RESEARCH PAPER

Flexible Bronchoscopic Removal of Foreign Bodies from Airway of Children: Single Center Experience Over 12 Years

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Objective: To report our experience of tracheobronchial foreign body removal in children using flexible bronchoscopy as the primary mode. **Methods:** Hospital records of tracheobronchial foreign body extractions between January, 2006 and January, 2018 were reviewed. Clinical presentations, radiological findings, location and types of tracheobronchial foreign bodies, types of bronchoscopes, complications and outcome of the procedures were analyzed. **Results:** 283 extractions in children with median (range) age of 18 (5-168) months were reviewed. Extraction by flexible bronchoscope, using wire baskets or grasping forceps, was successful in 260 cases. No major complications were encountered. Mean (SD) time for the procedure was 31 (6.3) minutes. **Conclusions:** Airway foreign bodies can safely be removed by flexible bronchoscopy with minimal complications. This procedure can be considered the primary mode for removal of airway foreign bodies by a trained and experienced person.

Keywords: *Management, Operative time, Outcome*.

Foreign body (FB) aspiration into the tracheobronchial tree in children can be a serious event, sometimes resulting in fatal outcomes [1]. Rigid bronchoscopy has been the gold standard for extraction of airway foreign bodies [2-4]. Flexible bronchoscopy has also been used for the diagnosis of tracheobronchial FB. Recently, extraction of tracheobronchial FB by flexible bronchoscopy is gaining popularity. We herein report our experience in using flexible bronchoscopy as the primary mode of removing tracheobronchial FB.

METHODS

Records of all pediatric flexible bronchoscopies from January 2006 to January 2018 (twelve years) at a tertiary-care hospital were reviewed/retrospectively. Primary mode of extraction was flexible bronchoscopy. A written informed consent, explaining the procedure and about the referral for a rigid bronchoscopy in operation theater of the same hospital by the otolaryngologist and pediatric surgeon, if the procedure failed, was obtained from the parents. Clearance was obtained from hospital ethics committee. A pre-bronchoscopic assessment was done in all cases. Chest *X*-ray was done routinely where it was possible, except in a few cases who presented with acute respiratory emergencies with a history suggestive of foreign body aspiration. They underwent bronchoscopy as an emergency procedure.

Olympus Hybrid bronchoscope BF-MP160F (manufactured), and Olympus flexible bronchoscope BF-3C30 were used in this study. Olympus Grasping basket FG-17K-1, mini grasping basket FG-55D, grasping forceps FG-14P-1 and mini, oval rat tooth forceps FB-56D-1 were used as ancillaries. Grasping baskets were used to remove most vegetable FB, grasping forceps were used for metallic FB. Flexible bronchoscopic procedures were carried out under instillation of topical anesthetic agents (1% and 2% xylocaine) and procedural sedation and analgesia using midazolam and ketamine. All the children were admitted in day care, the procedure was carried out under cardiorespiratory monitoring in a setting of pediatric intensive care unit (PICU), using all aseptic precautions. Trained anesthetists, technicians, nurses, and intensivists comprised our team. All procedures were carried by a single trained bronchoscopist. The bronchoscope was inserted intra-nasally in most of the children. In a few older children, the oral route using a bite block was used, laryngeal mask airway (LMA) was used for bronchoscopy in children below 9 months of age as a routine. A team of a pediatric surgeon and an otolaryngologist were available as standby, in case the

procedure with flexible bronchoscopy failed. In all cases, a check bronchoscopy was done after extraction of the FB.

Clinical presentations, radiological findings, location and types of tracheobronchial FB, types of bronchoscopes; flexible or rigid, ancillaries used, complications and outcome of the procedures were analyzed.

RESULTS

Out of 966 flexible bronchoscopies in 922 children, FB were found in 283 (29.3%) (70%, 198 males). Age group ranged from 5 months to 14 years with median being 18 months.

