

Original Article

Characteristics of correct diagnosis versus misdiagnosis of paediatric tracheobronchial foreign body

Lina Wang MM¹, Li Zhang MM¹, Chunyan Li MD¹, Hang Liang MM¹, Deli Li MM¹, Yan Wang BA¹, Xin Yin MM¹, Dawei Ren MM², Xiangfeng Meng BA³, Fanzheng Meng MD¹

¹Department of Pediatric Respiration II, The First Hospital of Jilin University, Changchun, Jilin, China; ²Department of Otolaryngological Head and Neck Surgery, The First Hospital of Jilin University, Changchun, Jilin, China; ³Jilin University, Changchun, Jilin, China

Correspondence: Fanzheng Meng, Department of Pediatric Respiration II, The First Hospital of Jilin University, NO.71 Xinmin Street, Jilin, Changchun, 130000, China. Telephone 86-1384-4976-600, e-mail mengfanzheng1972@163.com

ABSTRACT

Purpose: To characterize and compare children with correct diagnosis (CD) and misdiagnosis (MD) of tracheobronchial foreign body (TBFB).

Methods: A retrospective study was performed to review the medical records of children with CD group and MD group of TBFB. CD was defined when TBFB was identified during the first hospital visit. Otherwise, MD was considered. Demographic information, including gender, age, and clinical information, including clinical presentations and characteristics of foreign bodies, were retrieved. These characteristics were compared between two groups by Student's t-test or Wilcoxon two-sample test, or Chi-square analysis or Fisher's exact test, when appropriate.

Results: A total of 462 children with final diagnosis of TBFB were identified, with 276 children having CD and 186 children having MD. The most common location to identify the TBFB was right main bronchus in both CD and MD groups. Children with the previous history of respiratory tract foreign body were more likely to receive the CD. Children in MD group were more likely to have fever, as well as wheezing and crackles during physical examination. They were more likely to have pneumonia. Most common TBFB were peanuts. The majority of the TBFB were removed by the flexible bronchoscope coupled with forceps.

Conclusion: Careful history taking and physical examination, especially for those children with unclear causes for their pneumonia or asthma, or children with no improvement on the treatments, should be performed to rule out the possibility of TBFB. Bronchoscopy should be performed if necessary.

Keywords: Children; Diagnosis; Flexible bronchoscope; Tracheobronchial foreign body

Tracheobronchial foreign body (TBFB) is a common respiratory accident in young children (1,2). Misdiagnosed TBFB can lead to severe outcomes, including respiratory failure and death (3). Therefore, early correct diagnosis (CD) and removal of the foreign body are essential in these children. However, TBFB is easily misdiagnosed, due to variability of clinical presentations, types and locations of the foreign bodies, and accompanied complications (4).

Traditionally, rigid tracheobronchoscopy was used to remove TBFB (5). With recent advances of bronchoscope technology and the development of interventional equipment, applications of flexible bronchoscope to remove TBFB have been reported to achieve high success rate (6). However, misdiagnosis (MD) by TBFB was still reported (7,8). There was limited study to compare the characteristics between children with CD or MD of TBFB.

Received: February 19, 2019; Accepted: 2 August, 2019

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In the current research, we compared the characteristics of children with correct and misdiagnosed TBFB, with the purpose to remind the clinicians to pay more attention to children with high risk for MD of TBFB.

MATERIALS AND METHODS

Study design and participant selection

We performed a retrospective study in children with a final diagnosis of TBFB by the flexible bronchoscope in our hospital between January 2013 and December 2017. The study protocol was approved by the hospital ethics committee. Medical records were reviewed and children with final diagnosis of TBFB were included. Children with incomplete medical record were excluded from the current study.

