

Three different surgical methods of the special tracheobronchial foreign body (pen cap) in children: Case series

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Abstract

We present three novel cases of tracheobronchial foreign bodies (TFBs) in children caused by pen caps. One was removed by the rigid bronchoscopy successfully, the second was removed by rigid bronchoscopy combined with tracheotomy, and the last one was treated by bronchotomy from an external thoracic approach. Rigid bronchoscopy is the most widely used for treating TFBs in clinics, especially treating large and special foreign bodies, because rigid bronchoscopy can provide a good view for observation and operation. Successful removal of a foreign body under rigid bronchoscopy (an experienced doctor, suitable instruments, etc.) can obviate tracheotomy/tracheostomy or thoracotomy/bronchotomy.

Keywords

Tracheobronchial foreign body, pen cap, children

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Introduction

Tracheobronchial foreign body (TFB) is a life-threatening emergency in the otorhinolaryngology practice. It happens commonly in children younger than 3 years and may relate to immature dentition and a still-developing swallowing technique.¹ The most common types of TFB in children are seeds, peanuts, food particles, and toys.² Items such as toy parts, paper clips, pins, and pen caps usually happen in older children.³ TFB may be managed in many ways, including flexible bronchoscopy, rigid bronchoscopy, tracheotomy/tracheostomy, thoracotomy/bronchotomy, and sometimes even resection of a pulmonary lobe.^{4–6} Here we report three different surgical methods for the special TFB (pen cap) in children. Written informed consent was obtained from legally authorized representatives for anonymized patient information to be published in this article.

Case report

Case 1

A 14-year-old previously healthy boy presented for evaluation by otorhinolaryngology approximately 9 h after suffering a pen cap foreign body aspiration. The computed

tomography (CT) of the chest showed an opacity in the right lower lobe, arousing suspicion of TFB (Figure 1(a)).

The preoperative examination is completed at once. Subsequently, rigid bronchoscopy was performed under general anesthesia. A white-hollow foreign body was visualized in the right lower lobe bronchus. The initial attempts to remove the foreign body failed because of the intense pressure of the pen cap squeezed by the bronchus. Then we made the following attempts: (1) grasp the different edges of the TFB; (2) try to turn and adjust the pen cap to expose enough free edges to grasp; (3) to eliminate the distal negative pressure of the TFB by inflating; and (4) change different surgeons and try different instruments to remove the pen cap.

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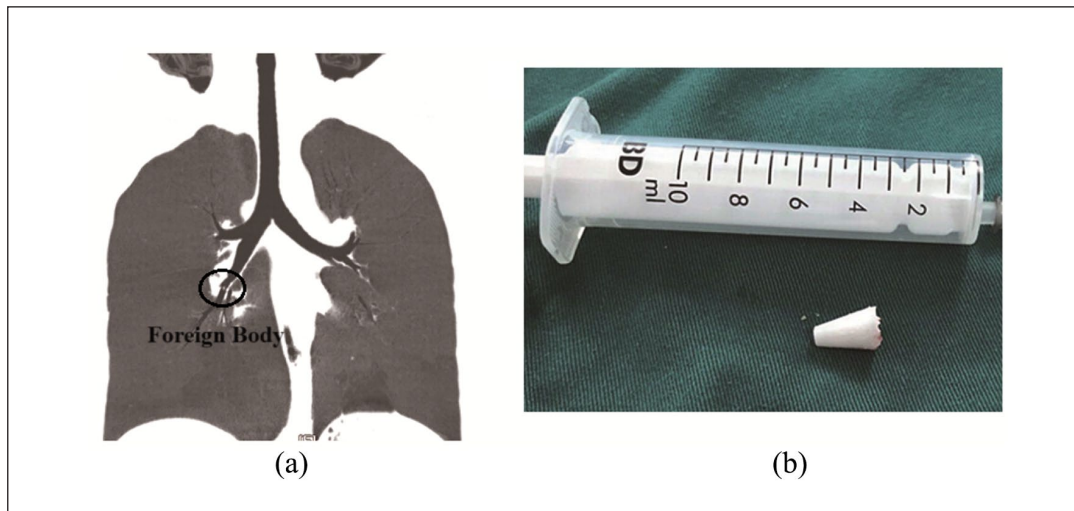


Figure 1. (a) The foreign body in the right lower lobe. (b) The plastic pen cap whose edges of the tail have been chewed up.