Only 38 (13.4%) patients gave a definite history of foreign body aspiration. Remaining 245 (86.6%) presented with prolonged cough, 103 (36.4%); sudden onset respiratory distress, 73 (26%); episodic cough, 37 (13%); choking spells, 12 (4%); failure to thrive, 10 (3.5%); cyanosis, 6 (2%); and seizures, 4 (1%). Amongst these, a presumptive diagnosis of a FB aspiration could be made in 126 (44.5%) cases. Remaining 119 (42%) patients did not provide any history suggestive of foreign body aspiration, it was an incidental finding during flexible bronchoscopy.

The *X*-ray chest findings were unilateral hyperinflation 112 (39.5%), bilateral hyperinflation 16 (5.6%), collapse consolidation 8 (3%), pneumothorax 5 (1.7%), and bronchiectasis in 2 (0.7%); in 87 (31%) it was normal. In 53 (18.7%) children, *X*-rays could not be done.

Flexible bronchoscopy was successful in removing 260 (92%) airway FB using wire baskets or grasping forceps. Twenty-three (8%) foreign bodies were removed by rigid bronchoscopy (after the flexible bronchoscopy failed). The conversion to this modality was more, 15 (5.3%) till 2009, after that only 8 (2.8%) required rigid bronchoscopy. These were the vegetable foreign bodies that had swollen up and were impossible to extract through the narrow glottic opening (2 cases). Five children had old vegetable foreign body covered by thick granulation tissue and were impacted and could not be extracted by flexible bronchoscopy. One child had a thumbtack which was slipping and could not be caught in the forceps. Risk factors for failure were impacted FB and sharp slippery objects.

Four (1.5%) children had transient apnea with intravenous sedation before the procedure. There were no major complications during the procedure. Minor complications like transient hypoxia and bradycardia occurred in 10 (3.5%) during the procedure, so the same had to be abandoned for some time. Eleven (3.9%) had mild bleeding while trying to extract the FB from significant amount of granulation tissue and debris at the site of impaction, eleven (3.9%) had minor epistaxis, eight (2.8%) had laryngeal edema post procedure which responded to inhaled epinephrine. In 3 (1%) children, the extracted airway FB slipped into the oral cavity and then into the stomach.

Seventeen different types of FBs were removed (***Table* I**). The most common site of FB lodgment was the right main bronchus in 149 (52.6%), larynx and trachea in 28 (10%), migrating FB in 23 (1.8%), and 1 (0.3%) case had bilateral FB. Post-procedure recovery was good in all the children, and none of the children required a day care stay for more than 8 hours. The mean time of procedure for extraction was 31 minutes (SD 6.3). There was no mortality noted in our series by flexible bronchoscopic removal. One 18 months old child died during extraction procedure by rigid bronchoscopy. It was a custard apple seed which had swollen over a year which could not be retrieved through the narrow glottic opening. The second child, a 2-year-old, with a peanut in her right main bronchus, died half an hour after successful extraction by rigid bronchoscopy. The reason for the second mortality could be post-obstruction pulmonary edema.

DISCUSSION

The present study highlights the use of flexible

TABLE I TYPE OF ASPIRATED FOREIGN BODIES IN CHILDREN (*N*=283)

Foreign body	*No. (%)*
Vegetable matter	
Peanuts	212 (74.9)
Betel nuts	21 (7.4)
Peanut peels	6 (2.1)
Bengal gram peels	5 (1.8)
Cashew nut pieces	5 (1.8)
Coconut pieces	2 (0.7)
Custard apple seed	1 (0.4)
Metal objects	
Whistle	4 (1.4)
Nails	4 (1.4)
Crayons	4 (1.4)
Splinters	4 (1.4)
Pearls	3 (1.1)
Thumbtacks	3 (1.1)
Screws	3 (1.1)

**Two each had ear-rings, hooks and pebbles.*

WHAT THIS STUDY ADDS?

- Tracheobronchial foreign bodies can safely be removed by flexible bronchoscopy and this procedure should be considered the first choice by trained and experienced persons. with a backup of rigid bronchoscopy.

bronchoscopy as a primary mode for extracting 92% tracheobronchial FB. Because of the initial learning curve more cases were referred for the rigid bronchoscopic removal in earlier years. We faced minimal complications during the procedure. The limitation of our study is that we did not study the risk factors for complications of FB aspiration, and the procedure and frequency of referring diagnosis, as the data were incomplete.

