Original Article

ISSN: 1735-0344 *Tanaffos 2022; 21(3): 354-361*

TANAFFOS

Role of Flexible Fiberoptic Bronchoscopy in the Diagnosis and Treatment of Pediatric Airway Foreign Bodies: A 5-Year Experience at a Tertiary Care Hospital in Iran

Danial Turk [1], Mohammad Ashkan Moslehi [2], Hamidreza Hosseinpour [1]

[1] School of Medicine, Shiraz University of Medical Sciences, Shiraz, Iran, [2] Pediatric Interventional Pulmonology Division, School of Medicine, Shiraz University of Medical Sciences, Shiraz, Iran.

Received: 28 April 2021
Accepted: 17 February 2022

Correspondence to: Moslehi MA
Address: Pediatric Interventional Pulmonology Division, School of Medicine, Shiraz University of Medical Sciences, Shiraz, Iran
Email address: ashkanmoslehi@gmail.com

Background: Foreign body aspiration can be a life-threatening incidence amongst children. The aim of this study was to evaluate the usefulness and outcomes of foreign body removal with emphasis on accuracy of flexible fiberoptic bronchoscopy and the predictors of post- procedure complications in children.

Materials and Methods: Records of patients who had undergone flexible fiberoptic bronchoscopy for foreign body extraction in Namazi Hospital affiliated to Shiraz University of Medical Sciences from 2012 to 2017 were retrospectively reviewed.

Results: 109 patients in whom foreign body were detected by flexible fiberoptic bronchoscopy were enrolled. The patients' age range was between 10 days to 16 years, with the male predominance and the peak incidence amongst toddlers aged 1 to 2 years. The majority of foreign body were situated in the left main bronchus (22.9%). Coughing (37.5%) and chocking (20.8%) were the most commonly recorded symptoms. Hyperinflation (63.5%) and lung collapse (19.2%) were the most radiological findings. The duration of the procedure for 50.5% of the patients was 5-8 minutes. No complications were recorded during the flexible fiberoptic bronchoscopy procedure. Ninety-five percent of the patients had more than one visit before their admission for bronchoscopy with incorrect diagnosis of asthma/reactive airway disease and pneumonia, 74 and 20%, respectively.

Conclusion: Although rigid bronchoscopy is still considered as the gold standard and preferred method in managing the airways foreign bodies, flexible fiberoptic bronchoscopy also can be used as an effective diagnostic and therapeutic tool with high success.

Key words: Airway Obstruction; Aspiration; Children; Foreign Body; Flexible Fiberoptic Bronchoscopy

INTRODUCTION

Foreign Body Aspiration (FBA) remains a serious medical condition amongst pediatrics, accounting for 7% of sudden deaths in children under four years old (1). The presence of a Foreign Body (FB) in the airways can lead to complications varying from lethal airway obstruction to recurrent respiratory infection, coughing, or wheezing (2). Evidence of FBA in the patient's clinical history, even if the physical and radiological findings are negative, requires timely diagnosis and treatment (3). Therefore, identifying the appropriate diagnostic tools seems to be of great importance. In the past, the use of Rigid Bronchoscope (RB)

was the preferred method for removing foreign objects from the airways. However, its limitations in removing special FBs (such as peanuts) have led to its substitution with alternative methods (3-5). These limitations, including tissue reactions and granulation and a high rate of false negative cases after the initial evaluation, have been reported as 7-16% by different authors (4,6). The flexible fiberoptic bronchoscopy (FFB) is a more appropriate procedure as patients are only lightly sedated. It can be performed safely with minimal risks and complications. A study by Swanson et al. found that the FFB was successful amongst children, while RB was unsuccessful in two cases (2). Another study by El dine Hamed et al. showed more effectiveness of FFB for diagnostic and therapeutic purposes in both upper and lower respiratory tracts in children, leading to reduced unnecessary procedures in comparison to RB (7). The aim of this study was to investigate the outcomes of FB removal as well as the role of FFB in the diagnosis and management of airway FBs among children admitted in a tertiary care hospital.

MATERIALS AND METHODS

Study design, patients, and data collection

This retrospective cross-sectional analysis was performed on 109 children suspected with FBA in Namazi Hospital from March 2012 to April 2017. Demographic data, history of FBA, type and location of FB, symptoms, results of radiographic investigations by CT scan or X-ray, duration of anesthesia and bronchoscopy intervention, complications arising during the procedure and inpatient treatment, number of visits, physician specialty, medications used before bronchoscopy, and eventually the outcomes were recorded for each patient.

