests did not show homogeneity. Statistical significance level was accepted as $p<0.05$ in all tests.

The chi-square test was employed to compare non-numerical parameters between categorical groups. The Fisher's Exact test was used when >20% of the expected value was less than 5. The Wilcoxon test was used for dependent variables.

Results

Thirty-seven patients underwent bronchoscopy. The median age of the cases was 20 (IQR 7-126) months (minimum 2 months, maximum 192 months). Twenty-three patients (62.2%) were younger than 3 years old and 17 patients (45.9%) were under one year old. 45.9% of the cases were girl (n=17) and 54.1% were boy (n=20). Bronchoscopy was performed for 17 (45.9%) patients in the pediatric intensive care unit, and for 20 (54.1%) patients in the operating room. Fifteen (40.5%) of the bronchoscopy procedures were performed by pediatric intensive care physicians, 13 (35.1%) by pediatric chest diseases physicians, and 9 (24.3%) by pediatric surgeons. Rigid bronchoscopy was performed in 9 patients and FB was performed in 28 patients (Table 1).

Thirty-four patients were followed up as intubated on a mechanical ventilator before bronchoscopy. Cuffed tube was used in 28 of intubated patients and uncuffed tube was used in 6 of them. Tracheostomy cannula was present in 6 patients. The number of intubated days in these patients was 34 (8.75-68.5) (minimum 1- maximum 201). All patients were given sedative and or analgesic treatment during the bronchoscopy procedure. Rocuronium was given to 8 patients, ketamine to 23 patients, fentanyl to 10 patients, and midazolam to 25 patients.

Twenty-five patients were monitored in pressure-SIMV mode and 9 patients were monitored in volume-SIMV mode.

Bronchoscopy was performed in 6 patients due to FBA. Peanuts in 2 patients, beans in 1 patient, and seeds in 1 patient were removed with bronchoscope. No foreign body was observed in two patients. Three of six patients were not intubated before and after bronchoscopy.

Cardiac arrest lasting 30 seconds to 1 minute was observed during the procedure in two of 6 patients. Two of these patients were admitted to the PICU as intubated and both were extubated on the first day of hospitalization.

Bronchoscopy was performed at night in 6 patients, outside of working hours. In these patients, the procedure was performed by pediatric surgeon in 2 patients and by pediatric intensive care physician in 3 patients.

Bronchoscopy was performed in 5 patients while being followed in ECMO. Three of these procedures were performed by a pediatric intensive care physician, one by a pediatric chest diseases physician, and one by a pediatric surgeon.

Table 1. Clinical and demographic characteristics of the patients

Demographic data	
Sex: Boy, n (%), girl n (%)	20 (54.1), 17 (45.9)
Age (month), median (IQR 25-75)	20 (7-126)
Time of bronchoscopy	
Daytime	31 (83.7)
Night	6 (16.3)
Indication	
Diagnostic	23 (62.1)
Therapeutic	14 (38.9)
Department performing bronchoscopy n (%)	
Pediatric intensive care	15 (40.3)
Pediatric chest diseases	13 (35.1)
Pediatric surgery	9 (24.4)
Place of bronchoscopy	
Pediatric intensive care unit	17 (45.9)
Operating room	20 (54.1)
Bronchoscopy type: n (%)	
Rigid	9 (24.3)
Flexible	28 (75.7)
Complication of bronchoscopy	
Desaturation	20 (54.1)
Bleeding	4 (10.8)
Bradycardia	4 (10.8)
Cardiac arrest	3 (8.1)

IQR: Interquartile range

Table 2. Comparison of blood gas parameters and mechanical ventilator settings before and after bronchoscopy

	Before bronchoscopy	After bronchoscopy	p
pH	7.40 (7.32-7.42)	7.39 (7.34-7.44)	0.1
$PaCO_2$	46 (37-55)	39.7 (34-49.8)	0.062
HCO_3	24.5 (18.8-28.8)	23 (19.7-26.4)	0.568
Lactate	1.4 (1.1-2.5)	1.6 (1.1-2.45)	0.156
Respiratory rate	30 (20-30.5)	26 (20-31)	0.752
PIP	24 (22-27.5)	22 (22-28)	0.943
PEEP	6 (6-8)	6 (6-8)	0.366

PIP: Peak inspiratory pressure, PEEP: Positive end-expiratory pressure, $PaCO_2$: Partial pressure of carbon dioxide, HCO_3: Bicarbonate

Table 3. Comparison of complications according to bronchoscopy type

	Rigid (n=9)	Flexible (n=28)	
Desaturation	6	14	0.659
Bleeding	2	2	0.291*
Bradycardia	3	1	0.022
Cardiac arrest	3	0	**0.015***
Pediatric intensive care unit	2	15	0.054
Operating room	8	12	

*Fisher's Exact test

In 23 patients, the plug was removed during the bronchoscopy procedure. Atelectasis appearance regressed in 8 patients after bronchoscopy. Peak inspiratory pressure (PIP) of mechanical ventilation and/or positive end-expiratory pressure (PEEP) were reduced in 13 patients. When the patients' blood gas parameters and mechanical ventilator settings such as respiratory rate, PIP and PEEP were compared before and after bronchoscopy, no significant difference was found (Table 2).

