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Tracheobronchial foreign body aspiration in pediatric patients: An experience on 1060 cases in 2015

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Abstract

This study aims to investigate the clinical characteristics of tracheobronchial foreign bodies (TFBs) in children and its methods of treatment, providing a theoretical basis for including TFBs into the clinical pathway for children and conducting bronchoscopy performed by senior residents and attending physicians under general anesthesia. The clinical data of 1060 patients diagnosed with TFBs from January 2015 to January 2016 were evaluated. The age, gender, clinical manifestations, foreign body properties, thoracic CT, and three-dimensional reconstruction, preoperative and postoperative complications, hospital stay, surgical and general anesthesia bronchoscopy, and foreign body removal surgery of these patients were analyzed. TFBs frequently occurred in 0- to 3-year-old patients, accounting for 92.5%, and 64.3% of these patients were male. There is no evident difference in foreign bodies detected in the left and right bronchus. Foreign bodies are mainly botanic, accounting for 88.9%, among which peanuts and melon seeds were mostly observed. All pediatric patients received tracheobronchoscopy under general anesthesia, and 97.3% of these surgeries were performed by senior residents and attending physicians. No complication or death occurred after the surgery. TFBs can be treated according to the clinical pathway. The timely and accurate diagnosis of TFBs and its performance under general anesthesia can evidently reduce the mortality rate. Senior residents and attending physicians can be qualified to perform the bronchoscopy after training.

Keywords

foreign body aspiration, pediatric airway, tracheobronchial

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Tracheobronchial foreign body (TFB) is an emergency treatment disease, which is life-threatening and commonly seen at the Department of Otolaryngology. It is also a worldwide health problem, and its severity depends on the nature of the foreign body and the degree of airway obstruction.[1] Due to anatomy, physiology, eating habits, infant curiosity, and other factors, accidents often occur in 1- to 3-year-old infants and children, and its complications and mortalities are comparatively high.[2–4] Although the awareness of the harm caused by TFBs is being actively broadened, the number of treatments on pediatric patients with TFBs does not decrease. Thus, TFB is an emergency symptom that clinicians should seriously be concerned about. With the continuous progress of general anesthesia and bronchoscopy, the accurate diagnoses of TFBs

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and timely treatment could significantly reduce related complications and accidents. This study retrospectively analyzed the clinical data of 1060 patients diagnosed with TFBs from January 2015 to December 2015, and these patients were diagnosed according to the clinical pathway. The details are reported as follows.

Materials and methods

Clinical data

Based on the clinical data obtained from 1060 pediatric patients, who were diagnosed with TFB and received rigid bronchoscopy at the Children's Hospital of Nanjing Medical University from January 2015 to December 2015, an analysis was conducted on age, gender, clinical manifestation, foreign body properties, three-dimensional reconstruction and complications of thoracic CT, location of foreign body retention (iconographic tips and the presence of foreign bodies in the operation), qualifications of surgeons, treatment results, and hospitalization time. Inclusion criteria were as follows: (1) with or without a clear foreign body cough history, and clinical manifestations of cough, asthma, fever, and dyspnea; (2) weakened breathing sound on one side in lung auscultation, coarse breathing sound for both lungs, wheezing, rale, and rhonchi; (3) chest CT examination shows emphysema, pulmonary atelectasis, and pneumonia, and the bronchial three-dimensional reconstruction shows a shadow of foreign body blockage in the airway; (4) bronchoscopy and foreign body removal surgery were performed within 24 h after admission; (5) the foreign bodies and granulation were removed altogether during the surgery; and (6) discharged from the hospital within 4–5 days after the surgery. Exclusion criteria were as follows: (1) coughing up the foreign body during the hospitalization period, with a history of asthma and acute upper respiratory infection (URI); (2) pediatric patients who need to be transferred to another department for treatment due to failure of removing the foreign body using a rigid bronchoscope.

Operation and treatment

General anesthesia. All children are treated with intravenous drip complex anesthesia. Anesthesia induction was first performed with an intravenous injection of 0.1 mg/kg of midazolam (batch number: 20130480; Jiangsu Enhua Pharmaceutical Co., Ltd), and injected with 0.3 mg/kg of dexamethasone sodium phosphate (batch number: 1208176412; Shandong Chenxin Pharmaceutical Co. Ltd) and 2 mg/kg of propofol (batch number: KA500; AstraZeneca). After 30 s, a slow intravenous injection of fentanyl was performed (batch number: 2121130; Hubei Yichang Renfu Pharmaceutical Co. Ltd) at 3 ug/kg (administration was finished within 60 s, and spontaneous breathing was maintained). Then, the patient was maintained with 100 $ug/kg^{-1} \cdot min^{-1}$ of propofol after local anesthesia of the larynx with 0.5% to 1% lidocaine.

