

Successful retrieval of a plastic bead from the airway of a child by flexible bronchoscopy and a balloon-tipped catheter

A case report and literature review

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Abstract

Rationale: Bronchial foreign body aspiration is a critical condition that jeopardizes the respiratory function of children. Prompt diagnosis and removal of the foreign body can reduce occurrence of foreign body complications and mortality. Aspiration of spherical plastic beads is rare, and the bead is difficult to retrieve.

Patient concerns: An 8-year-old girl developed cough, transient throat wheezing, and intermittent cough after she accidentally inhaled a plastic bead 7 hours ago. Chest computed tomography scan revealed a round shadow 1.2 cm in diameter in the right main bronchus.

Diagnoses: Foreign body in the right main bronchus.

Interventions: Retrieval by balloon-tipped catheter via flexible bronchoscopy was undertaken.

Outcomes: The bead was successfully retrieved and the child recovered uneventfully.

Lessons: Foreign body aspiration in children constitutes a medical emergency in severe cases. Flexible bronchoscopy and balloon-tipped catheter retrieval can be used as an effective noninvasive treatment for aspiration of plastic beads.

Abbreviations: AFB = Airway foreign bodies, FB = fiberoptic bronchoscope, FBA = foreign body aspiration, RMB = right main bronchus, TFBA = tracheobronchial foreign body aspiration.

Keywords: balloon, flexible bronchoscopy, Fogarty catheter, foreign body, plastic bead, retrieval

1. Introduction

Airway foreign bodies pose a severe choking hazard for children, particularly those who are younger than 3 years of age. In the United States, it is estimated that 17,537 children aged 14 years or younger visited emergency departments for choking-related episodes in 2001, and many of these episodes were associated with candy/gum (19.0%) and coins (12.7%).^[1] A review of tracheobronchial foreign body aspiration in children in South Africa revealed that metal foreign bodies are the most common

(44%) followed by plastic foreign bodies (21%).^[2] Furthermore, coins are the commonly aspirated foreign bodies (30%) followed by beads (8%). In China, on the contrary, nuts are the most common inhaled foreign bodies in children,^[3] with 1 report indicating that peanuts account for 87% of foreign bodies.^[4] Though a child with an airway foreign body may manifest paroxysmal cough, wheezing, and dyspnea upon initial presentation, he or she may also have atypical manifestations, rendering diagnosis difficult in the absence of a definite history of foreign body aspiration or ingestion and thus mandating a high index of clinical suspicion. In cases where a relatively large foreign body is inhaled such as round beads, apparent breathing difficulties, and asphyxiation may ensue, endangering the lives of the children and mandating emergency treatment. Removal of beads is challenging as beads are typically round or oval and slippery and in severe cases, extraction is undertaken of aspirated bead by open chest surgery under extracorporeal circulation.^[5] In the present study, we describe a case of plastic bead aspiration in a young girl that was successfully managed by bead retrieval via a balloon-tipped catheter and also provide a relevant literature review.

2. Case report

An 8-year-old girl was admitted to the Emergency Department of our hospital on April 10, 2015 because of accidental aspiration of a plastic bead 7 hours ago. A transient bout of coughing and labored breathing appeared, which spontaneously resolved

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This study was approved by ethics committee of the First Hospital of Jilin University.

Informed consent to the use of patient data for the current report was obtained from the parent of the patient and patient data was anonymized in the study.

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Figure 1. Flexible bronchoscopy reveals an impacted bead in the right bronchus.

without subsequent breathing difficulty. She had cough, transient throat wheezing, and intermittent cough. Examination at admission showed that the child was in a general good condition. No throat wheezing was present. There was no cyanosis and the inspiratory 3-concave sign was negative. The child had no breathing difficulty and hoarseness. Bilateral lung sounds were coarse on auscultation and chest expansion was largely symmetrical. No slap sound by a foreign body was heard. Chest computed tomography scan revealed a round shadow 1.2 cm in diameter in the right main bronchus, but was otherwise unremarkable. A diagnosis of foreign body in the right main bronchus was entertained.

Emergency bronchoscopy was carried out upon admission, and the child underwent rigid bronchoscopy (STORZ) under general anesthesia for retrieval of the foreign body. A blue plastic bead was visualized directly under the rigid bronchoscope and was found to be closely impacted on the opening of the right main bronchus (Fig. 1). The bead was 1.0 cm in diameter with a central hole 1 mm in

diameter and was not readily mobile and cannot be retrieved by forceps. A fiberoptic bronchoscope (Olympus BF-P260, Olympus medical corporation, Tokyo, Japan the external diameter 4.0 mm) was advanced through the laryngeal mask airway for re-exploration and a balloon-tipped catheter (lacrosse balloon catheter 4.0 mm × 20 mm) was entered at the same time via the maneuvering channel. The balloon was advanced through the central hole in the plastic bead and released and inflated after passing beyond the hole. The inflated balloon was 4 mm and after it was secured, it was pulled out along with the plastic bead (Fig. 2). The child had an uneventful recovery.

