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Removal of foreign bodies from the respiratory tract of young children: Treatment outcomes using newly developed foreign-body grasping forceps☆,☆☆,★

Makoto Endoh *, Hiroyuki Oizumi, Naoki Kanauchi, Hirohisa Kato, Hiroshi Ota, Jun Suzuki, Hikaru Watarai, Megumi Nakamura, Mitsuaki Sadahiro

Department of Surgery II, Faculty of Medicine, Yamagata University, 2-2-2 Iida-Nishi, Yamagata City, 990-9585, Yamagata Prefecture, Japan

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ABSTRACT

Background: Although a foreign body in the airway of children constitutes a medical emergency, most available therapeutic tools are insufficient, and treatment can be difficult. Herein, we evaluated the outcomes of various treatment methods of foreign body removal from the respiratory tract.
Methods: We retrospectively analyzed 24 children (13 boys, 11 girls; median age, 18 months [range, 9–60 months]) treated for airway foreign bodies from January 1994 to December 2013 by examining their preoperative diagnoses and anesthesia and surgical methods.
Results: The foreign body was a peanut, green soybean, almond, chestnut, dental prosthesis, and bead in 15, 3, 3, 1, 1, and 1 cases, respectively. General anesthesia was used in all cases, and flexible bronchoscopy was performed under airway maintenance using a laryngeal mask in 23 cases. The mean operation time was 51 ± 32 min. Grasping forceps, basket forceps, and a Fogarty catheter were used in 14, 7, and 2 cases, respectively. In July 2003, 3-pronged foreign-body grasping forceps with a 2.0-mm diameter designed for use with a thin bronchoscope were introduced. Of 16 treated cases, 9 were successfully treated with only forceps. The mean operation time was significantly shortened to 38 ± 24 min (range, 7–91 min) compared to the traditional operation time of 82 ± 42 min (range, 23–147 min) ($p = 0.01$).
Conclusions: These novel forceps are useful for reducing the operation time and are suitable for removing airway foreign bodies from children with a narrow tracheobronchial caliber.

Although a foreign body in the respiratory tract of a young child is an emergency that requires advanced diagnostic and therapeutic modalities, the currently available instruments for intervention are insufficient. The rigid endoscope is still considered the standard instrument for removal of a foreign body; however, the use of flexible bronchoscopy has been increasing in recent years, and tools such as modified grasping forceps have also been devised. In this retrospective study, we report on the outcomes of the various treatment methods used in our department since 1994.

1. Materials and methods

The subjects were 24 children (13 boys and 11 girls) treated at our department for foreign bodies in the respiratory tract from January 1994 to December 2013. Their median age was 18 months (range, 9–60 months). In our institution, most of the foreign bodies were found to be located in the bronchi. Accordingly, the otolaryngologist usually treated the tracheal foreign bodies using a rigid tracheoscope. We retrospectively reviewed the patients' medical and operative records in terms of their preoperative diagnoses, the anesthetic and surgical methods, and their postoperative course.

The present study was approved by the Institutional Review Board of Yamagata University Hospital and was conducted in accordance with the Declaration of Helsinki. The legal guardians of the patients provided written informed consent for their medical data to be published.

The *t*-test was used for all statistical analyses, and p-values <0.05 were considered statistically significant.

2. Results

The foreign body was a peanut in 15 cases, a green soybean in 3 cases, an almond in 3 cases, and a chestnut, dental prosthesis, and bead in 1 case each. The location of the foreign body was the trachea in 2 cases, tracheal carina in 1 case, right main bronchus in 7 cases, left main bronchus in 7 cases, the truncus intermedius in 1 case, from the

Abbreviations: HFJV, High frequency jet ventilation.

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* Corresponding author.
E-mail address: m-endoh@med.id.yamagata-u.ac.jp (M. Endoh).

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Table 1
Patient characteristics and foreign body status.

