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Upper airway abnormalities detected in children using flexible bronchoscopy

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ABSTRACT

Objectives: Rapid anatomical evaluation is essential to establish the severity of cases with upper respiratory obstruction and to define the degree of respiratory distress. Detailed airway endoscopy is required in most patients, not only for diagnosis, but also to treat the condition.. In this study, as two of the largest paediatric pulmonology centres in Turkey, we reviewed the data of our bronchoscopy patients, and aimed to document the upper airway abnormalities that we detected during these procedures.

Patients and methods: A retrospective analysis was made of the records of 1076 paediatric cases with pulmonary/airway disease who had undergone flexible bronchoscopy between 2007 and 2011.

Results: Upper airway malacia disorders were the most common (79.6%, $n = 259$) bronchoscopic findings detected in the patients. The other most common pathologies were laryngeal edema (12.9%, $n = 42$), external tracheal compression (12.3%, $n = 40$), subglottic stenosis (4.0%, $n = 13$), tracheal stenosis (2.8%, $n = 9$), and vocal cord paralysis/irregularity (2.8%, $n = 9$). The mean duration of symptoms was shortest in patients with vocal cord paralysis, and longest in patients with tracheal nodules ($p < 0.001$).

Conclusion: Paediatricians should keep in mind the possibility of malacia disorders and other congenital and acquired upper airway abnormalities in children with chronic respiratory problems. Diagnosis of underlying diseases, as soon as possible, permits the withdrawal of antibiotics or antiasthmatic drugs often used unnecessarily for long periods to treat these children.

1. Introduction

There are many congenital or acquired causes of upper airway respiratory distress in children. Stridor, the most common symptom in such cases, is a harsh, vibratory sound of variable pitch caused by partial obstruction of the respiratory passages that result in turbulent airflow through the airway. Although stridor may be the result of a relatively benign process, it may also be the first sign of a serious and even life-threatening disorder [1]. Congenital airway anomalies are the most frequent causes of stridor in newborns and infants, of which laryngomalacia is the main etiologic abnormality [2–6]. Although laryngomalacia is a self-limiting condition which may only occasionally need any intervention [5], other common causes of airway obstruction should be excluded as these may be life threatening and require early surgical intervention [5,7]. Other relatively common congenital malformations of the larynx and trachea that cause stridor include tracheomalacia, atresia, laryngeal webs, cysts, subglottic stenosis, laryngeal clefts, haemangiomas, laryngocele and vocal cord palsy [2,3,8]. Vascular rings compressing the trachea, prolonged intubation, foreign bodies and tumours are some of the acquired causes of paediatric upper airway respiratory distress [2,6].

Rapid anatomical evaluation is essential to establish the severity of cases with upper respiratory obstruction and to define the degree of respiratory distress. Flexible fibreoptic bronchoscopy (FOB) under local anaesthetic was first used to investigate these cases in infants by Silberman et al. [9]. Detailed airway endoscopy will be required in most patients, not only for diagnosis, but also to treat the condition. Flexible bronchoscopy does not require general anaesthesia and allows the examination of the nose, the pharynx, the supra and subglottic regions and laryngeal and tracheal dynamics [6]. There are few studies in literature to date, which investigate laryngeal and tracheal pathologies in childhood, aided by flexible fibreoptic bronchoscopy. In this study, as two of the largest paediatric pulmonology centres in Turkey, we reviewed the data of our bronchoscopy patients, and aimed to document the upper airway abnormalities that we detected during these procedures.

2. Materials and methods

A retrospective analysis was made of the records of 1076 paediatric cases with pulmonary/airway disease who had under-

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gone flexible bronchoscopy between 2007 and 2011 in two of the top paediatric pulmonology centres of the biggest city of Turkey, Istanbul (Sureyyapasa Chest Diseases and Thoracic Surgery Training and Investigation Hospital and Bezmialem Vakif University, Faculty of Medicine). Patient details, indication for procedure, co-morbidities, clinical, radiological and pathological information and bronchoscopy findings were obtained by reviewing patient charts, bronchoscopy reports, and laboratory results.

Procedures were performed transnasally with paediatric or adult type bronchoscopes according to the size of the patient (Olympus BF 3C40, with outer diameter of 3.6, and 4.9 mm, Two Corporate Center Drive, Melville, NY). All the procedures were performed in the paediatric bronchoscopy units. An intravenous catheter was secured, and the nasopharynx, usually the right side was topically lubricated with lidocaine jelly (2%), and the vocal cords were locally anesthetized, after the initial examination, with 0.3–2.5 ml of 2% lidocaine solution, not exceeding 2 mg/kg. It was applied to the region of the vocal cords, then to the trachea above the carina and the bronchi. The patients were sedated with intravenous midazolam (max. dose of 0.1 mg/kg) and pethidine infusion (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. The effects of midazolam were reversed by flumazenil in all patients after the procedure. Peripheral perfusion and depth of respirations were closely monitored by a registered nurse. Respirations and blood oxygen saturation were also monitored electronically in all patients. Continuous oxygen was delivered via a nasal cannula for children who were spontaneously breathing.

