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Perioperative management of severe life-threatening airway obstruction caused by an accidentally inhaled foreign body in an 11-month-old child: A case report

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Abstract

An 11-month-old child experienced a severe life-threatening airway obstruction due to an accidentally inhaled foreign body that had become lodged in his tracheal carina. He showed shortness of breath, continued to groan, and had three positive concave signs when he came to our emergent department. The blood gas analysis showed the following: pH 7.14, partial pressure of CO2 (PCO2) 79.4 mmHg. Then intubation (13 cm depth) with a 4.0-mm tracheal catheter was performed, followed by invasive mechanical ventilation. Chest computed tomography (CT) was also performed. However, 2 hours after invasive mechanical ventilation, PCO2 dramatic increased from 79.4 to 157mmHg. Emergency FAB removal using flexible bronchoscope was performed under general anesthesia to avoid sudden death because of severe asphyxiation. foreign body was found to lodge in his tracheal carina, and the cavity was nearly blocked. The AFB was removed on the first attempt without complications. The child recovered uneventfully and was discharged 2 days later. As result, we would urge caution that If an AFB is suspected, and PCO2 dramatic increased after invasive mechanical ventilation, emergency FAB removal should be performed immediately to avoid sudden death due to severe asphyxia. A standard pediatric flexible bronchoscope (2.8 mm outer diameter) can be inserted successfully via a size 4.0 endotracheal tube for AFB removal.

Abbreviations: AFB= airway foreign body, CT= computed tomography, AFBs= foreign bodies, SPO2 = oxygen saturation, PO2 = pressure of oxygen, PCO2 =pressure of CO2, ETCO2 = end-tidal CO2,

Keywords: airway foreign body removal, flexible bronchoscope, Intraoperative anesthetic management

1. Introduction

Inhaled foreign bodies (AFBs) occur frequently in children[1-2] 。When the AFB becomes firmly lodged in a child's tracheal carina, asphyxiation, a life-threatening

emergent situation, may result in death, especially in children less than 1 year of age. Removal of the AFB may be the only solution for this emergent problem[3] , but it is associated with a high anesthesia risk[4]and possible asphyxiation during the operation[5] . We reported an emergent case in which an 11-month-old child suffered a severe, life-threatening airway obstruction due to an inhaled AFB that had become completely lodged in the tracheal carina. Fortunately, the AFB was successfully removed via endotracheal intubation using a flexible bronchoscope under general anesthesia. The patient had a smooth recovery and was discharged home 2 days later.

2. Case report

The patient was male, aged 11 months, and weighed 9 kg. Five hours before admission, he fell while eating peanuts and started choking. His lips became cyanotic, and he was groaning and exhibited dyspnea. The parents immediately performed backslapping, and the child stopped choking after about 10 min. The cyanosis lasted for about 30 min. The child was still groaning, however, was dyspneic, and exhibited mental malaise. He had no fever, vomiting, diarrheas or convulsions. He was referred to our hospital and was admitted to our pediatric respiratory ward. His admission temperature was 36.8°C, heart rate was 178 beats/min, and respiration was 37 breaths/min. Under oxygen inhalation, the functional oxygen saturation (SPO2) was 96%. He showed shortness of breath, continued to groan, and had three positive concave signs. The blood gas analysis was conducted in an emergent situation, with the patient inhaling pure oxygen when the blood was collected. Analyses showed the following: pH 7.14, partial pressure of oxygen (PO2) 92.7 mmHg, and partial pressure of CO2 (PCO2) 79.4 mmHg. Chest computed tomography (CT) scan was performed and revealed a nodular, high density shadow at the bifurcation of the main bronchus（Fig 1）, suggesting an AFB. There was nothing special about his medical history.