Case	Age (months)	Sex	Weight (kg)	Symptoms	Preoperative examination	Foreign body	Size (mm)	Location[a]
1	48	F	19.6	Cough	Xp	Dental prosthesis	NA	Upper trachea
2	20	F	11.1	Cough	Xp	Peanut	NA	Tint-RLLB
3	60	M	NA	NA	NA	Almond	NA	NA
4	31	F	12.8	Stridor	Xp, CT	Peanut	8	RMB
5	15	M	10.6	Cough, Stridor	Xp	Bead	5	LUDB
6	23	M	10	Cough, Stridor	Xp, CT	Peanut	NA	LMB
7	18	M	13.7	Cough, Stridor	Xp, CT	Peanut	10	RMB
8	24	F	12.5	Cough	Xp, CT	Peanut	NA	RMB
9	9	M	7.6	Cough, Dyspnea	Xp, CT	Green Soybean	NA	Carina
10	14	M	8.4	Cough, Stridor	Xp, CT	Peanut	8	LMB-Lt. 2nd carina
11	15	F	8	Cough, Stridor, Vomiting	Xp, CT	Peanut	6	LMB
12	13	F	9.8	Cough, Stridor	Xp, CT	Green Soybean	7	Lower trachea
13	27	F	12	Cough, Fever	Xp, CT	Peanut	10	LMB
14	11	M	9.5	Cough, Stridor	Xp, CT	Green Soybean	10	RMB
15	41	M	12.4	Cough, Stridor, Dyspnea, Vomiting	Xp, CT	Peanut	10	Middle trachea
16	14	F	9.5	Cough, Stridor	Xp, CT	Peanut	7	RMB
17	24	F	10	Cough	Xp, CT	Almond	9	LMB, LLDB
18	28	F	12.5	Cough, Stridor, Fever, Vomiting	Xp, CT	Peanut	12	RMB
19	11	M	8	Cough, Stridor, Dyspnea, Fever	Xp, CT	Chestnut	8	LMB
20	18	M	12.5	Intubation, Stridor, Dyspnea,	Xp, CT	Peanut	7	LULB
21	18	M	9.6	Cough, Stridor, Dyspnea	Xp, CT	Peanut	10	RMB
22	25	F	10.5	Stridor, Dyspnea,	Xp, CT	Peanut	8	LMB
23	18	M	8.3	Cough, Stridor, Dyspnea, Fever	Xp, CT	Peanut	9	LMB
24	11	M	9	Cough	Xp, CT	Almond	4	LBB

[a] RMB, right main bronchus; tint, truncus intermedius; RLLB, right lower lobe bronchus LMB, left main bronchus; LULB, left upper lobe bronchus; LUDB, left upper division bronchus LLDB, left lingular division bronchus; LBB, left basal bronchus; NA, not available.

truncus intermedius to the right lower lobe bronchus in 1 case, at the bifurcation of the left upper and lower lobe bronchi in 1 case, in the left upper lobe bronchus in 1 case, left upper division bronchus in 1 case, left lingular division bronchus in 1 case, and left basal bronchus in 1 case. The foreign bodies were more frequently located within the central airways than in the segmental bronchi (Table 1, Fig. 1).

At the time of the examination, 20 patients presented with cough, out of whom 16 had accompanying stridor. Four patients had fever and 3 had vomiting, out of whom 2 were diagnosed with a common cold by a local doctor and referred to our department more than 7 days later. Preoperative computed tomography was performed for 20 patients. In the 12 patients treated since 2007, multidetector-row computed tomography was used without use of sedative agents. The volume data were reconstructed using a workstation (Ziostation; Ziosoft, Inc., Tokyo, Japan) to diagnose and assess the foreign bodies as well as to measure the tracheal and bronchial diameters.

General anesthesia was administered on operation in all cases. Airway management was performed using a rigid endoscope in 1 early case, whereas flexible bronchoscopy using a laryngeal mask was performed in all other cases (Table 2).

The main bronchoscopes used were the BF-p200, p240, 260, and p260 bronchoscopes (outer diameter, 4.4–5.3 mm; channel diameter, 2.0 mm; Olympus Medical Science Sales, Tokyo, Japan). Grasping forceps, basket forceps, and a Fogarty catheter were used in 14, 7, and 2 cases, respectively, whereas Jackson forceps were used in 1 case (in which a rigid endoscope was used) and data were unavailable for 5 cases. The foreign body was successfully removed in all 24 cases, with an overall mean operative time of 51 ± 32 min.

Bronchoscopes designed for adults have large outer diameters and are unsuitable for use in young children. Therefore, we introduced three-pronged foreign-body grasping forceps (FG-45D) designed to fit the thin bronchoscope BF-p series, which have 2.0-mm channel

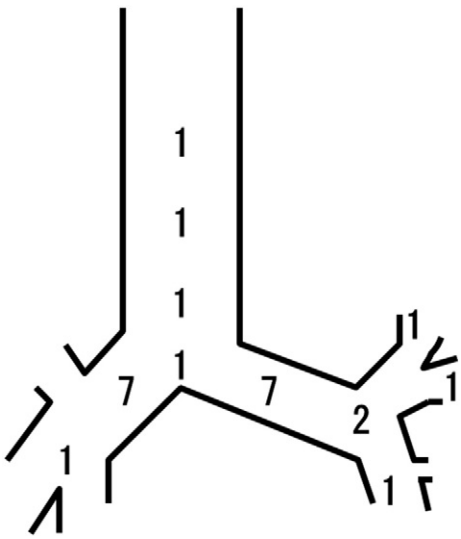

Fig. 1. Locations of the foreign bodies in the tracheobronchial tree.