Case Report

Retrieval of a spherical foreign body in the right bronchus of a small child

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ABSTRACT

Background: Bronchial foreign body aspiration can result in life-threatening obstruction of the airway, which makes it a serious emergency, particularly in children. **Purpose:** To report and discuss the challenges in extracting a spherical foreign body in right bronchus of a small child. **Case report:** A 3-year-old child, inadvertently inhaled a tiny, metallic ball, which resulted in respiratory distress. Diagnostic evaluation revealed high density opacity on chest X-ray, suggestive of a foreign body in the right main bronchus. The round metallic foreign body was successfully retrieved through bronchoscopy using optical forceps and magnetic forceps. **Method:** Literature search was conducted using keywords ”round foreign body in bronchus”, ”bronchial foreign body”, and ”bronchoscopy” in Medline and PubMed. **Result:** A total of 5 cases of round foreign bodies in the bronchus were published from 2003 to 2020. One case reported surgical removal of the foreign body, while 4 others were extracted via bronchoscopic intervention. **Discussion:** This case underscores the complexities in managing bronchial foreign body aspiration, particularly spherical shaped foreign body. The foreign body was round shaped and metallic, so it was difficult to be grasped, and the patient’s bronchus was very frail. Prompt diagnosis and appropriate interventions, guided by thorough clinical assessment and imaging, are crucial in ensuring favorable outcomes in such cases. **Conclusion:** In managing patients with foreign bodies in the bronchi, it is essential to select the appropriate instruments depending on the shape and type of foreign body, and surgical intervention should be considered as the last resort for foreign body extraction.

Keywords: foreign body, spherical, bronchus, bronchoscopy

ABSTRAK

Latar belakang: *Aspirasi benda asing dapat mengakibatkan penyumbatan jalan nafas yang mengancam jiwa, sehingga hal ini merupakan keadaan darurat yang serius, terutama pada anak-anak.* ***Tujuan:*** *Melaporkan dan mendiskusikan tantangan dalam mengekstraksi benda asing berbentuk bulat di bronkus kanan pada anak.* ***Laporan kasus:*** *Seorang anak berusia 3 tahun, secara tidak sengaja tersedak bola logam kecil, yang mengakibatkan gangguan pernapasan. Evaluasi diagnostik menunjukkan adanya opasitas berdensitas tinggi di bronkus utama kanan. Benda asing berbentuk logam bulat berhasil diekstraksi melalui bronkoskopi kaku dengan menggunakan forsep optik dan pinset yang bermagnetisasi.* ***Metode:*** *Pencarian literatur dilakukan dengan menggunakan kata kunci “benda asing bulat di bronkus”, “benda asing bronkus”, dan “bronkoskopi” di* Medline *dan* PubMed. ***Hasil:*** *Sebanyak 5 kasus benda asing berbentuk bulat di bronkus dipublikasikan dari tahun 2003 hingga 2020. Satu kasus dilaporkan ekstraksi benda asing melalui operasi, sementara 4 kasus lainnya melalui intervensi bronkoskopi.* ***Diskusi:*** *Kasus ini menekankan bahwa penanganan aspirasi benda asing di bronkus sangat rumit, khususnya benda asing berbentuk bulat. Kesulitan dalam ektraksi benda asing dikarenakan bentuk dari benda asing yang bulat dan terbuat dari besi, serta ukuran lumen bronkus pada anak. Diagnosis yang cepat dan intervensi yang tepat, yang dipandu oleh penilaian klinis dan pencitraan radiologi yang menyeluruh, sangat penting untuk memastikan hasil yang baik dalam kasus tersebut.* ***Kesimpulan:*** *Dalam menangani pasien dengan benda asing di bronkus, pemilihan*

instrumen yang tergantung pada bentuk dan jenis benda asing, sangat penting. Intervensi bedah harus dipertimbangkan sebagai pilihan terakhir untuk ekstraksi benda asing.