The patients were considered for bronchoscopy procedure based on the initial examination, clinical symptoms, and imaging. According to the patients' age, pediatrics and adult video FFB were used with 4.2 and 5-mm Outer Diameter (OD), respectively (BF-P 190 and BF-H 190, Olympus, Japan). Written informed consent was signed by the children's parents or guardians. No food or drink was consumed within 6 hours prior to the procedure. All patients underwent general anesthesia in the bronchoscopy suite, through supplemental oxygen and intravenous propofol under continuous cardiorespiratory and blood oxygen saturation monitoring. The bronchoscope was inserted through the oropharynx and into the trachea via Endotracheal Tube (ETT) and Laryngeal mask airway (LMA) under direct vision. Diluted lidocaine (2%) was administrated using the Spray-As-You-Go method for topical anesthesia during FFB. After localization of the FB, slight suction was applied. Whenever the heart rate dropped to <80 beats per minute or saturation <80% for> 10 seconds, FFB was withdrawn and active positive pressure ventilation (PPV) began. Diluted epinephrine was used at the point of lodged FB in the condition of FB-induced granulation tissue formation. After achieving the best view, FBs were extracted using appropriate size instruments matching with the 2 mm working channel of FFB, including various types of FB retrieval forceps (alligator forceps), Dormia baskets, or balloons. All AFBs were retrieved en-block along with the bronchoscope.

After successful removal, the bronchoscope was reinserted through the patients' mouth to find out any possible complications that might have occurred during the procedure (including bleeding or obstruction) or to remove the remains of the FB.

Ethical statement

The study protocol was approved by the local Ethics Committee of Shiraz University of Medical Sciences.

Statistical analysis

SPSS software (Statistical Package for the Social Sciences) version 22.0 was used for data analyses. Normally distributed quantitative data are presented as the mean values, minimum, maximum, and standard deviation, while qualitative variables are indicated as percentage and frequency. P-value <0.05 was considered as statistically significant. Confidence intervals were extended to a level of 95%.

RESULTS

Patients' demographic characteristics

In this study, 109 patients diagnosed with FBA following FFB were included. The patients' mean±standard deviation of age was 3.29±3.21 years (ranging from 10 days to 16 years) with the male predominance (male to female ratio 2.6:1). However, the analysis showed no significant difference between the mean age of the patients concerning gender ratio (p-value=0.59). The peak incidence of pediatric FBA occurred amongst the toddlers aged 1 to 2 years (37.6%), and the lowest incidence was noted amongst preschoolers aged 3 to 5 years (6.4%).

Clinical and radiological presentations

Evaluation of the removed FBs from the airways showed that the majority of organic objects, mostly food items, were aspirated in younger children (aged less than 4 years), while inorganic objects were more frequent in older ones (aged 7 years to 16 years) (p<0.001) (Table1). Plant seeds (including Sunflower, watermelon, and pumpkin seeds) were the most common objects aspirated in both genders (40% boys *vs.* 42.3% girls) (Figure 1).

Table 1. Nature of foreign bodies according to the average age in 109 patients

Foreign bodies	Age Mean±SD (years)	P value
Living objects	16.00±1.00	
Chicken bone	0.73±0.30	
Hair	2.01±2.80	
Nuts	2.20±1.60	
Seeds	2.59±1.81	
Other organic materials	3.50±5.53	<0.001
Rice/corn	4.00±3.39	
Tooth	7.00±2.45	
Plastic	8.50±3.79	
Metals	9.00±0.34	

The majority of the FBs were located in the left main bronchus in 25 patients (22.9%) and right main bronchus in 23 (21.1%), respectively (Figure 2). Coughing in 83 cases (37.5%) and choking in 46 (20.8%) were the most common symptoms recorded, followed by wheezing in 34 cases (15.3%), fever in 13 (5.8%), and cyanosis in 12 (5.4%) (Table 2). The frequency distribution of clinical signs based on the type of FB is shown in Figure 3. A significant relationship was found between hemoptysis with living objects (leech) (P<0.001); nausea and vomiting with nuts, seeds, and metal objects (p<0.001); rales with nuts and living objects (p-value<0.001); and decreased blood oxygen saturation with hair (p<0.001).