In the bronchoalveolar lavage samples taken, *Streptococcus* mitis grew in 1 patient, *Klebsiella pneumoniae* in 3 patients, *Klebsiella oxytoca* in 1 patient, *Pseudomonas aeruginosa* in 1 patient, coagulase negative *Staphylococci* in 1 patient, *Stenotrophomonas maltophilia* in 1 patient, and *Candida albicans* in 1 patient.

The mean duration of bronchoscopy was 10 minutes (7.5-15). Bronchoscopy was beneficial in 31 patients. Desaturation was observed in 20 patients, bleeding in 4 patients, bradycardia in 4 patients, and cardiac arrest in 3 patients during bronchoscopy. All 3 patients developing cardiac arrest were those who underwent rigid bronchoscopy by the pediatric surgeon.

It was determined that there was a significant difference in the frequency of cardiac arrest between patients who underwent rigid bronchoscopy and those who underwent FB (p=0.015) (Table 3).

Bedside bronchoscopy was performed in 17 patients in the pediatric intensive care unit. Twelve of these patients were girls and the median age of the patients was 32 months. Fifteen of the bronchoscopy procedures were performed during the daytime and 2 of them were performed at night. It was performed for diagnostic purposes in 13 patients and for therapeutic purposes in 4 patients. All patients were performed with FB. Significant atelectasis appearance in 5 patients regressed after bronchoscopy procedure. As a complication of bronchoscopy, desaturation was observed in 9 patients, bleeding in 2 patients, and bradycardia in 1 patient. Bronchoscopy was performed in 14 patients by a pediatric intensive care physician, and in 3 patients by a pediatric chest diseases physician (Table 4).

One patient was found to have a kinked intubation tube during the bronchoscopy procedure. The bronchoscopy procedure was terminated and the patient's intubation tube was changed. Bronchomalacia was found in 5 patients and tracheomalacia in 2 patients. All of these patients were performed bronchoscopy by pediatric chest diseases physician and the median number of intubated days of these patients was 50 (26-11) (minimum 25-maximum 192 days). Cardiac disease was present in 6 of 7 patients with malaise. One patient was diagnosed with lissencephaly. Tracheostomy cannula was inserted in 3 of 7 patients. Two of the 7 patients died (one had a tracheostomy).

One of our patients who underwent fiberoptic bronchoscopy had granulation tissue that almost completely covered the trachea (Figure 1). This patient was a one-year-old boy patient, who was admitted to the PICU for postoperative follow-up after the closure of the ventricular septal defect and patent ductus

Table 4. Clinical and demographic characteristics of patients who underwent bedside bronchoscopy	
Demographic data	
Sex: Boy, n (%), girl n (%)	5 (29.5%) 12 (70.5%)
Age (month), median (IQR 25-75)	32 (7-156)
Number of days intubated	45 (20-118)
Number of hospitalization days	54 (28.5-179)
Time of bronchoscopy	
Daytime	15
Night	2
Indication	
Diagnostic	13
Therapeutic	4
Department performing bronchoscopy n (%)	
Pediatric intensive care	14 (82.3%)
Pediatric chest diseases	3 (17.7%)
Pediatric surgery	
Bronchoscopy type: n (%)	
Rigid	2 (11.8%)
Flexible	15 (88.2%)
Duration of bronchoscopy (min)	**10 (6-19)**
Complication of bronchoscopy	
Desaturation	9 (52.9%)
Bleeding	2 (11.8%)
Bradycardia	1 (5.9%)
Cardiac arrest	0
IQR: Interquartile range	

Figure 1. Pseudomembrane causing tracheal stenosis in the middle and lower part of the trachea

arteriosus. After being admitted to the PICU, the patient had poor ventilation despite being on a mechanical ventilator, and although pressure support was increased, his lungs were not well ventilated. It was observed that the intubation tube did not progress during re-intubation, and tracheal granulation tissue was observed in the rigid bronchoscopy. A chest tube was inserted because he had pneumothorax on the third day of his hospitalization. On the 4th day of his hospitalization, the patient who developed respiratory arrest and then cardiac arrest was connected to Veno-Arterial Extracorporeal Membrane Oxygenation (VA-ECMO) by performing CPR for 8 minutes. He was extubated on the 14th day of ECMO administration and decannulated on the 16th day of ECMO administration. After ECMO decannulation, the patient was given non-invasive mechanical ventilation for one month.

