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Original Article

Importance of flexible bronchoscopy in the diagnosis of childhood respiratory diseases

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Abstract

Aim: One of the methods used for the diagnosis of childhood respiratory diseases is flexible fiber optic bronchoscopy (FFB). This diagnostic method allows examination of the nose, pharynx, larynx, and tracheobronchial tree. In this study, we present 2 years of FFB experience and highlight its diagnostic advantages in pediatric medicine.

Material and Methods: We retrospectively evaluated 213 FFB procedures that were performed between March 2017 and April 2019. Age, sex, FFB indication, bacterial growth in bronchoalveolar lavage (BAL) analysis, the presence of pathological bronchoscopy findings and complications after bronchoscopy were assessed.

Results: Of the 213 patients included in the study, 116 (54%) were female and 97 (46%) were male. The mean age was 4.7 ± 6.32 months. The most common indications for bronchoscopy were abnormal radiological findings (30.5%), stridor (13.6%), and chronic cough (11.3%). In 152 patients (71%), diagnostic and therapeutic findings were obtained after bronchoscopy. Transbronchial biopsy was performed in eight patients for whom the etiology could not be determined; a diagnosis was obtained in five of these patients. Bacterial growth in BAL was detected in 68 patients (32%). Temporary complications developed in 17 patients (7.9%) with the most common complication being coughing during the procedure in 8 patients (3.8%).

Conclusion: FFB is an important method that allows visualization of the upper and lower airways. The widespread use of pediatric FFB will enable early and non-invasive diagnosis of many respiratory diseases.

Keywords: Bronchoscopy; bronchoalveolar lavage; childhood respiratory diseases; flexible bronchoscopy; transbronchial biopsy

INTRODUCTION

Flexible fiber optic bronchoscopy (FFB) has an important role in the identification of airway diseases and has been used in the diagnosis and treatment of pulmonary diseases in adults for a long time (1,2). It was first used in pediatric patients by Robert Wood in 1978 (1).

FFB aids in the visualization of the airway anatomy (e.g. agenesis), the assessment of airway dynamics (e.g.malacia), in the localization and treatment of obstructions (e.g.mucus plugs), obtaining fluid samples [i.e., bronchoalveolar lavage (BAL)], and brushing/ biopsy for microbiology and histopathology. Additional therapeutic indications consist of suctioning, therapeutic wash out, administration of medication, and guidance for difficult intubation (2,3). Also FFB is a safe diagnostic tool used in clinically and radiologically undiagnosed cases and less invasive and easy method for parenchymal or lymph node biopsy compared to open lung biopsy. Visualization of mucosal features and dynamic anomalies of the airways and access to the end airways can be detected with FFB (4). In addition it provides an important advantage because it does not require general anesthesia everytime and its complications are low (3,4). Some of its complications are desaturation, airway trauma, and laryngeal spasm. These complications are often temporary and easily tolerated by children.

FFB is used in pediatric patients by very few centers in Turkey. We retrospectively evaluated patients who had undergone FFB, to better understand the efficacy of FFB in diagnosis and treatment and assess whether this method can also be used safely in pediatric respiratory diseases.

MATERIAL and METHODS

Overall, 213 FFB procedures performed between March 2017 and April 2019 were evaluated retrospectively. Patients' age, sex, FFB indications, the presence of pathological bronchoscopy findings, bacterial growth in BAL, transbronchial biopsy results, and complications were evaluated. Hypoxia was defined as any oxygen desaturation of less than 90%. Moderate desaturation was defined as an SaO_2 between 80% and 90% and severe desaturation was an SaO_2 of less than 80%.