Persistent/recurrent unexplained wheezing, inspiratory and expiratory stridor, chronic cough, and haemoptysis were the most common indications for flexible bronchoscopy. Severe hypoxemia ($PaO2 < 50$ mm Hg), bleeding diathesis, severe haemoptysis, haemodynamic instability, or arrhythmia and extreme upper airway obstruction were contraindications for the procedure. Informed consent for the FOB and to use the information for research was obtained from the parents. Statistical analysis was performed using SPSS for Windows 18.0. Data are presented as either percentages or mean ± SD as appropriate. Evaluation of the data was made by *t*-test, one-way ANOVA test and Chi-square test, and a value of $p < 0.05$ was accepted as statistically significant.

3. Results

A total of 1076 children with respiratory symptoms underwent bronchoscopy procedure during the study period. Laryngeal and tracheal abnormalities were detected in 30.2% ($n = 325$) of the patients; the male/female ratio was 1.77, with a mean age of 26.4 ± 17.1 months (range 1 months to 15 years), and mean duration of respiratory symptoms to diagnosis by FOB at 13.8 ± 7.8 months (median: 6 months, 25th/75th percentiles: 2.5/12.0 months). The most common indications for performing FOB were persistent airway obstruction symptoms (81.5%, $n = 265$), chronic cough (25.2%, $n = 82$), respiratory distress (12.6%, $n = 41$), persistent infiltrations (9.2%, $n = 30$), and atelectasis (6.1%, $n = 20$). There were two indications for FOB in 175 cases, and three FOB indications in 43 cases.

Upper airway malacia disorders were the most common (79.6%, $n = 259$) bronchoscopic findings detected in the patients. Laryngomalacia was the most common malacic disorder (56.7%, $n = 217$), and tracheomalacia was seen in 42.8%, bronchomalacia was seen in 4.6% of patients with laryngomalacia. The other most common pathologies were laryngeal edema (12.9%, $n = 42$),

Table 1
Bronchoscopic findings of the patients.

Findings	*N*	%	Age (months)	Duration of symptoms (months)	Male/Female ratio
Upper airway malacia disorders	259	79.6	19.2 ± 9.6	11.3 ± 7.4	1.8
Laryngomalacia	124	38.1	20.8 ± 10.1	12.2 ± 10.1	1.9
Laryngotracheomalacia	93	28.6	13.4 ± 7.8	9.9 ± 7.2	1.6
Tracheomalacia	42	12.9	28.3 ± 20.7	25.1 ± 20.6	2.5
Laryngeal edema	42	12.9	22.3 ± 18.3	6.5 ± 5.6	1.5
External tracheal compression	40	12.3	55.9 ± 48.0	27.4 ± 17.2	1.4
Subglottic stenosis	13	4.0	26.1 ± 20.9	5.8 ± 4.9	5.5
Bronchomalacia	10	3.0	22.0 ± 15.9	11.2 ± 12.4	1.5
Tracheal stenosis	9	2.8	10.0 ± 4.0	7.8 ± 5.4	2.0
Vocal cord paralysis/irregularity	9	2.8	81.0 ± 59.8	2.7 ± 0.3	1.0
Tracheal granulation scar	8	2.4	95.6 ± 65.7	14.5 ± 12.0	7.0
Tracheal bronchus	7	2.1	98.5 ± 71.0	7.1 ± 6.6	0.75
Tracheoesophageal fistula	6	1.8	33.6 ± 15.6	18.7 ± 11.7	2.0
Tracheal polyp	4	1.2	22.5 ± 6.2	11.2 ± 5.2	3.0
Subglottic web	4	1.2	6.6 ± 5.5	3.8 ± 3.3	0.3
Tracheal nodul	4	1.2	120.0 ± 16.9	72.0 ± 36.6	1.0
Others (tracheal mucous plug, foreign body aspiration, tracheitis, endotracheal tuberculosis, haemangioma)	6	1.8	72.6 ± 34.8	41.5 ± 12.8	1.2
p Value*			<0.001	<0.001	<0.001

* *p* Value was calculated with one-way ANOVA test.

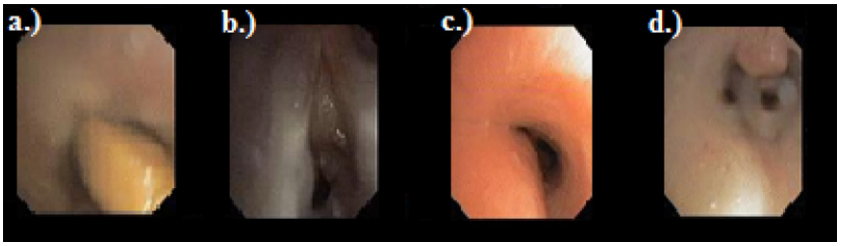

Fig. 1. Different types of endotracheal lesions; (a) aspirated foreign body, (b) endotracheal granulation scars secondary to prolonged entubation, (c) extrinsic tracheal compression secondary to vascular abnormality, and (d) endotracheal polyp.