Tracheal dilatation was performed by the pediatric surgeon because of the increase in tracheal stenosis every 2 weeks during the patient's hospitalization. He was re-intubated on the 49th day of his hospitalization due to cardiac arrest and CPR was performed for 15 minutes. Tracheostomy was opened on the 60th day of hospitalization and then he was connected to a home mechanical ventilator. On the 95th day of his hospitalization, the patient with normal vital signs was transferred to the pediatric surgery unit on the 95th day of his admission to the PICU.

In our study, 3 patients (8.1%) had extraluminal airway compression. Two of these patients were postoperative cardiac surgery patients. The other patient was a patient with a hemangioma that almost completely occupied the trachea and propranolol was started by oncology (Figure 2).

Figure 2. The appearance of a smooth and soft subglottic hemangioma covered with normal mucosa, causing subglottic stenosis at the stage 3 level

Considering the number of intubated days of the patients according to the departments performing the bronchoscopy procedure, it was found that there was no significant difference.

The median number of hospitalization days of the patients was 52 (9-119) (minimum: 1, maximum: 210). Nine of our patients who underwent bronchoscopy died due to their primary disease.

Discussion

Traditional FB is usually performed by pediatric chest diseases physicians under elective conditions in operating rooms and intensive care units.[2] Under these conditions, FB procedure is generally a low-risk procedure with high efficiency and low complications (<1-2%).[2] In addition, FB is increasingly used by pediatric intensive care physicians because of its diagnostic and therapeutic value and high safety profile.[8] In recent years, studies emphasizing the importance of FB in pediatric intensive care have been published.[9] The first study on pediatric intensive care inpatients only was conducted between 1982 and 1986.[10] In this study, 87 patients were evaluated with FB and reported minimal morbidity and no mortality.[10] This study demonstrated the benefit of the bedside technique in critically ill pediatric patients.[10]

The most common complications during bronchoscopy are related to oxygenation and ventilation.[1,11] Patients may become hypoxic or hypercapnic, which can cause bradycardia and possibly cardiac arrest.[1] Barotrauma (e.g., pneumothorax, pneumomediastinum) may result from inadequate air outflow from oxygen insufflation during bronchoscopy.[1]

Fortunately, the mortality rate for both flexible and rigid bronchoscopy in the pediatric population has been reported to be quite low.[1] In addition, complications such as perforation, bleeding, lung abscess, and epistaxis may also be observed.[11]

In our study, despite the difference in patient populations, a higher rate of critical illness compared to previous studies was proven by our mechanical ventilation (91.9%) and ECMO (13.5%) rates. Not surprisingly, this was associated with higher complication rates. Desaturation was observed in 20 patients, bleeding in 4 patients, bradycardia in 4 patients, and cardiac arrest in 3 patients during bronchoscopy. Three patients with cardiac arrest were those who were performed rigid bronchoscopy by the pediatric surgeon. Two of these patients were followed up with a diagnosis of FBA and one with a diagnosis of Hemophagocytic lymphohistiocytosis. In these three patients, the heart rate was observed as >60/min after CPR. However, most physiological impairments were short-lived, responsive to standard therapy, and not associated with long-term sequelae.

The diversity of inpatients in the PICU has changed significantly in recent years.[9] As in our study group, long-term mechanical ventilation may be required in patients after cardiac surgery and in patients receiving extracorporeal therapy.[6] Long-term mechanical ventilation is associated with high mortality and morbidity, and extubation should be planned as early as possible to minimize these risks.[12] However, extubation failure is an important problem in these patients. Visualization of the upper and lower airways with FB, assessment of BAL, and removal of mucous plugs provide accurate diagnosis and facilitate appropriate management of patients.[8,12]

In our study, 14 (37.8%) patients were hospitalized for cardiac reasons. In a study, it was reported that the frequency of airway abnormalities was 87% in cardiac patients undergoing bronchoscopy.[9] In our study, this rate was 71% (10 patients). FB may provide therapeutic benefit in patients with mucus plug alone as the cause of atelectasis.[6] It has been reported that the incidence of atelectasis is high in mechanically ventilated children with severe pneumonia, and the main causes may be mucus and sputum plugs.[13] In cases where medical treatments fail, FB should be performed to identify the cause of atelectasis and to remove mucus plugs, and to prevent prolonged atelectasis that can cause irreversible lung damage.[12,14] In this study, mucus plug was removed in 23 patients (62.1%). A decrease in atelectatic area was detected in 13 patients (35.1%) after bronchoscopy. In 13 patients (35.1%), PIP or PEEP was reduced in mechanical ventilation after bronchoscopy.