2.1. Literature review

We searched PubMed for published cases of bronchial aspiration of plastic beads using the keywords “bead,” “endobronchial foreign bodies,” “foreign body bronchus,” “Fogarty catheter,” and “balloon.” A total of 4 cases (including our current case) of bronchial aspiration of plastic beads published between January 1975 and November 2017 were identified in PubMed (Table 1). One report described the retrieval of the foreign body by surgery in a child in a critical condition.^[5] Their age ranged from 6 to 12 years. These children had varied manifestations. Chest X-ray findings were positive in most patients, including atelectasis, hyperventilation, and shadow of a foreign body. Except in the surgical case, all the plastic beads were removed using the “balloon bead technique.” Three cases underwent successful retrieval of the foreign body on the first attempt. In the remaining child, the balloon was improperly positioned and improper force was used to pull out the balloon, leading to rupture of the balloon. The plastic bead was retrieved on the second attempt under C-arm guidance. All the children recovered uneventfully after foreign body removal.^[5–11]

3. Discussion

Foreign body aspiration in children constitutes a medical emergency in severe cases and is a major cause of accidental death in infants and preschool children.^[12] The earliest reported case involves the use of a balloon-tipped catheter to retrieve a carnival bead, but details are not provided.^[13] In 1959, Cantor described extraction of beads in 2 cases.^[14] Plastic beads may not be easily discerned radiologically that could delay diagnosis and prompt treatment.^[15] In the present study, we report a case of inhaled plastic bead that became impacted in the right main bronchus in an 8-year-old girl. The bead was successfully

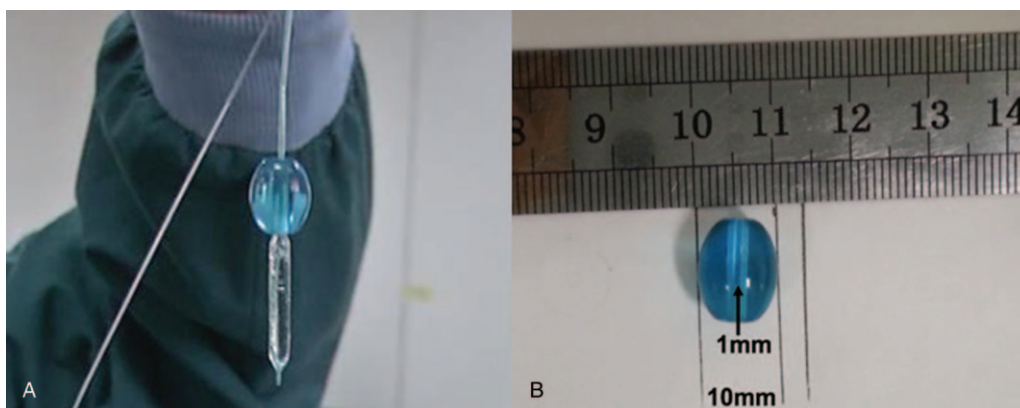


Figure 2. (A) A plastic bead is retrieved, and (B) the bead is 10 mm in size with a 1 mm central hole.

Table 1**Literature review of pediatric cases with aspirated plastic beads.**

No.	References	Sex	Age, y	Type of beads	Manifestations	Location of foreign body	Management	Imaging manifestations
1	Bawa et al ^[6]	Boy	12	Plastic	NA	Right main bronchus	Rigid bronchoscope	Ovoid radio opaque shadow in the right main bronchus
2	Deng et al ^[5]	Girl	6	Plastic	Immediate dyspnea, restlessness, and cyanosis and became comatose 5h later; blood oxygen saturation, 40–50%; heart rate, 172 beats/min	Right main bronchus	Conventional bronchoscopy failed; surgical removal under extracorporeal life support	Trachea shifting to the right and right lung atelectasis
3	Wankhede et al ^[11]	Girl	8	Plastic	Recurrent coughs for 3 d	Right main bronchus	Removal with grasping forceps failed via rigid bronchoscopy under general anesthesia; Fogarty catheter under C-arm guidance was successful	4 Fr FC Decreased air entry on right side
4	The current report	Girl	8	Plastic, 1 cm in diameter	Transient bouts of coughing and labored breathing	Right main bronchus	Balloon catheter removal via rigid bronchoscopy under general anesthesia	

retrieved with the use of a balloon-tipped catheter and the girl recovered uneventfully.