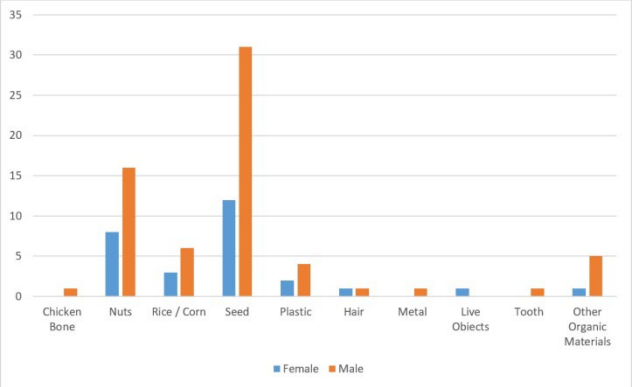

Figure 1. Frequency of foreign bodies aspirated in 109 patients

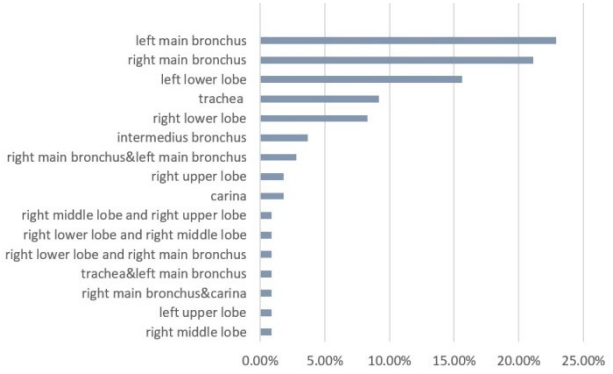

Figure 2. Anatomical locations of foreign bodies in the 109 patients

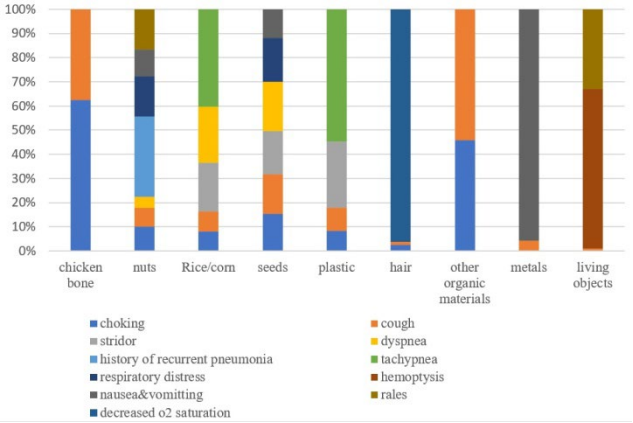

Figure 3. Frequency distribution of clinical signs based on the type of foreign body

More than half of the patients (57 cases=52.2%) with FBs had no detectable radiological findings. The most prevalent visible radiological signs were as follows: 33 (63.5%) showed hyperinflation and 10 (19.2%) revealed lung collapse (Table 2). The frequency distribution of the FB types based on radiological findings is shown in Figure 4. A significant relationship was found between pleural effusion with living objects (P<0.001); lung collapse with the chicken bone, nuts, seeds, hair, and living objects (p<0.001); and infiltration with nuts, rice/corn, and metal objects such as a screw.