After a long extensive effort (4.5 h), the pen cap was successfully grasped and removed by an alligator forceps. Minor blood of bronchus was dealt with squirts of diluted epinephrine solution. The TFB was confirmed to be a pen cap, about 15 mm in length and 8 mm in diameter, the edges of the tail had been damaged by forceps (Figure 1(b)). After the operation, the patient was transferred to a pediatric intensive care unit (PICU). A chest X-ray was done 6 h later, which reported no obvious signs of hemopneumothorax or subcutaneous emphysema in the neck or chest wall. Then, he received intravenous antibiotics, hydrocortisone, and budesonide inhalation for 3 days after the operation. The patient recovered well and was discharged after 3 days with a normal voice and no hemoptysis or stridor. He remained asymptomatic and healthy after 3 months of follow-up.

Case 2

A 4-year-old previously healthy boy presented to the local emergency department with cough and wheezing after aspiration of a pen cap. The chest CT of the local institution showed a cone-looking opacity in the subglottic, indicating a suspicion of a TFB (Figure 2(a)). A rigid bronchoscopy was then performed under general anesthesia at the local hospital revealing a TFB below the vocal cords and buried in the tracheal mucosa. They were unable to remove the foreign body via bronchoscopy after 90 min and elected to transfer this patient to our hospital for evaluation and management.

The case was presented to our department with stable vital signs. Auscultation of the lungs suggested that the TFB might have moved, rechecked chest CT proved that the foreign body had migrated to the right main bronchus (Figure 2(b)). We believed that the first operation might lose the TFB, and then it migrated by cough or body movement. A rigid bronchoscopy was then performed and found that the glottic mucosa was swollen, and the hollow-cone foreign body was buried into the edematous mucosa. After many attempts, the

TFB was removed from the right main bronchus to the proximal trachea, but the foreign body was unable to pass through the glottis. Many maneuvers were attempted, such as contracting the glottic mucosa with diluted epinephrine solution, increasing the dosage of muscle relaxants, changing another surgeon, and trying different instruments. The pen cap was ultimately unable to be removed via bronchoscopy; during the operation, the oxygen was sent into the patient's lungs by rigid bronchoscopy. To avoid a second surgery, we took tracheotomy to remove TFB which turned out to be a pen cap (Figure 2(c)). Postoperatively, the patient was treated with intravenous dexamethasone, antibiotics, and budesonide inhalation for 1 week. The patient recovered healthily and only a thin neck scar remained (Figure 2(d)). He remained asymptomatic after 3 months of follow-up.

Case 3

A 13-year-old previously healthy boy presented to the local emergency department with cough and wheezing after a pen cap aspiration. A flexible fiberoptic bronchoscopy was performed at once and a TFB was identified in the right main bronchus, but difficult to retrieve due to the dense impaction around it. Then the operation was over, and the patient was treated with albuterol and antibiotic therapy in the hospital. A repeat flexible fiberoptic bronchoscopy was conducted after 3 days at the local institution. This time, the TFB was removed from the right main bronchus to the proximal trachea, but could not get through the glottis. Then the patient was transferred to our hospital.

The patient presented to our department with a productive cough and shortness of breath. The rigid bronchoscopy was then performed immediately. We found that the right bronchus mucosal was hyperemia and edema but with no foreign body, but a hollow-cone foreign body was found in the left main bronchus with part of the edge buried into the surrounding edematous mucosa (Figure 3(a)). This indicated that