Bronchoscopy procedure

Based on the age, weight, and the size and the location of the foreign body, either Olympus BF-XP260 (external diameter 2.8 mm, working channel 1.2 mm) or BF-P260 (external diameter 4.0 mm, working channel 2.0 mm) (Olympus Medical Systems Corp., Japan) was applied, which was coupled by foreign body forceps (external diameter 1.8 mm, Jiuhong, Changzhou, China), biopsy forceps, balloon catheter (4.0 mm × 20 mm, Goodman, Japan), or carbon dioxide cryoprobe (external diameter 1.8 mm, Kulan, Beijing, China), to remove the foreign body. During the procedure, the child was given oxygen supply through nasal cannula and monitored for oxygen saturation and heart rate. They were placed under local anaesthesia (lidocaine) with sedation (midazolam) if flexible bronchoscope was used, or generalized anaesthesia if rigid

bronchoscope was used, according to the difficulty of the foreign body removal.

Outcome measurements

Demographic information, including gender and age, and clinical information, including clinical presentations and characteristics of foreign body, were retrieved from the hospital medical records.

Children were assigned into either the CD group or MD group, based on whether their TBFB was correctly diagnosed during the first visit to our hospital.

Statistical analysis

Continuous data were presented as mean ± standard deviation or median with interquartile range (IQR), and were compared by the Student's t-test or Wilcoxon two-sample test, when appropriate. Categorical data were presented as percentage (%), and were compared by Chi-square analysis or Fisher's exact test. Statistical analysis software was SAS 9.3 (SAS, NC, USA). A $P < 0.05$ in a two-tailed test was considered statistically significant difference.

RESULTS

A total of 462 children with final diagnosis of TBFB by the flexible bronchoscope examination were identified. Their median age was 1.67 with IQR of 1.33 to 2.71 years old. There were 309 (66.9%) boys and 153 (33.1%) girls. Two hundred and seventy-six children (59.7%) were correctly diagnosed as TBFB on the initial hospital visit and 186 children (40.3%) had MDs of TBFB when they went to outside hospital for their symptoms.

Table 1. Baseline characteristics

Variables, N (%)	Classification	Correct diagnosis (N=276)	Misdiagnosis (N=186)	P
Age	<1 year old	10 (3.62)	7 (3.76)	0.420
	1–2 years old	169 (61.23)	103 (55.38)	
	2–3 years old	60 (21.74)	53 (28.49)	
	>3 years old	37 (13.41)	23 (12.37)	
Gender	Male	178 (64.49)	131 (70.43)	0.184
	Female	98 (35.51)	55 (29.57)	
Days of retained foreign body*	<1 day	15 (5.43)	0 (0.00)	<0.001
	1–5 days	200 (72.46)	19 (10.22)	
	5–10 days	37 (13.41)	63 (33.87)	
	10–30 days	22 (7.97)	67 (36.02)	
	>30 days	2 (0.72)	37 (19.89)	
History of foreign body	Yes	264 (95.65)	122 (65.59)	<0.001
	No	12 (4.35)	64 (34.41)	

*Days of retained foreign body estimated from the reported foreign body ingestion to its removal. Date of foreign body ingestion was obtained by the parents.

Table 1 listed the baseline demographics and medical information. Most TBFB happened to children between 1 and 2 years old. More boys than girls had accidents of TBFB. There were no statistically significant differences in age and gender distributions between the CD and MD groups. Children with a previous history of respiratory tract foreign body were more likely to receive a CD during the initial hospital visit. Compared to children with CD and removal of TBFB, children in the MD group had prolonged foreign body retaining in the respiratory tract.

At clinical presentation, children in the MD group were likely to have fever than the children in the CD group. Lung auscultations were also more likely to reveal wheezing and crackles in children in the MD group than those in the CD group (Table 2). Children in the MD group were more likely to have pneumonia during the initial clinical presentation.

The most common location to find the TBFB was the right main bronchus (109 children in CD group and 86 children in MD group, with a total of 195 children in both CD and MD groups, Table 3). However, the TBFB was recovered at every segment from the glottis to the lobar bronchus in both sides. A small number of children had TBFB that was mobile and bounced back and forth in the respiratory tract.