Table 2. Clinical signs, symptoms, and radiological findings in 109 patients

Variable	Female (N,%)	Male (N,%)	Total (N,%)	P-value
Signs and symptoms				
Cough	22(26.5%)	61(73.5%)	83(37.5%)	0.53
Choking	14(30.4%)	32(69.6%)	46(20.8%)	0.60
Generalized wheezing	5(23.8%)	16(76.2%)	21(9.5%)	0.02*
Localized wheezing	4(30.8%)	9(69.2%)	13(5.8%)	0.80
Fever	1(7.7%)	12(92.3%)	13(5.8%)	0.007*
Cyanosis	3(25.0%)	9(75.0%)	12(5.4%)	0.81
Dyspnea	2(25.0%)	6(75.0%)	8(3.6%)	0.85
Decreased breathing sound	4(80.0%)	1(20.0%)	5(2.3%)	0.008*
Stridor	0	4(100.0%)	4(1.8%)	0.2
Rales	1(33.3%)	2(66.7%)	3(1.3%)	0.83
Respiratory distress	1(33.3%)	2(66.7%)	3(1.3%)	0.83
Nausea &vomiting	0	3(100%)	3(1.3%)	0.27
History of recurrent pneumonia	0	3(100%)	3(1.3%)	0.27
Tachypnea	0	2(100%)	2(0.9%)	0.37
Hemoptysis	1(100%)	0	1(0.9%)	0.10
Decreased oxygen saturation	1(100%)	0	1(0.9%)	0.10
Radiologic findings				
Hyperinflation	12(36.4%)	21(63.6%)	33(63.5%)	0.04*
Lung collapse	2(20.0%)	8(80.0%)	10(19.2%)	0.68
Infiltration	1(20.0%)	4(80.0%)	5(9.7%)	0.77
Shift to the left of mediastinum	1(50.0%)	1(50.0%)	2(3.8%)	0.39
Pleural effusion	1(100.0%)	0	1(1.9%)	0.08
Pneumothorax	0	1(100.0%)	1(1.9%)	0.55

Bronchoscopy intervention and patients' complications

In our study, the mean duration of the FFB procedure from time of visualization to retrieval of the FB was six minutes (lasted 5-8 minutes), and no significant difference was observed between both genders on the duration of bronchoscopy (P=0.82). However, the age difference of children based on the duration of bronchoscopy was not statistically significant (P = 0.27).

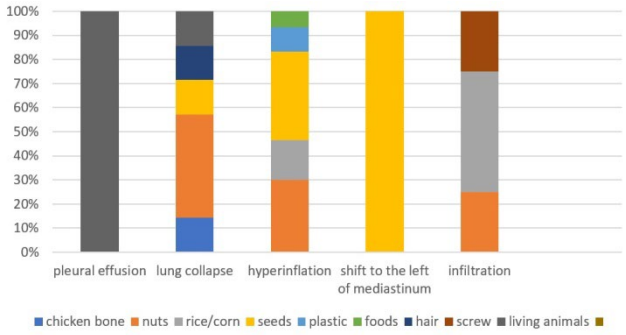

Figure 4. Frequency distribution of foreign bodies based on radiological findings

No major complication was recorded during the bronchoscopy procedure. However, one case (0.9%) suffered minor hemoptysis after bronchoscopy. Since all the patients were successfully managed with the FFB methods, no one had to undergo the RB. Due to radiological findings, most of the patients (73.4%) completely improved right after the bronchoscopic intervention, while the remaining cases (26.6%) experienced improvement within 48 hours after the intervention.

Referrals and medications in FBA and bronchoscopy

Ninety-five percent of the patients had more than one visit before their hospital admission for bronchoscopy, and 40% of them had three visits with incorrect diagnosis as asthma/reactive airway disease and pneumonia (74% and 20%, respectively). The referrals were as follows: 47 patients (43.1%) were visited by general practitioners, 34 (31.2%) of them were visited by pediatricians, 12 (11.0%) children were visited by allergists, 6 (5.5%) of them were visited by infectious disease specialists, 3 (2.8%) patients were visited by otolaryngologists, and 2 (1.8%) of them were visited by adult pulmonologists.

The duration of hospitalization was 7±3 (mean±SD) hours with a range of 4 hours to 3 days that had a significant relationship with delay in diagnosis and number of visits by physicians (P<0.005). Consequently,

antibiotics were prescribed for more than half of the cases (51.4%), inhalation sprays for 39.4%, and both antibiotics and inhalation sprays for 4.6% as they were misdiagnosed with pneumonia or asthma.

DISCUSSION

For years, the RB has been the first choice for both diagnosis and treatment of most FBAs amongst children. Despite the safety and advantages of RB, removing FBs needs alternative methods following limited access to equipment and techniques in some medical centers. This method should be used in the operating room with a deep general anesthesia level and more recovery time after the procedure (2). However, the FFB is simpler to learn, is widely available, and can be done in the bronchoscopy suite, but an expert with all necessary equipment should use it, and RBs and the operating room should be in reserve for backups (8).