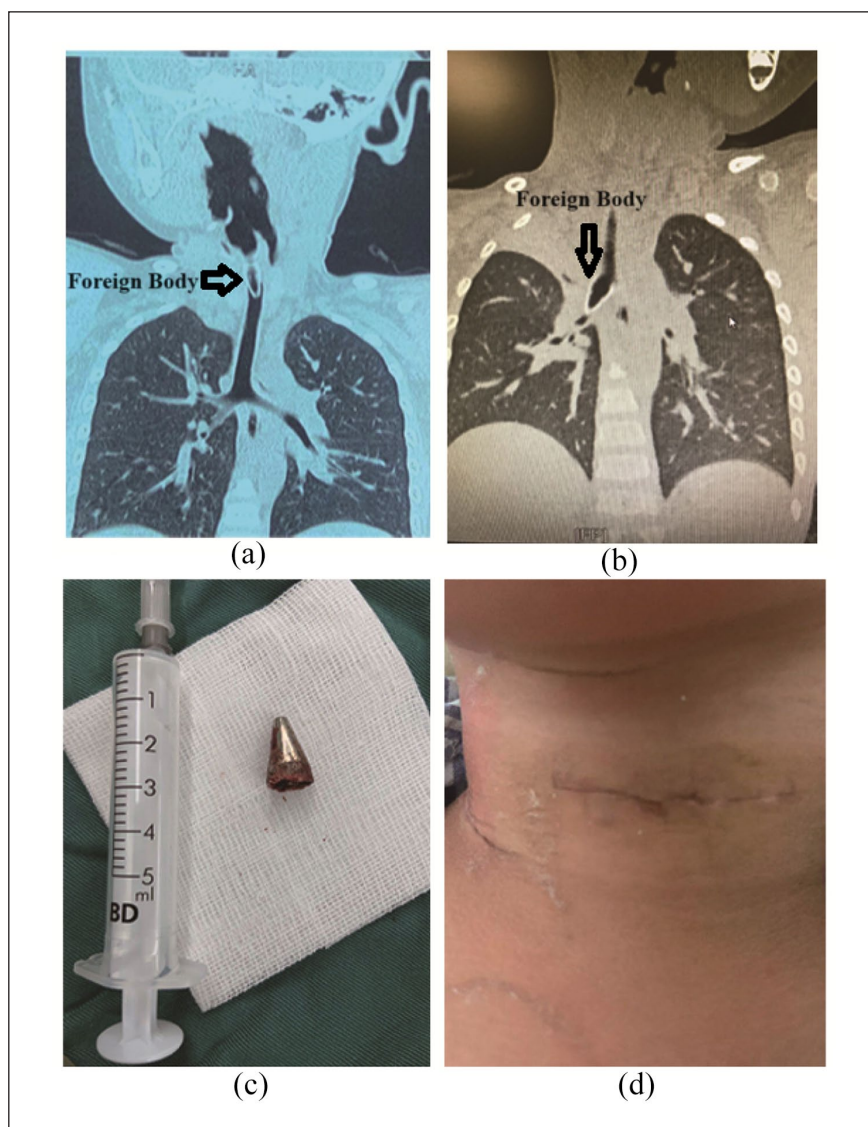


Figure.2. (a) The foreign body in the subglottic. (b) The foreign body in the right main bronchus. (c) Metal pen cap foreign body. (d) Recovery of the neck incision.

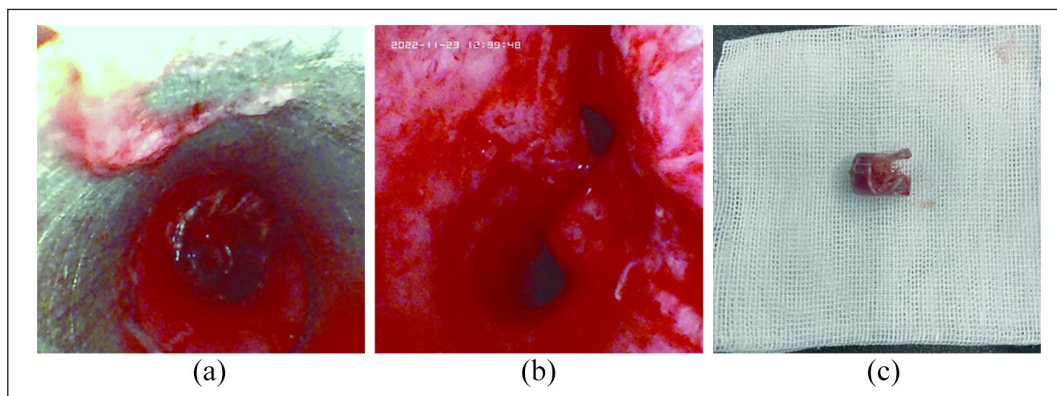


Figure.3. (a) The foreign body with part of the edge impacted into the surrounding edematous mucosa under endoscopy. (b) The bronchial fistula under endoscopy. (c) Broken plastic pen cap foreign body.

the foreign body had migrated due to the cough or previous operations. Attempts were made to remove the TFB via bronchoscopy but were unsuccessful because of pressure on the surrounding tissue. Further attempts were made, but the procedure had to be aborted due to the development of a bronchopleural fistula illustrated by rigid bronchoscopy (Figure 3(b)). Considering the TFB had migrated into the thorax, the Pediatric Cardiothoracic Operation Service suggested performing the left anterolateral thoracotomy. The TFB was removed by bronchotomy (Figure 3(c)) and the bronchial fistula was repaired simultaneously. He recovered and was discharged from the hospital after 17 days until the surgical wound of the chest recovered completely in the PICU. He remained asymptomatic and healthy after 3 months of follow-up.