Bronchial foreign body aspiration often occurs in children younger than 3 years of age and is more frequent in boys than girls.^[16,17] However, aspiration of beads is more common in girls, likely because girls use beads more often as toys. A foreign body is more commonly located in the right bronchus, which may be related to the anatomic features of the right main bronchus: the angle in the right bronchus is smaller while the diameter of the right bronchus is larger than that of the left bronchus. Bronchial foreign bodies mostly consist of peanuts, sunflower seeds, walnuts, and chicken bone in younger children, and pen caps and small toys or toy parts in older children.^[18,19] Plastic beads as foreign bodies are rare and difficult to retrieve, and no more than 10 cases have been reported over the previous decades.

Bronchial foreign body may cause partial or complete airway occlusion and lead to complications. The optimal time for retrieval of bronchial foreign body falls within 24 hours of foreign body aspiration and if retrieval is successful within this time frame, complications can be avoided.^[18] Pneumonia, bronchitis, and esophagobronchial fistula often ensue if the foreign body stays for more than 4 weeks.^[20] Therefore, prompt retrieval of the foreign body is critical. Williams et al^[21] categorize complications into mild and severe complications. The former includes decreased arterial blood saturation, bradycardia, bronchial spasm, and others. The latter includes larynx edema, pneumothorax, and sudden cardiac arrest. Ball-shaped foreign body-associated complications mainly depend on the diameter of the foreign body. A foreign body with a larger diameter may become fully impacted in the trachea and the main bronchi, and can directly cause death. If the foreign body becomes impacted on the main bronchus, in the absence of prompt retrieval, tissue compression and necrosis ensue, leading to atelectasis and lung collapse, eventually mandating surgery. The current case and the case reported by Landy et al^[10] experienced transient breathing difficulty upon foreign body aspiration. Deng et al^[5] found that the patient had immediate marked decline in blood oxygen saturation and metabolic acidosis and hypoxemia. Therefore, prevention of development of severe complications caused by ball-shaped foreign bodies requires prompt diagnosis and retrieval.

Foreign body clamp and tissue clamp are conventionally used for retrieving aspirated foreign body via bronchoscopy, and clasp clamp and visual foreign body clamp are used for removal of the foreign body via rigid bronchoscopy. Foreign body clamp and biopsy clamp can also be used for retrieving aspirated foreign body by flexible bronchoscopy; however, because of the slippery property, size and location of ball-shaped foreign body, the foreign body clamp is not very effective in retrieving a foreign body. Ullyot and Norman report the use of the Fogarty catheter to aid bronchoscopic removal of foreign bodies in 1968.^[22] It has also been reported that balloon-tipped catheter is effective in retrieving aspirated nuts, and blunt foreign bodies including peanuts, pumpkin seeds, olive nucleus, soybeans and pig bone,^[23] as well as downward facing thumbtacks.^[24]

Balloon-tipped catheter is also considered a good option for retrieving aspirated plastic beads. For plastic bead, because of its large volume and smooth surface, it may become fully impacted in the main airway and it is difficult to retrieve using clamp, freezing, or net. Because there is a hole in the center of the bead, a balloon-tipped catheter can be advanced over the hole and after the balloon is inflated, the bead can be pulled out. The literature on retrieval of plastic beads uses this method. Balloon-tipped catheter can be advanced via a rigid or flexible bronchoscope. The anterior

segment of the flexible bronchoscope is more flexible and makes it easier to pass the catheter over the central hole in the bead and has better maneuverability than the rigid bronchoscope.

In addition, the size of the balloon-tipped catheter ranges from 2 to 4 mm and the balloon does not need to be inflated to the greatest diameter and it suffices as long as the balloon passes beyond the center hole of the bead. Meanwhile, the pressure of the balloon is smaller than that used for treatment and moderate force is applied to pull out the foreign body. The major complication of the procedure is balloon rupture, which is generally due to improper positioning of the balloon, undue pressure, repetitive pulling out, or use of excessive force for pulling out the foreign body. These can be avoided during maneuvering and, if necessary, the balloon can be released under guidance by C-arm.^[8,11]

In conclusion, aspiration of a ball-shaped foreign body by children is a critical condition, and prompt foreign body retrieval and prevention of complications should be undertaken. Balloon-tipped catheter retrieval may offer a noninvasive effective treatment method.

Author contributions

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