Evaluation of the lower airway by the FFB is preferable to RB due to its smaller size and better navigating properties. In addition, various procedures, such as bronchoalveolar lavage (BAL), cryotherapy, balloon dilation, endobronchial, or transbronchial biopsies can be performed, if necessary (9). Successful removal of airway FBs using the FFB was reported in studies (10). However, the patients' characteristics and complications during and after the procedure were not considered in detail.

In this present retrospective study, the patients' mean age at diagnosis was 3.29±3.21 years with the male predominance, which was consistent with the literature (9-11). It seems that playfulness amongst boys is a possible reason for the greater prevalence of FBA in male cases (12). The reason for the greater prevalence of the FBA in boys is not mentioned in the sources, but we hypothesized that the male cases' greater tendency to put objects into their mouth or the evolution of swallowing mechanisms should be tested by more extensive and advanced researches in the neuropsychology field. A study by Skoulakis et al. indicated various factors predisposing younger children to the FBA, including lack of sufficient teeth to chew foods properly, and children's propensity to talk, cry, laugh, and play while chewing (12).

Our data showed that the most common age group in which the FBA occurred (1-2 years) was one year less than several studies, which was similar to some other studies (13-16). The youngest patient of our study was a ten-day old infant who had developed unresolving pneumonia, and the patient's mother long hair strand was found in his left main bronchus in his bronchoscopy. To our knowledge, this is the lowest age reported for FBA so far. We found no significant difference between the mean age of the patients concerning gender ratio (P=0.59).

The location of a FB in the tracheobronchial tree is dependent on not only the shape and size of the aspirated object, but also the child's age and his/her posture at the time of aspiration. In children older than 15 years, due to the wider and steeper anatomy of the right main bronchus as well as the development of a prominent aortic indent, affecting the trachea and left main bronchus, aspirated FBs commonly become logged on the right side. Nonetheless, in younger children, especially infants and toddlers, due to the left main bronchus predominance, it can lodge equally or more than the right-side bronchus (17,18). In our study, 22.9% of the FBs were found in the left bronchial tree, 21.10% in the right one, and 9.20% of the objects were located in the trachea (Figure 4). This shows the importance of careful chest examination, which highlights the significance of the left side findings. Since many doctors believe that the FBs are not able to lodge in the left side bronchus, it leads to misinterpretation of the findings and ultimately misdiagnoses, such as asthma or pneumonia. It may cause delayed or incorrect diagnosis as asthma, reactive airway disease and pneumonia, being mistreated with anti-asthma or antibiotics. Although pneumonia is also a well-known complication of the airway FB, knowing the duration laps between the FB aspiration and diagnosis of pneumonia may help to clarify if the pneumonia was an incorrect diagnosis or a complication of airway FB; as it is anticipated that the

longer duration the FB stays in the airway, more inflammation and infection are expected.

Organic objects (chicken bone, hair, nuts, seeds, rice, corn, etc.) were the most common aspirated bodies in children less than 4 years, whereas aspirations of inorganic bodies increase with age (Table 1). Our study revealed that there was a significant relationship between age and type of FB aspirated (P<0.001). This finding is consistent with the results of Amini-Ranjbar's study (19).

The results of our study showed that sunflower seeds were the most common cause of FBA amongst the studied children. However, according to the type of FB, the difference between male and female patients was not statistically significant (p=0.84). Swanson et al. reported 53.1% peanuts, 2.6% seeds, 35.5% other food objectives, 3.9% plastic objects, and 1.3% metal objects in cases performed with FBB (2). It should be noted that the type of commonly aspirated organic objects depends on the society and family's cultural, social, and economic factors. In our study, the most common aspirated bodies are sunflower and watermelon seeds due to availability and low cost.

In our study, coughing (37.5%) and choking (20.8%) were the most common symptoms recorded, followed by wheezing (15.3%), fever (5.8%), and cyanosis (5.4%). Farzizadeh et al. also stated coughing as the most prevalent complaint amongst the patients (20). To the best of our knowledge, our study is the first to investigate the association between clinical symptoms and the type of aspirated FB. As a result, a significant relationship was found between hemoptysis with living objects; nausea and vomiting with nuts, seeds, and metal objects; and rales with nuts and living objects.