Early and accurate diagnosis is essential to ensure optimal treatment given in children with recurrent pneumonia and to minimize the risk of progressive or irreversible lung injury.[15] Congenital airway anomalies such as tracheomalacia, tracheobronchomalacia, tracheal bronchus, tracheoesophageal fistula, tracheal stenosis, and unilateral lung hypoplasia, FBAs, hemosiderosis, and middle lobe syndrome are among the causes of recurrent pneumonia.[15]

FB is considered the gold standard for the diagnosis of airway malaise.[12] Airway malaise is one of the causes of airway obstructions and can cause a wide variety of symptoms, from persistent cough and lower respiratory tract infections to respiratory failure, depending on the length, location and severity of the malacic segment.[12] Airway malaise may be primary (congenital) or secondary to external compression to the airways, positive pressure ventilation, or respiratory tract infections, resulting in high rates of malaise in the newborn and PICU.[12] Airway malaise can cause unsuccessful extubation attempts, decreased mucociliary clearance, and secondary infections in intensive care units.[12] In our study, bronchomalacia was found in 5 patients and tracheomalacia

in 2 patients. Six of these patients were cardiac patients. All of these patients had prolonged intubation times.

One of the indications for bronchoscopy was FBA. FBA is one of the most common causes of unintentional injuries and carries a significant morbidity and mortality burden, especially in the first 3 years of life.[16] Although modern bronchoscopy techniques have resulted in an important reduction in mortality, FBAs are still responsible for more than 100 deaths per year in the United States and can lead to serious complications.[16] Rigid bronchoscopy is indicated in patients with a history of positive FBA, such as asphyxia, or in those with unilateral decreased breath sounds, obstructive emphysema, and atelectasis.[17] However, in some children, the diagnosis may not be so easily understood and for these patients, FB is the procedure that is preferred.[15] Up to 50% of patients with FBA may not have a typical history of aspiration.[15] In our series, foreign body was not observed in 2 of 6 (16.2%) patients with suspected FBA. Short-term cardiac arrest was observed in two of 6 patients. Both patients were extubated on the first day of hospitalization in the pediatric intensive care unit.

The occurrence of atelectasis is common in patients on ECMO due to heart failure or respiratory failure, and there are studies showing that atelectasis is treated with FB to prevent barotrauma due to high PEEP in these patients.[6]

In our study, bronchoscopy was performed on 5 patients followed up on ECMO by a pediatric intensive care physician (3 patients), a pediatric chest diseases physician (1 patient), and a pediatric surgeon (1 patient). Atelectasis was observed in 4 patients after bronchoscopy procedure. In these patients, systemic anticoagulation was interrupted for 1 hour before the procedure and no active major bleeding was observed in any of the patients.

Study Limitations

The limitations of our study are its retrospective nature and the small number of cases.

Conclusion

Bronchoscopy is a safe procedure that provides direct imaging of the airways in patients who are followed up on mechanical ventilators for a long time in pediatric intensive care units, thus enabling the recognition of airway anomalies, and also providing appropriate treatment options by aspirating mucous plugs and allowing BAL sample to be taken. In addition, it can prevent unnecessary intubation tube changes by allowing us to see directly whether the intubation tube is clogged or mucus plugs. We think that it may be a routine practice for intubated patients in pediatric intensive care units in the coming years.

Ethics

Ethics Committee Approval: Written permission was obtained from the Clinical Research Ethics Committee of Ankara University Faculty of Medicine for the study (decision no: 2021/406).

Informed Consent: Retrospective study.

Peer-review: Externally and internally peer-reviewed.

Authorship Contributions

Concept: T.K., E.G., H.U., F.K., E.B., A.G., B.B., H.Ö., F.A., G.Ç., G.Ö., F.Z., S.S., Design: E.G., H.U., F.K., E.B., A.G., B.B., H.Ö., F.A., G.Ç., G.Ö., F.Z., S.S., Data Collection or Processing: E.G., H.U., F.K., E.B., A.G., B.B., H.Ö., F.A., G.Ç., G.Ö., F.Z., S.S., Analysis or Interpretation: T.K., E.E., E.G., H.U., F.K., E.B., A.G., B.B., H.Ö., F.A., G.Ç., G.Ö., F.Z., S.S., Literature Search: T.K., E.G., H.U., F.K., E.B., A.G., B.B., H.Ö., F.A., G.Ç., G.Ö., F.Z., S.S., Writing: E.G., H.U., F.K., E.B., A.G., B.B., H.Ö., F.A., G.Ç., G.Ö., F.Z., S.S, E.E., N.Ç., T.K.

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