Kata kunci: *benda asing, bentuk bulat, bronkus, bronkoskopi*

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INTRODUCTION

Tracheobronchial foreign bodies are organic or non-organic object or material, that physiologically does not exist in the tracheobronchial tract. Tracheobronchial foreign body cases are common problems worldwide and a life-threatening emergency condition that can cause airway obstruction and endanger life.[1]

According to data from the National Safety Council, tracheobronchial foreign bodies are a cause of 40 % of deaths in children under 1 year of age. The highest incidence occurs in children aged 1 to 3 years and the ratio between male and female is 3:1.[1,2]

The clinical presentation of bronchial foreign bodies in the emergency unit varies greatly depending on the type, characteristic, size, shape, location, and duration of the foreign body, as well as the age of the patient.[3,4] Some patients may not exhibit clear clinical symptoms. However, common complaints often include sudden onset cough, choking, and/or shortness of breath.[3,5] In addition to history taking and physical examination, radiological examination may reveal various findings ranging from normal radiographic images to the presence of radio-opaque shadows, and if complications are present, findings such as pneumonia, atelectasis, bronchiectasis, and unilateral hyperinflation may be observed.[6,7]

One of the principles in managing patients with bronchial foreign bodies is the immediate endoscopic removal of the foreign body.[5] The procedure that can be performed is bronchoscopy. Bronchoscopy is an endoscopic examination used to visualize the trachea, bronchi, and their branches and can be used for diagnosis, therapy, or both.[8] In the management of bronchial foreign bodies, there are several difficulties in extracting the foreign body depending on its location, type, and shape.[9]

This case report will further discuss the aspiration of a round-shaped foreign body in the airway, specifically in the right bronchus. This case report is expected to provide information and enhance the literature regarding respiratory tract aspiration incidents, especially in children, and can offer appropriate management for cases of foreign body aspiration in the bronchus.

CASE REPORT

A 3-year-old girl living in Denpasar was brought to the Emergency Department of Prof. Dr. IGNG Ngoerah Denpasar General Hospital on December 21st 2023, 23.30 o'clock by her parents. The patient had persistent cough and chest pain after accidentally inhaled a small iron ball, which was a ball from a pen spinner, while playing 30 minutes before arriving at the hospital. Subsequently, the patient appeared to have breathing difficulty and vomited three times. There was no history of drug or food allergies. Medical history, including asthma, heart disease, and diabetes, was negative.

There was no history of previous surgery, developmental delays, or mental retardation.

On physical examination, the patient appeared anxious but alert, with a weight of 13.5 kgs. Vital signs revealed a heart rate of 100 beats per minute, respiratory rate of 24 breaths per minute, axillary temperature of 36.7°C, and oxygen saturation of 97% on room air. Physical examination revealed symmetrical chest movements, decreased breath sounds on the right side, no retractions in respiratory muscles, absence of audible wheezing, palpable thuds, or stridor. Examination of the ears, nose, and throat revealed normal findings.

On cervical-thoraco-abdominal AP/lateral X-ray examination, a round high-density opacity projected at the level of the right paravertebral Th-6, suggested suspicion of a foreign body in the right main bronchus.

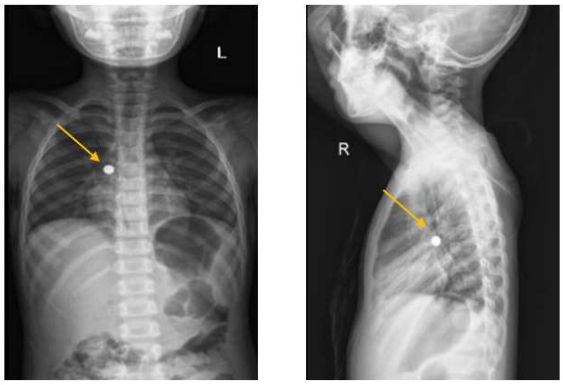


Figure 1. Cervical-thoraco-abdominal AP/lateral X-ray (Arrow: foreign body)

A complete blood count, basic metabolic panel, coagulation profile, and arterial blood gas analysis were then performed. Results revealed white blood cell count (10.38 x 10^3/µL), neutrophil count (40.00 x 10^3/µL), hemoglobin level (11.5 g/dL), INR (1.00), and APTT (34.1 seconds). Additionally, arterial blood gas analysis showed normal pH (7.43), decreased pCO2 (30.0 mmHg), and increased pO2 (113.00 mmHg).