In a study by Ghaffari et al., 29% of their patients had normal chest radiographs; however, the most common abnormal radiological findings were emphysema (44%) and atelectasis (16%) (21). The most common radiological finding reported by Goren et al. was atelectasis due to the smaller airway diameter in children (22). In another study, the most common chest X-ray findings were obstructive emphysema (53%) although 34% of patients had a normal chest X-ray (23). As to our study, no radiologic abnormality was detected in 57 patients (52.2%) with FBA. However, hyperinflation (63.5%) and lung collapse (19.2%) were the most common radiological findings in the remaining patients (47.8%). We found that there was a significant relationship between the lung collapse with the type of FB aspirated (p<0.05).

Organic foreign bodies, such as roasted nuts, are more likely to form more granulation tissues quickly. On the other hand, our study revealed that a higher amount of granulation tissues directly led to the development of pneumonia and collapse consolidation as well as longer bronchoscopy duration time. Although RB is considered as the gold standard in the diagnosis and removal of airway FBs, in our study, all foreign objects were successfully removed by FFB. The bronchoscopic procedure duration lasted 3 to 5 minutes for the diagnosis and 5 to 8 minutes, with a median duration of 6±3 minutes, for the removal of FBs. Since all FBs were removed on the first attempt without any complications, there was no need to re-perform FFB (except to check for any remaining foreign objects) or to do RB. Nevertheless, no significant difference was observed between both genders and the duration of bronchoscopy (P=0.82). Several other studies also have shown similar promising values of FFB in the retrieval of airway FBs (3,24). Therefore, although rigid bronchoscopy is considered the gold standard, FFB can be chosen as the primary method for FFB removal by an experienced bronchoscopist (25-28).

This project was limited in several ways. First, it was a retrospective study. The second and most important limitation in the present study lies in the fact that all patients were included from a single center. Furthermore, conducting prospective case-control studies by comparing the two methods and larger number of patients is strongly suggested.

CONCLUSION

FBA is a frequent pathology amongst children, and delay in diagnosis and lack of timely treatment can cause complications. The absence of clinical and radiographic

findings cannot rule out the pathology. In any patient suspected of FBA, direct evaluation via bronchoscopy is pivotal for a definitive diagnosis. FFB can be used as a useful diagnostic and therapeutic tool in the respiratory system due to its high success and reduction in false-negative RB rates. However, RB should be used as a backup method in every FFB procedure.