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Bronchoscopy procedures were performed with pediatric type bronchoscopes according to the size of patient with outer diameters of 4 mm and 5.2 mm. An intravenous catheter was secured and typically the right side of the nasopharynx was lubricated with lidocaine jelly (2%). Following the initial examination, 0.3–2.5 mL 2% lidocaine solution not exceeding 2 mg/kg was applied to the region of the vocal cords, the trachea above the carina, and the bronchi. The patients were sedated with intravenous midazolam (max. dose of 1 mg/kg), and in some cases ketamine 1 mg/kg was used if the above modalities failed to achieve appropriate sedation for the procedure. Peripheral perfusion and depth of respiration were closely monitored by a registered nurse. Respiration and blood oxygen saturation were also monitored electronically in all patients. Biopsy sites were selected based on the location of radiographic abnormalities. For focal or patchy processes, sampling was directed to affected areas. If diffuse infiltrates were present or no significant abnormalities were observed, multiple locations within one lung were biopsied. The study protocol was approved by the medical ethics committee of Cerrahpasa Faculty of Medicine, Istanbul University-Cerrahpasa.

For the purpose of statistical analyses, each procedure was counted as a separate bronchoscopy and the patient demographics (age and sex) were considered separately.

RESULTS

Of the 213 patients included in the study, 116 (54%) were female and 97 (46%) were male. The mean age was 4.7 ± 6.32 months, and 61% of the patients were under 5 years old. The most common indications for bronchoscopy were abnormal radiological findings (30.5%), stridor (13.6%), and chronic cough (11.3%) (Table 1).

Table 1. Indications for FFB

Indications	N	%
Stridor	29	13.6
Chronic cough	24	11.3
Persistent wheezing	17	8
Recurrent croup	7	3.3
Hemoptysis	11	5.2
Radiographic abnormalities (total)	65	30.5
Recurrent/persistent consolidations	42	19.7
Recurrent/persistent atelectasis	18	8.5
Localized hyperinflation	5	2.3
Localized bronchiectasis	12	5.6
Suspected foreign body	5	2.3
Removal for airway secretions, mucus plugs	18	8.5
Microbiologic identification	22	10.3
Evaluation for interstitial lung diseases	3	1.4

Bronchoscopy findings revealed excessive purulent secretions and mucus plugs in 46 (21.6%) patients, laryngomalacia in 38 (17.8%), and inflammatory changes in the airways (hyperemia and edema of the bronchial mucosa) in 32 (15%). Laryngomalacia was the most common upper airway abnormality while excessive purulent bronchial secretions and inflammatory changes were observed in the lower airways. Bronchoscopy findings were normal in 61 (28.6%) patients (Table 2).

Table 2. Diagnosis via Flexible Bronchoscopy

Diagnosis	N	%
Normal anatomy	61	28.6
Upper airway anomalies	45	21.2
Laryngomalacia	38	17.8
Laryngeal web	2	0.9
Subglottic stenosis	3	1.4
Vocal cord paralysis	2	0.9
Lower airway anomalies	107	50.2
Excessive purulent bronchial secretions and mucus plugs	46	21.6
Bronchial atresia/segment atresia	3	1.4
Tracheomalacia	10	4.7
Bronchomalacia	7	3.2
Foreign body	3	1.4
Endobronchial tuberculosis	2	0.9
Tracheoesophageal fistula	1	0.4
External bronchial compression	3	1.4
Inflammatory changes (excessive redness and edema of bronchial mucosa)	32	15

BAL detected growth in 68 patients (32%). The isolated microorganisms were *Streptococcus pneumoniae* (n = 27), *Haemophilus influenzae* (15), *Moraxella catarrhalis* (9), *Pseudomonas aeruginosa* (7), *Mycobacterium tuberculosis* (3), *Bacteriodes spp* (3), *Acinetobacter* (2), *Aspergillus fumigatus* (1). Two microorganisms (*Streptococcus pneumoniae and Moraxella catarrhalis*) were detected in one patient.

Transbronchial biopsy was performed in eight (3.7%) patients with abnormal radiological findings and non-determined etiology of the disease. Four of these patients underwent transbronchial biopsy due to pathologic lymph nodes in the mediastinum, two due to suspected interstitial lung disease, one due to diffuse nodular lesions

in the lung parenchyma, and one due to tracheobronchial stenosis. After the pathological evaluation of the samples, two patients were diagnosed with tuberculosis infection, one patient with Langerhans cell histiocytosis, and two patients with ANCA-related vasculitis. In three patients, no diagnosis was established from the biopsy specimen.