Based on her medical history, physical examination, and diagnostic tests, the patient was diagnosed with suspected foreign body (iron ball) in the airway, and was planned for extraction using rigid bronchoscope. The patient was consulted to the Department of Anesthesia and Intensive Therapy for surgical eligibility assessment, to the Department of Pediatric Respirology, and to the Department of Thoracic Cardiovascular Surgery for back up thoracotomy. The Department of Anesthesia and Intensive Therapy approved the surgical procedure with ASA II physical status (mild systemic disease, no functional limitations). The Department of Thoracic Cardiovascular Surgery agreed to assist in the bronchoscopic extraction procedure, and the Department of Pediatric Respirology advised post-procedure PICU backup. The patient was given IV fluid therapy with Ringer's lactate-Dextrose 5% at 18 drops per minute, intravenous ceftriaxone 500 mg every 12 hours, and intravenous dexamethasone 2.5 mg every 12 hours.

The patient underwent foreign body extraction procedure using a rigid bronchoscope on December 23, 2023, under general anesthesia. After the patient was sedated, bronchoscopy was performed using a size 4 rigid bronchoscope, revealing the foreign body at the opening of the right main bronchus. At first, extraction was attempted using basket extractor, but failed because there was lack of space to insert the basket guide.

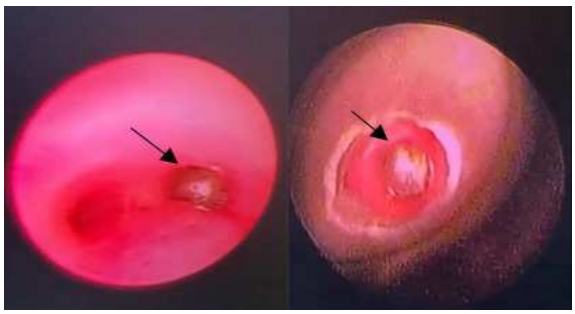
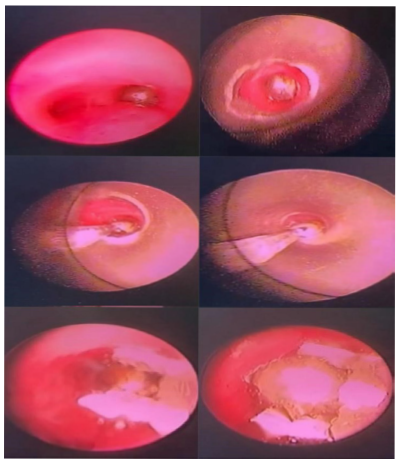


Figure 2. Foreign body (iron ball) in the right main bronchus

Subsequently, the extraction was performed using a size 16 suction catheter. The suction was able to pull the iron ball into trachea, but could not pass the vocal cords. Extraction was continued using optical forceps with adhesive tape attached to both sides. The iron ball could be removed but became stuck at the vocal cords. A magnetized forceps was then used to pull the iron ball passed the vocal cord successfully, but unfortunately it felt down into the hypopharynx. The iron ball was then removed using McGill forceps. The foreign body retrieved was an iron ball with 0.6 cm diameter. Further evaluation of the right and left bronchi revealed no other foreign bodies, nor complications.



(A)

(B)

Figure 3. (A) Foreign body extraction attempt using a basket and optical forceps. (B) Postoperative finding of iron ball with a diameter of 0.6 cm.

After the procedure, the patient was transferred to the Pediatric Intensive Care Unit (PICU), and intravenous antibiotic therapy along with corticosteroids was continued. The patient was then hospitalized for 2 days with improving clinical status. Upon discharge, the patient was conscious, able to breathe spontaneously without oxygen support, no dyspnea, and able to eat and drink well.

Three days after the extraction procedure, the patient was re-evaluated at the outpatient clinic. There were no signs of dyspnea or retractions, and physical examination revealed no rhonchi, nor wheezing. The patient was discharged with education to the parents on supervising the child during playtime to prevent ingestion of foreign bodies.

METHOD

Literature search conducted on February 14, 2024, using keywords "round foreign body in bronchus," "bronchial foreign body," and "bronchoscopy management" in Medline and PubMed databases. A total of 5 cases of round foreign bodies in the bronchus were published from 2003 to 2020 (Tabel 1). One case reported surgical removal of the foreign body, while the other 4 were successfully extracted via bronchoscopic intervention. Literature regarding other bronchial abnormalities was not included in this analysis.