Discussion

TFB is a common emergency in the otorhinolaryngology department in children under 5 years.⁷ The majority of TFB are organic (peanuts, seeds, beans) and usually lead to fever and pneumonia, unlike inorganic TFB, which happens more frequently in older children and adolescents.⁸ The most common symptoms indicating the possibility of a TFB include sudden onset of suffocation, coughing, stridor, cyanosis, and/or dyspnea. TFB requires immediate hospitalization and treatment; even if the patient's respiration is stable, coughing or body movements can trigger the migration of foreign bodies causing dyspnea and even leading to death.⁹

Rigid and flexible bronchoscopies are the main two ways to treat foreign body aspiration in children.¹⁰ A recent systematic review indicated that flexible bronchoscopy successfully removed foreign bodies in 87.1% of the patients.¹¹ However, complications such as migration or loss of foreign bodies, fragmentation, and oxygenation impairment commonly occur in flexible bronchoscopy than in rigid bronchoscopy.¹² Thus (and especially in children), rigid bronchoscopy is the most preferred treatment for respiratory-unstable patients as it ensures safe ventilation in patients with asphyxiating foreign bodies, large, and/or sharp foreign bodies, and gives a chance to tamponade possible bleed and a step-up for failed flexible bronchoscopy.^{13,14} Sometimes, the extraction would be unsuccessful by rigid or flexible bronchoscopy, and conventional surgery is needed to manage complications.^{15,16} Surgical procedures involve tracheotomy, thoracotomy, bronchotomy, and pulmonary resections.

This report described three different managements of three children with a special TFB (pen cap). Case 1 was brought to our department immediately and successfully removed the foreign body under a rigid bronchoscopy at once. Case 2 was transferred to our department after a failed attempt to remove the TFB by rigid bronchoscopy at a local hospital. We still failed to remove the TFB by rigid bronchoscopy as the pen cap was stuck under the edematous glottis. We analyzed the reasons for the TFB that could not get through the glottis: (1) the pen cap was large and had a special shape, (2) the young age (4 years old) of

the child resulted in a narrow glottis, and (3) multiple and prolonged rigid bronchoscopy resulted in mucosal edema, which aggravated the glottic stenosis. Finally, the TFB was removed by rigid bronchoscopy combined with tracheotomy. Case 3 was transferred to our department after two failed flexible bronchoscopies in a local hospital. We made a further attempt to remove the TFB by rigid bronchoscopy but failed with a perforation of bronchia and the migration to the thorax of TFB. Thus, the TFB was removed by bronchotomy in the external thoracic approach. There are few articles about pen cap TFB, only one article has reported a pulmonary lobectomy because of pen cap TFB,¹⁵ and thoracotomy and bronchotomy had to be performed to remove the pin TFB has been reported too.¹⁰ So we speculated that the large and irregular shape of TFB such as a pen cap might be not suitable for flexible bronchoscopy. And, the first way of operation is very important, unsuccessful attempts will aggravate the injury and edema of the tracheal mucosa which will increase the difficulty of the following operation. Rigid bronchoscopy or flexible bronchoscopy is a better option, based on the location of TFB, shape, and size of the TFB, the tracheal diameter on CT, and so on. If preoperative CT shows a TFB with a special shape or at lower thorax, then more experienced centers would be a better choice.

Conclusion

The pen cap is a conical shape and easy to be blocked by the glottis and tracheal ring, which should not be treated like normal TFB, and CT is useful for the identification and location of pen cap TFB. Rigid bronchoscopy is still the first and most useful choice for treating special TFB like pen caps because rigid bronchoscopy can provide a better view for observation and operation than flexible bronchoscopy, and experienced medical institutions and surgeons are critical too.

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Author contribution

All the authors contributed to the conception, design, and data collection of this study.

Teng Zhi-pan contributed to the acquisition and interpretation of data and drafted the manuscript.

Li Qi contributed to data collection and interpretation and provided critical feedback on the manuscript.

Shen Xiao-fei contributed to the interpretation of data and provided significant revisions to the manuscript.

Data Availability Statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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.

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Ethical approval

I certify that this manuscript is original, has not been published, and will not be submitted elsewhere for publication while being considered by SAGE Open Medical Case Reports. The study is not split up into several parts to increase the number of submissions to various journals or to one journal over time. No data have been fabricated or manipulated (including images) to support my conclusions. No data, text, or theories by others are presented as if they were our own. Our institution does not require ethical approval for reporting individual cases or case series.

Informed consent

Written informed consent was obtained from legally authorized representatives for anonymized patient information to be published in this article.

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