Operation and treatment. Under general anesthesia, the bronchoscope was inserted (refers to any type of STORZE made in Germany, which was chosen according to the age of the pediatric patient) using the rigid bronchoscopy placed through the throat. The foreign body was taken out using the bronchoscope in the air tube and bronchus. If any granulation was found, these granulation tissues were cleared. If the foreign body was splintered or the mucosa bled, tracheobronchial irrigation was performed with a solution of 2 mL of 1% lidocaine with 1:100,000 adrenaline. After 30 s, 50–70 mmHg of negative pressure was used to suck the liquid, and this was repeatedly irrigated until the lumens of the air tube and bronchus became clear. During the surgery, routine electrocardiogram and oxyhemoglobin saturation supervision were performed; antibiotics, hormone, and aerosol inhalation were routinely and intravenously given after surgery; and anti-infection and symptomatic treatment were conducted. The hospitalization time was generally 4 days. Chest fluoroscopy was performed on the third day after the surgery. If there is no obvious abnormity, the patient was discharged from the hospital.

Statistical analysis

Data analysis was performed using the SPSS Statistics 19.0 software (StataCorp LP, College Station, TX, USA). Enumeration data were expressed in percentage.

Results

Gender and age distribution

Among these 1060 pediatric patients, the youngest patient was 6 months old and the eldest patient was 9 years and 11 months old. Among these patients,

Table 1. Age distribution of the pediatric patients with TFB.

Age	Frequency	Effective percentage	Accumulative percentage
<1 year	96	9.1	9.1
1 year and above	734	69.2	78.3
2 years and above	151	14.2	92.5
3 years and above	79	7.5	100.0
Total	1060	100.0	

Table 2. Gender distribution of the pediatric patients with TFB.

Gender	Frequency	Effective percentage	Accumulative percentage
Male	682	64.3	64.3
Female	378	35.7	100.0
Total	1060	100.0	

Table 3. Type distribution of TFB.

Type of foreign body	Frequency	Effective percentage	Accumulative percentage
Organic	909	88.9	88.9
Animal	69	6.8	95.7
Chemical	26	2.5	92.5
Other	18	1.8	100.0
Total	1022	100.0	

96 patients were <1 year (9.1%), 734 patients were 1–2 years (69.2%), 151 patients were 2–3 years (14.2%), and 79 patients were >3 years (7.5%) (Table 1). Furthermore, among these patients, 682 patients were males (64.3%) and 378 patients were females (35.7%). Hence, male patients were more frequently observed (Table 2).

Distribution of the type of foreign bodies

After performing the bronchoscopy and TFB extraction surgery, it was found that botanic foreign bodies were more frequently observed. Among these patients, the foreign bodies found were mostly peanuts, sunflower seeds, and watermelon seeds in 909 patients (88.9%), animal foreign bodies such as fish bones and chicken bones in 69 patients (6.8%), and chemical foreign bodies that were mainly plastic toys or caps of a pen in 26 patients (2.5%) (Table 3). Furthermore, other types of foreign bodies were found in 18 patients (1.8%), which also had endogenous foreign bodies. In 28 patients, no foreign body was found by bronchoscopy.

Clinical presentation

Among these 1060 pediatric patients, 95% of these patients were diagnosed with TFB in other hospitals before they came to our hospital for brochoscopy. These patients presented with an evident history of inhalation and coughing caused by foreign bodies. Among these patients, 80 pediatric patients manifested with coughing, in which 30% had wheezing, a weakened or faded breathing sound on one side of the lung, as well as with or without wheezing, rale, and rhonchi. Approximately 5% of pediatric patients presented with shortness of breath and had difficulty breathing, wheezing, and cyanosis. These conditions of these patients were mainly caused by foreign bodies in the air tube or bronchus, and the breathing sounds of these patients were coarse in the auscultation of both lungs, which sometimes had a weakened sound, and wheezing could be heard sometimes.

Chest CT and three-dimensional reconstruction

Among these 1060 cases, 1007 pediatric patients received routine chest CT and three-dimensional reconstruction before the surgery. Results revealed that 479 patients had foreign bodies in the left bronchus (47.6%), 457 cases had foreign bodies in the right bronchus (45.3%), and 71 cases had foreign bodies in the air tube (foreign body in the main airway, 7.1%). Furthermore, 53 patients did not receive chest CT and received bronchoscopy under general anesthesia due to the severity of their illness. These patients all had an evident history of foreign body coughing and revealed throat wheezing, difficulty in breathing when inhaling, and cyanosis. In the examination, these patients were in low spirits, had a clear mind, and presented with a clear three-depression sign. Furthermore, these patients demonstrated hyoxemia, their blood oxygen was 80%–90%, and they did not receive a chest CT examination due to the time period. In the bronchoscopy on 53 patients, 43 cases had foreign bodies at the air tube and 10 cases had foreign bodies at the glottis; and these foreign bodies extended downward to the air trachea and bronchus.