Table 1. Literature review of pediatric cases with aspirated round shape foreign body

No	Reference	Sex	Age	Type of foreign body	Imaging manifestation	Manifestation	Location of foreign body	Management
1.	Lina et al.[12] (2018)	Girl	8 y	Plastic beads	Chest CT scan: round shadow 1,2 cm in diameter in the right main bronchus	Transient bouts of coughing and labored breathing	Right main bronchus	- Removal with grasping forceps via rigid bronchoscopy failed - Balloon catheter removal via rigid bronchoscopy under general anesthesia was successful
2.	Ahmed et al.[13] (2020)	Boy	9 y	Plastic beads	Chest X-ray: rounded smooth opacity related to foreign body in the left lower lobar bronchus	No symptoms	Left lobar bronchus	- Removal with conventional forceps via rigid bronchoscopy failed - Forgaty catheter via rigid bronchoscopy was success
3.	Hesham et al.[14] (2015)	Boy	11 mo	Plastic beads	Chest X-ray: left upper lobe hyperinfla-tion, rightward shift of the heart	- Hoarse cough - Fever - Decrease oral intake	Left main bronchus	- Removal with conventional forceps via rigid bronchoscopy under general anesthesia, failed - Removal with Forgaty catheter via flexible bronchoscopy was success
4.	Ravindra et al.[15] (2017)	Girl	8 y	Plastic beads	Chest X-ray: round shadow in the right main bronchus	- Reccurent coughs for 3 days	Right main bronchus	- Removal with grasping forceps via rigid bronchoscopy, failed - Removal with Forgaty catheter under C-arm guidance was successful
5.	Julie et al.[16] (2003)	Boy	12 y	Marble	Chest X-ray: round foreign body lodge at the right main bronchus, complete right lung atelectasis, mediastinal shift to the right	- Difficult to breathing - Mild pain in the right scapular region	Right main bronchus	- Removal with optical forceps and conventional forceps via rigid bronchoscopy, failed - Removal with Forgaty balloon catheter, failed - Removal with thoracotomy was successfull

6.	The current report	Girl	3 y	Iron ball	Chest X-ray : round foreign body on the right main bronchus	- Reccurent cough - Pain on the chest	Right main bronchus	- Removal using basket extractor failed - Removal with suction catheter no.16, the foreign body couldn't pass through the vocal cord - Removal using optical forceps which was attached with adhesive tape on both sides, the foreign body got stuck in the vocal cord - Removal continued with magnetized dissecting forceps, f.b. fell into hypopharynx - Removal continued with Magill forceps and, was successful

DISCUSSION

Cases of bronchial foreign bodies are rare but potentially life-threatening situations that require immediate intervention. This condition is a leading cause of death due to accidents in infants and children.[4] According to gender, there was a discrepancy where incidents were more commonly reported in males, with a male-to-female ratio of 2:1 to 3:1.[1,2]

According to Wang et al.[7], bronchial foreign bodies frequently occur in children, peaking at ages 1-3 years. This is associated with children's high curiosity and tendency to put objects in their mouths, often going unnoticed by parents or caregivers. Additionally, in children, immature swallowing coordination, undeveloped molar tooth structure, the habit of putting objects in the mouth for environmental exploration, and incomplete reflexes make foreign body aspiration into the airway was more likely.[3,7] This aligns with the reported case where the patient was 3 years old, who inadvertently swallowing a foreign object, while playing.

The patient's complaint was in line with the theory, in which cases of foreign body aspiration can be determined by a history of choking, persistent coughing, discomfort or chest pain, and breathing difficulties due to the foreign body, especially in children. Additionally, substernal or epigastric pain may occur in children, triggering vomiting as an attempt to remove the foreign body from the airway.[1,3] This was consistent with similar cases reported by Wankhede et al.[4] and Elsharkawy et al.[8,] where patients with bronchial foreign bodies commonly experienced persistent coughing, difficulty breathing, chest pain, and, if complications arose, fever and shortness of breath.