In the recent years, there has been an increasing numbers of publications and evidence recommending flexible bronchoscopy as the primary method for tracheobronchial FB removal in children [5-15]. Reports from large centers state that since 1993 all tracheobronchial FB extractions have been performed by flexible bronchoscopy [15]. Two previous studies have also reported successful extraction of head pins by flexible bronchoscopy [11,13]. Most papers have reported minimal complications during this procedure [5-7, 10-13, 15].

Using this technique, we could avoid two separate procedures. We can conclude that tracheobronchial FB can safely be removed by flexible bronchoscopy in experienced hands with a backup of rigid bronchoscopy.

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REFERENCES

1. Foltran F, Ballali S, Passali FM, Kern E, Morra B, Passali GS *et al*. Foreign bodies in airways: A meta-analysis of published papers. Int J Pediatr Otorhinolaryngol. 2012;76S: S12-9.
2. 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. American J Respiratory Crit Care Med. 2015;191:1066-80.
3. Ernst E, Antón-Pacheco JL, Blic JD, Doull I, Faro A, Nenna R, *et al*. ERS statement: Interventional bronchoscopy in children. Eur Respir J. 2017;50:1700901.
4. Schramm D, Ling K, Schuster A, Nicolai T. Foreign body removal in children: Recommendations versus real life – a survey of current clinical management in Germany. Pediatr Pulmonol. 2017;52:656-61.
5. Kim K, Lee HJ, Yang EA, Kim HS, Chun YH, Yoon J-S, *et al*. Foreign body removal by flexible bronchoscopy using retrieval basket in children. Ann Thorac Med. 2018;13: 82-5.
6. Hata A, Nakajima T, Ohashi K, Inage T, Tanaka K, Sakairi Y, *et al*. Mini grasping basket forceps for endobronchial foreign body removal in pediatric patients, Pediatr Int. 2017;59:1200-04.
7. Tenenbaum T, Kähler G, Janke C, Demirakca S. Management of foreign body removal in children by flexible bronchoscopy. J Bronchology Interv Pulmonol. 2017;24:21-8.
8. Jayaraj AK, Jayaraj PK, Murugesh M, Aruchamy S, Yousefzadeh A, Siddiqui NT. Tracheal foreign body removal using flexible bronchoscope in a pediatric patient. A novel approach, American J Respiratory Crit Care Med. 2017;196:1071-2.
9. Endoh M, Oizumi H, Kanauchi N, Kato H, Ota H, Suzuki J, *et al*. Removal of foreign bodies from the respiratory tract of young children: Treatment outcomes using newly developed foreign-body grasping forceps. J Pediatr Surg. 2016;51:1375-9.
10. Rodrigues AJ, Scussiatto EA, Jacomelli M, Scordamaglio PR, Gregório MG, Palomino AL *et al*. Bronchoscopic techniques for removal of foreign bodies in children's airways. Pediatr Pulmonol. 2012;47:59-62.
11. Gad AYS, Hadidi MS. Removal of tracheobronchial foreign bodies using flexible and rigid bronchoscopy. Egyptian J Chest Dis Tuber. 2012;61:501-4.
12. Tang LF, Xu YC, Wang YS, Wang CF, Zhu GH, Bao XE, *et al*. Airway foreign body removal by flexible bronchoscopy experience with 1027 children during 2000-2008. World J Pediatr. 2009;5:191-5.
13. Gencer M, Ceylan E, Koksal N. Extraction of pins from the airway with flexible bronchoscopy. Respiration. 2007;74:674-9.
14. 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: 392-7.
15. Swanson KL, Prakash UBS, Midthun DE, Edell ES, Utz JP, McDougall JC, *et al*. Flexible bronchoscopic management of airway foreign bodies in children. Chest. 2002;121:1695-1700.