Complications of TFBs

The complications of TFBs include pulmonary atelectasis, emphysema, pneumonia, mediastinal emphysema, subcutaneous emphysema, and

pneumothorax. Furthermore, 297 patients had complications, which were confirmed by chest CT before surgery. Moreover, 710 patients were found with no complications, and the absence of a CT examination in 53 patients could be observed in the results presented in section "Chest CT and three-dimensional reconstruction."

Results of the rigid bronchoscopy

Through rigid bronchoscopy under general anesthesia, 1022 patients were diagnosed with TFB. Among these patients, 486 patients had foreign bodies in the left bronchus (45.8%), 475 patients had foreign bodies in the right bronchus (44.8%), and 61 patients had foreign bodies in the air tube (5.8%). These foreign bodies are taken out using nippers. No foreign body was found in the air tube and left-right bronchi of 38 pediatric patients after examination. However, purulent secretion was sometimes observed in the air tubes. The purulent secretion was sucked out with aspirators, and 2 mL solution of 1% lidocaine with 1:10,000 adrenaline was used for tracheobronchial irrigation.

Distribution of the professional rank of surgeons

Among these 1060 TFB patients, the surgery of 479 patients was performed by senior residents (45.2%), the surgery of 516 patients was performed by attending physicians (48.7), the surgery of 64 patients was performed by an associate chief physician (6.0%), and the surgery of one patient was performed by a chief physician (0.1%).

Transference and returning of TFB pediatric patients and their hospitalization stay

A total of 1060 pediatric patients underwent bronchoscopy and the extraction of foreign bodies. Among these patients, 38 patients had no evident foreign body in the trachea or left–right bronchi by bronchoscopy, while 1022 patients had foreign bodies and were removed. These 1022 patients were given anti-infection and symptomatic treatments until full recovery. No complication or death occurred, and the average hospital stay of these 1060 patients was 4.3 days.

Discussion

This study revealed that 0- to 3-year-old patients with TFB account for 92.5%, and 682 of these cases are male pediatric patients, which account for 64.3%. This is in agreement with a previously mentioned research report. Previous studies have also shown that 77%–86% of TFBs found in pediatric patients were botanic.[5,6] This study revealed that the botanic TFBs of pediatric patients account for 88.9%, among which peanuts and watermelon seeds are mostly observed. Among the 1060 pediatric patients in this study, 80% of these patients presented with coughing and 30% of these patients presented with wheezing, which were in agreement with previous studies.[7,8]

Rigid bronchoscopy under general anesthesia is the gold standard for diagnosing TFBs.[9,10] In this study, 1060 pediatric patients underwent bronchoscopy under general anesthesia. Among these patients, 486 patients had foreign bodies in the left bronchus (45.8%), 475 patients had foreign bodies in the right bronchus (44.8%), and 61 cases had foreign bodies in the air tube (5.8%). These results show that there is no evident difference for foreign bodies in the bronchi. However, previous studies have revealed that the difference in foreign bodies in the right bronchus is bigger than that in the left bronchus.[11–15]

Among these 1060 patients, the surgery on 479 patients was performed by residents (45.5%) and the surgery on 516 patients was performed by visiting physicians (48.7%). No complication or death occurred. The scheduled hospitalization stay was 4 days.

Generally speaking, TFBs can be treated according to the clinical pathway. The timely and accurate diagnosis of TFBs and its performance under general anesthesia can evidently reduce the mortality rate. Senior residents and attending physicians can be qualified to perform the bronchoscopy after training.

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Author contribution

All authors acquired data. All authors drafted the manuscript. All authors contributed substantially to its revision. All authors take responsibility for the paper as a whole. All authors read and approved the final manuscript.

Availability of data and material

The authors declared that materials described in the manuscript, including all relevant raw data, will be freely available to any scientist wishing to use them for non-commercial purposes, without breaching participant confidentiality.

Consent for publication

All participants signed a document of informed consent.

Declaration of conflicting interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Ethical approval and consent to participate

The authors confirm that they have read the Editorial Policy pages. This study was conducted with approval from the Ethics Committee of the hospital. This study was conducted in accordance with the Declaration of Helsinki. Written informed consent was obtained from all participants.

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