The majority of the TBFB were peanuts, which was followed by nutshells (Table 4). Children in the MD group also had more unidentifiable objects, compared with the children in the CD group, although this did not reach statistically significant inter-group difference. The most common reason for unidentified foreign body was that we only obtained a small part of the foreign body. It was difficult to identify the type of foreign body based on a small part of it.

Table 2. Clinical presentations and physical examination findings

Variable, N (%)	Correct diagnosis (N=276)	Misdiagnosis (N=186)	P
Accompanied pneumonia	54 (19.57)	106 (56.99)	<0.001
Cough	270 (97.83)	184 (98.92)	0.484
Dyspnea	103 (37.32)	81 (43.55)	0.180
Fever	27 (9.78)	75 (40.32)	<0.001
Shortness of breath	27 (9.78)	12 (6.45)	0.207
Hoarseness	0 (0.00)	2 (1.08)	0.162
Stridor	7 (2.54)	1 (0.54)	0.152
Diminished breath sounds	100 (36.23)	68 (36.56)	0.943
Wheezing	79 (28.62)	77 (41.40)	0.004
Crackles	36 (13.04)	82 (44.09)	<0.001
Retractions	5 (1.81)	3 (1.61)	1.000

The majority of the TBFB were removed by the flexible bronchoscope coupled with forceps (Table 5).

DISCUSSION

In the current study, we described the clinical characteristics of children with TBFB, and we further reported the differences between children with CD of TBFB and children with MD of TBFB.

The rate of misdiagnosed TBFB in the current study was 40.3%, which was higher than those reported before (20.1% by Gang et al. (9) and 25% by Cataneo et al. (10)). This might be because we looked for children with misdiagnosed TBFB in the current study and identified more cases that otherwise might be missed in other studies.

TBFB often happens to children in certain age range. Previous studies reported that most TBFB occurred in children between

Table 3. Locations of the foreign body

Locations, N (%)	Correct diagnosis (N=276)	Misdiagnosis (N=186)	P
Glottis	1 (0.36)	0 (0.00)	0.345
Infraglottic cavity	2 (0.72)	1 (0.54)	
Trachea	10 (3.62)	4 (2.15)	
Right main bronchus	109 (39.49)	86 (46.24)	
Left main bronchus	103 (37.32)	52 (27.96)	
Right upper opening	2 (0.72)	0 (0.00)	
Right lower opening	6 (2.17)	10 (5.38)	
Left upper opening	6 (2.17)	2 (1.08)	
Left lower base opening	1 (0.36)	0 (0.00)	
Left lower opening	10 (3.62)	12 (6.45)	
Right lower subsegment	2 (0.72)	2 (1.08)	
Left lower subsegment	1 (0.36)	2 (1.08)	
Mixed locations	19 (6.88)	11 (5.91)	
Mobile locations	4 (1.45)	4 (2.15)	

Table 4. Types of foreign bodies

Type, N (%)	Correct diagnosis (N=276)	Misdiagnosis (N=186)	P
Beans/corn kernels	13 (4.71)	6 (3.23)	0.003
Bone-like materials	12 (4.35)	8 (4.30)	
Nutshells	23 (8.33)	27 (14.52)	
Pulps	6 (2.17)	1 (0.54)	
Peanuts	187 (67.75)	117 (62.90)	
Others	11 (3.99)	5 (2.69)	
Plastic materials	14 (5.07)	2 (1.08)	
Unidentified objects	10 (3.62)	20 (10.75)	

Table 5. Methods coupled to the flexible bronchoscope to remove the foreign bodies

Location of foreign body	Forceps, N(%)	Others, N(%)	Spontaneous cough, N(%)	P
Glottis	1 (0.24)	0 (0.00)	0 (0.00)	0.006
Infraglottic cavity	3 (0.71)	0 (0.00)	0 (0.00)	
Trachea	14 (3.30)	0 (0.00)	0 (0.00)	
Right and left main bronchus	326 (76.89)	8 (44.44)	16 (80.00)	
Right upper and lower opening, left upper, lower, and lower base opening	42 (9.91)	3 (16.67)	4 (20.00)	
Right and left lower subsegments	7 (1.65)	0 (0.00)	0 (0.00)	
Mixed	25 (5.90)	5 (27.78)	0 (0.00)	
Mobile	6 (1.42)	2 (11.11)	0 (0.00)	

Others included suction nine cases, flexible and rigid bronchoscopes five cases, foreign body forceps + balloon one case, forceps + cryroprobe one case, and balloon one case.