Physical examination findings in patients with respiratory tract aspiration vary depending on the location of the foreign body. Clinical symptoms that may be found include cough, tachypnea, decreased breath sounds, wheezing, stridor, dyspnea, cyanosis, and suprasternal retractions.[1,3,5] In this case, the

patient's vital signs were within normal limits, and there were no additional breath sounds or cyanosis. This aligns with Abdelaziz et al.[9], who reported cases of bronchial foreign bodies in asymptomatic patients. According to theory, symptoms and signs of foreign bodies in the respiratory tract are divided into 3 stages: an initial period lasting shortly with complaints of cough and wheezing, followed by an asymptomatic period depending on the size and characteristic of the foreign body and occurring for several hours to several weeks after the aspiration event. Asymptomatic periods are frequently encountered with unorganic foreign bodies.[1,3]

On cervical-thoraco-abdominal AP/ lateral X-ray examination, a suspicion of a foreign body in the right main bronchus was observed. According to Wei et al.[10], radiological examination such as chest X-ray is needed to identify indirect signs of foreign body aspiration, with common findings including normal results, radio-opaque foreign bodies, lung hyperinflation, atelectasis, mediastinal shift, and pneumonia. Chest X-rays are routinely performed in two positions, anteroposterior and lateral. Elsharkawy et al.[8] reported chest X-ray findings in patients suspected of having a foreign body in the bronchus showing lung hyperinflation and rightward heart displacement due to obstruction.

The location of the foreign body obstruction in this case aligns with theory, where a radiopaque shadow indicating the presence of a foreign body was found in the right bronchus. Foreign bodies tend to enter the right bronchus due to the anatomic features of the right main bronchus: the angle of the right bronchus is smaller while the diameter of the right bronchus is larger than that of the left bronchus, a greater amount of inspired air enters the right bronchus compared to the left bronchus, and the right bronchus being almost parallel to the trachea.[3,4]

Bronchial foreign bodies can cause partial or total airway obstruction and may lead to complications. To avoid complications, the optimal time for bronchial foreign body removal is within 24 hours after aspiration. Williams et al.[11] categorized complications into mild complications such as bradycardia, bronchospasm, and decreased oxygen saturation, and severe complications such as laryngeal edema, pneumothorax, and cardiac arrest. In this case, the foreign body was round-shaped, and the complications depended on its diameter and the location of obstruction. A large-diameter foreign body, if lodged in the trachea, could cause complete obstruction, and might directly lead to death. Meanwhile, if the foreign body was lodged in the main bronchus and immediate extraction was not performed, tissue compression and necrosis might occur, leading to atelectasis and lung collapse. Wankhede et al.[4] and Wei et al.[10] reported similar cases where significant oxygen desaturation occurred along with metabolic acidosis, underscoring the need for prompt diagnosis and management to prevent the severity of complications.

Several difficulties were encountered in managing this case, including the round shape and metallic composition of the foreign body, making it difficult to grasp with forceps due to its slippery nature. Further challenges arose because the patient was a 3-year-old child, with small bronchial lumens, and the size of the foreign body was relatively large for a 3-year-old child, resulting in difficulty evaluating the foreign body during extraction. In this case, the foreign body was extracted using various methods. First the foreign body pulled into trachea using suction catheter and optical forceps, then pulled pass the vocal cords using magnetized forceps, and finally removed from hypopharynx using McGill forceps. Wang et al.[7], Elsharkawy et al.[8], and Abdelaziz et al.[9] reported difficulties in foreign body extraction depending on the type and location of the foreign body. A round-shaped

foreign body would make it difficult for forceps to grasp due to its slippery nature, thus extraction could be performed using a catheter with a balloon tip (Fogarty catheter) inserted into the hole in the middle of the foreign body. Wankhede et al.[4] reported a similar incident where the balloon of the Fogarty catheter burst during extraction, necessitating repeat extraction under C-arm guidance. Meanwhile, Wei et al.[10] reported a failed attempt to extract a round-shaped foreign body using forceps and Fogarty catheter, with concerns that continued foreign body extraction would risk entry into other bronchial branches, necessitating extraction via thoracotomy.

In conclusion, aspiration of a ball-shaped foreign body in children is a critical condition, and prompt foreign body retrieval and prevention of complications should be undertaken. In managing patients with foreign bodies in the bronchi, it is essential to select the appropriate instruments depending on the shape and type of foreign body, and surgical intervention should be considered as a last resort for foreign body extraction.

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