At least one complication was detected in 17 patients (7.9%) during the FFB procedure. Cough developed in eight (3.8%) patients, transient hypoxia in five (2.3%) patients, epistaxis in three (1.4%) patients, and transient bradycardia in one (0.5%) patient. Four of the patients who developed transient hypoxia were under 2 years of age, and oxygen saturation rapidly normalized in three patients with oxygen support and removal of the bronchoscope from the airway. Oxygen saturation increased in two patients shortly after initiating short-term mask positive pressure ventilation. There were no mortalities.

DISCUSSION

FFB is important in the diagnosis and treatment of acute and chronic pediatric diseases. Our study explored the diagnostic and therapeutic usefulness of FFB and BAL, to highlight potential complications and report the overall diagnostic yield of BAL.

61% of the patients were under the age of 5 years in our study. Similar to our study, in many studies on this subject, most of the patients who underwent FFB were in the younger age group (2–4). The most common indications for bronchoscopy were abnormal radiological findings and stridor. In Woodhull et al. (2), abnormal radiological findings (56.7%) were the most common FFB indication followed by stridor (23.1%). In another study conducted on 1328 pediatric patients, the most common indications for bronchoscopy were recurrent/persistent pneumonia (22.1%), recurrent wheezy bronchitis (15.4%), and persistent productive cough (9%) (5). In a study conducted in our country, the most common indication for bronchoscopy in patients younger than 3 years was stridor, whereas in patients older than 3 years it was the detection of infectious agents (6). In the same study, the most common pathological FFB findings were laryngomalacia in patients younger than 3 years and infectious causes in patients over 3 years of age. In our study, the most common pathological findings regardless of age were excessive purulent bronchial secretions, mucus plaques, and laryngomalacia. Many structural anomalies such as laryngeal webs, subglottic stenosis, tracheomalacia, bronchomalacia, and tracheoesophageal fistulae, which can be diagnosed only through endoscopic imaging, were detected via FFB. In addition, FFB has become essential to the detection of lower respiratory tract infections through BAL analyses and subsequent antibiotic selection.

Transbronchial biopsy greatly helps to diagnose lung diseases in adults. It is less invasive than thoracoscopic lung biopsy and a few centers use it in children. One study found that transbronchial biopsy allowed sufficient and safe biopsy collection in the majority of pediatric patients (7). In our study, few patients underwent biopsy, which was performed in only eight patients for various indications, five of whom were able to be diagnosed.

Complications may be observed during the pediatric FFB procedure. These include epistaxis, cough, desaturation, bradycardia, laryngospasm, fever, and infection. In only 7.9% of our patients, we observed minor complications such as cough, epistaxis, desaturation, and bradycardia that did not last long enough to disrupt the patient's hemodynamics. In a previous study conducted on this subject, complications were seen in 6.9% of the patients, with cough, transient desaturation, epistaxis, and laryngospasm reported to be among the most common complications (5).

Hypoxia is a common complication observed during the FFB procedure. A wide variety of mechanisms can lead to hypoxia. Although laryngospasm and bronchospasm develop after excessive cough, they often occur due to the temporary obstruction of the airway by the bronchoscope. Affected patients usually recover after a short time with oxygen support but a few of them require positive pressure ventilation (8,9).

In Blic et al. (5), major complications such as severe hypoxia, bronchospasm, and pneumothorax were reported in a very small number of patients. Hypoxia was seen more frequently in patients less than 2 years of age who had laryngotracheal anomalies. In another study, transient hypoxia associated with FFB developed in 23% of infants (10-12). Schnaph et al. (11) reported that hypoxia most frequently developed in young children, particularly those who were 6–12 months of age. In our study, four of five patients with transient hypoxia were under the age of 2 years and only two of them required positive pressure ventilation via mask.

CONCLUSION

In conclusion, pediatric FFB is a valuable tool in the the diagnosis and treatment of pediatric airway diseases. It has a good safety profile with rarely reported life threatening or longstanding complications.

Competing interests: The authors declare that they have no competing interest.

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Ethical approval: Ethical protocol was approved by the medical ethics committee of Cerrahpasa Faculty of Medicine, Istanbul University-Cerrahpasa, Turkey.

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