REFERENCES

1. Johnson DG, Condon VR. Foreign bodies in the pediatric patient. ***Curr Probl Surg*** 1998;35(4):271-379.
2. Swanson KL, Prakash UB, Midthun DE, Edell ES, Utz JP, McDougall JC, et al. Flexible bronchoscopic management of airway foreign bodies in children. ***Chest*** 2002;121(5):1695-700.
3. Kim K, Lee HJ, Yang EA, Kim HS, Chun YH, Yoon JS, et al. Foreign body removal by flexible bronchoscopy using retrieval basket in children. ***Ann Thorac Med*** 2018;13(2):82-5.
4. Righini CA, Morel N, Karkas A, Reyt E, Ferretti K, Pin I, et al. What is the diagnostic value of flexible bronchoscopy in the initial investigation of children with suspected foreign body aspiration? ***Int J Pediatr Otorhinolaryngol*** 2007;71(9):1383-90.
5. Cutrone C, Pedruzzi B, Tava G, Emanuelli E, Barion U, Fischetto D, et al. The complimentary role of diagnostic and therapeutic endoscopy in foreign body aspiration in children. ***Int J Pediatr Otorhinolaryngol*** 2011;75(12):1481-5.
6. Oncel M, Sunam GS, Ceran S. Tracheobronchial aspiration of foreign bodies and rigid bronchoscopy in children. ***Pediatr Int*** 2012;54(4):532-5.
7. El dine Hamed DH, Naguib ML, El Attar MM. Foreign body aspiration in children and role of flexible bronchoscopy: a 3 year experience. ***Egyptian Pediatric Association Gazette*** 2016;64(4):167-70.
8. Paradis TJ, Dixon J, Tieu BH. The role of bronchoscopy in the diagnosis of airway disease. ***J Thorac Dis*** 2016;8(12):3826-37.
9. Moslehi MA. A rare case of massive foreign body aspiration mimic asthma. ***Respir Med Case Rep*** 2019;28:100963.
10. Soong WJ, Tsao PC, Lee YS, Yang CF. Retrieval of tracheobronchial foreign bodies by short flexible endoscopy in children. ***Int J Pediatr Otorhinolaryngol*** 2017;95:109-13.
11. Baharloo F, Veyckemans F, Francis C, Biettlot MP, Rodenstein DO. Tracheobronchial foreign bodies: presentation and management in children and adults. ***Chest*** 1999;115(5):1357-62.
12. Skoulakis CE, Doxas PG, Papadakis CE, Proimos E, Christodoulou P, Bizakis JG, Velegrakis GA, Mamoulakis D, Helidonis ES. Bronchoscopy for foreign body removal in children. A review and analysis of 210 cases. ***Int J Pediatr Otorhinolaryngol*** 2000;53(2):143-8.
13. Bittencourt PF, Camargos PA, Scheinmann P, de Blic J. Foreign body aspiration: clinical, radiological findings and factors associated with its late removal. ***Int J Pediatr Otorhinolaryngol*** 2006;70(5):879-84.
14. McGuirt WF, Holmes KD, Feehs R, Browne JD. Tracheobronchial foreign bodies. ***Laryngoscope*** 1988;98(6 Pt 1):615-8.
15. Chiu CY, Wong KS, Lai SH, Hsia SH, Wu CT. Factors predicting early diagnosis of foreign body aspiration in children. ***Pediatr Emerg Care*** 2005;21(3):161-4.
16. Wunsch R, Wunsch C, Darge K. Foreign body aspiration. ***Der Radiologe*** 1999;39(6):467-71.
17. Van Looij MA, Rood PP, Hoeve LJ, Borgstein JA. Aspirated foreign bodies in children: why are they more commonly found on the left? ***Clin Otolaryngol Allied Sci*** 2003;28(4):364-7.
18. Ding G, Wu B, Vinturache A, Cai C, Lu M, Gu H. Tracheobronchial foreign body aspiration in children: A retrospective single-center cross-sectional study. ***Medicine (Baltimore)*** 2020;99(22):e20480.
19. Amini-Ranjbar S. Foreign body ingestion in Iranian children: a 4 years observational study. ***Russian Open Medical Journal*** 2012;1(3):0307.
20. Farzizadeh M, Hashemian H, Atrkar-Roshan Z. Clinical and radiographic findings of foreign body aspiration in children admitted to 17-Shahrivar hospital in Rasht during 1996-2008. ***KAUMS Journal (FEYZ)*** 2013;17:495-500.
21. Ghaffari J, Sahebpour AR, Mousavi SA, Saffar MJ. Respiratory foreign body aspiration in children referred to booali hospital, Sari, Iran. ***Journal of Mazandaran University of Medical Sciences*** 2010;20(75):17-22.

22. Goren S, Gurkan F, Tirasci Y, Kaya Z, Acar K. Foreign body asphyxiation in children. ***Indian Pediatr*** 2005;42(11):1131-3.
23. Aslan AT, Yalcin E, Ozcelik U, Ciftci AO, Kiper N. Foreign-body aspiration mimicking congenital lobar emphysema in a forty-eight-day-old girl. ***Pediatr Pulmonol*** 2005;39(2):189-91.
24. Faro A, Wood RE, Schechter MS, Leong AB, Wittkugel E, Abode K, et al. Official American Thoracic Society technical standards: flexible airway endoscopy in children. ***Am J Respir Crit Care Med*** 2015;191(9):1066-80.
25. Goyal R, Nayar S, Gogia P, Garg M. Extraction of tracheobronchial foreign bodies in children and adults with rigid and flexible bronchoscopy. ***J Bronchology Interv Pulmonol*** 2012;19(1):35-43.
26. Ramírez-Figueroa JL, Gochicoa-Rangel LG, Ramírez-San Juan DH, Vargas MH. Foreign body removal by flexible fiberoptic bronchoscopy in infants and children. ***Pediatr Pulmonol*** 2005;40(5):392-7.
27. Rodrigues AJ, Oliveira EQ, Scordamaglio PR, Gregório MG, Jacomelli M, Figueiredo VR. Flexible bronchoscopy as the first-choice method of removing foreign bodies from the airways of adults. ***J Bras Pneumol*** 2012;38(3):315-20.
28. Kapoor R, Chandra T, Mendpara H, Gupta R, Garg S. Flexible Bronchoscopic Removal of Foreign Bodies from Airway of Children: Single Center Experience Over 12 Years. ***Indian Pediatr*** 2019;56(7):560-2.