1 and 3 years old, with 1- to 2-year old as the peak period (11–13). In the current study, most children with TBFB were between 1 and 2 years old. The high incidence of TBFB in this age group might be due to incomplete tooth development, immature laryngeal protective reflex, and weak cough responses (13). Children usually have high curiosity and like to try new things, which also increase their risk for TBFB. Our study also found that boys were more likely to have TBFB compared to girls. This was consistent with a previous report (14). Parents should pay attention to children, especially boys between 1 and 2 years old, to decrease the risk of TBFB.

Our study found that children in the CD group were more likely to have previous history of TBFB. Previous history of TBFB might draw more attention from physicians to look for the foreign body in the current hospital visit. This suggested that thorough medical history taking was important during the clinical interview to minimize the change of MD of TBFB.

Children in the MD group were more likely to present with fever. Physical examination of these patients was more likely to reveal wheezing and crackles. Physician who examined these children were more likely to give children a diagnosis of pneumonia or asthma, and missed the diagnosis of TBFB. This suggested that alternative diagnosis for children with pneumonia or asthma, especially for those with no risk factor for pneumonia or asthma, should be carefully ruled out.

Most TBFB were found in the right main bronchus. This might be due to respiratory anatomical characteristics in children. However, TBFB was actually recovered in every segment from the glottis to the lobar bronchus in both sides of the lung. A small number of children even had mobile TBFB. All of these indicated that physician who examined children with suspected TBFB should carefully inspect every segment of the respiratory tract.

We think that the common reasons for MD of TBFB include 1) parents missed or did not report the history of possible foreign body intake; 2) negative imaging studies; and 3) lack of

knowledge or experience on TBFB by physicians. Thus, careful history taking and physical examination, especially to those children with unclear causes for their respiratory symptoms, or children with no improvement after appropriate treatments, should be performed to rule out the possibility of TBFB. Bronchoscopy should be performed if necessary.

The most commonly identified TBFB was peanut, which was similar to those reported before (15,16). Previously, rigid bronchoscope was commonly applied to remove the foreign bodies (17). Recently, flexible bronchoscope was more frequently used (18–20). In the children included in this study, most TBFB was removed by the flexible bronchoscope coupled with forceps. We think that the following points should be paid attention to when removing the TBFB: 1) the distance between the forceps and the foreign body; 2) the angle and size of the opening of the forceps; and 3) the close cooperation of the physician and assistants. Our hospital commonly removed the TBFB under local anaesthesia, which could save operational time and reduce medical costs, as well as decrease the burden on the patients. It should be emphasized that vital signs of the children, including blood oxygen saturation and heart rate, should be closely monitored during the procedure.

CONCLUSION

Careful history taking and physical examination, especially for those children with unclear causes for their respiratory symptoms, or children with no improvement after appropriate treatments, should be performed to rule out the possibility of TBFB. Bronchoscopy should be performed if necessary.

Ethics approval and consent to participate: Ethical approval was given by the Ethics Committee of the First Hospital of Jilin University. All patients gave their written information consent.

Availability of data and material: The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Author's contributions: FM contributed to the study design; all authors collected the data and performed the data analysis; all authors prepared the manuscript.

Funding: There are no funders to report for this submission.

Potential Conflicts of Interest: All authors: No reported conflicts of interest. All authors have submitted the ICMJE Form for Disclosure of Potential Conflicts of Interest. Conflicts that the editors consider relevant to the content of the manuscript have been disclosed.

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