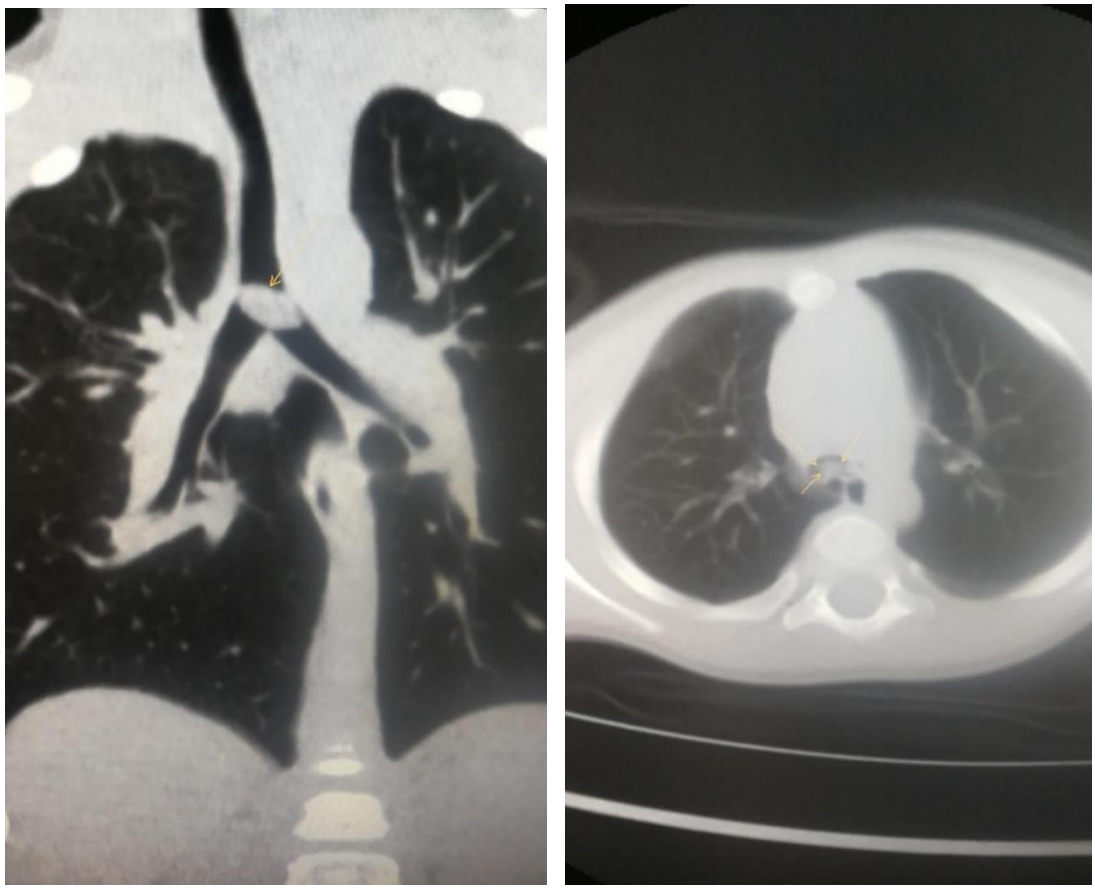

Fig.1 Chest computed tomography scans. Nodular high density shadow is present at the bifurcation of the main bronchus.

Because of the patient's dyspnea, the presence of three positive concave signs, and a high PCO2 level, the pediatrician immediately consulted with the anesthesiologist to plan emergent endotracheal intubation. The anesthesiologist administered 25 mg propofol intravenously and the patient was intubated (13 cm depth) with a 4.0-mm tracheal catheter under visual laryngoscopy, followed by invasive mechanical ventilation. After intubation, midazolam and sufentanil were injected intravenously for sedation and pain relief. SPO2 was 99% under oxygen inhalation after intubation.

Blood gas analyses was performed again and showed: pH 6.916, PCO2 157 mmHg, PO2 348 mmHg, and lactate 0.42 mmol/L. The pediatricians decided to remove the AFB immediately. The patient was transported to the operating room under invasive mechanical ventilation. Heart rate was 138 beats/min, SPO2 was92%. Remifentanil 10 μg was immediately injected intravenously to induce anesthesia, followed by continuous intravenous infusion of 0.2

μg/kg/min. Anesthesia was maintained with 3% sevoflurane in fresh gas at 3 L/min. A fiberoptic bronchoscope (outer diameter 2.8 mm) was inserted into the trachea through the tracheal catheter. It showed that (1) the structure of the annular cartilage in the inferior segment of the trachea was clear, (2) a foreign body was embedded in the distal lumen of the trachea, and (3) the cavity was nearly blocked (Fig 2). A disposable foreign body retrieval basket was used to remove the 13-×7-×4-mm peanut through the fiberoptic bronchoscope. Because of the AFB's large volume, the retrieval basket containing the AFB could not be removed through the tracheal catheter. Hence, the pediatrician withdrew the tracheal catheter from the airway together with the foreign body retrieval basket and the fiberoptic bronchoscope. Thus, the peanut foreign body was completely removed and the tracheal catheter was pulled out. A 4.0-mm normal tracheal catheter was then inserted by the anesthesiologist under visible laryngoscopy. After endotracheal intubation and under pressure-controlled mechanical ventilation (pressure at 12 cm H2O), fluctuation of the chest was deemed good, and the SPO2 was 100%. The pediatrician continued bronchoalveolar lavage under general anesthesia and withdrew the fiberoptic bronchoscope. After continued mechanical ventilation for 20 min, the patient's ETCO2 recovered to 45 mmHg. Still on tracheal intubation and invasive mechanical ventilation, the patient was transferred to the pediatric intensive care unit. The tracheal catheter was removed 40 min after the operation, and postoperative blood gas analyses were undertaken, and the result was normal. The child was discharged from the hospital 2 days postoperatively without complications.

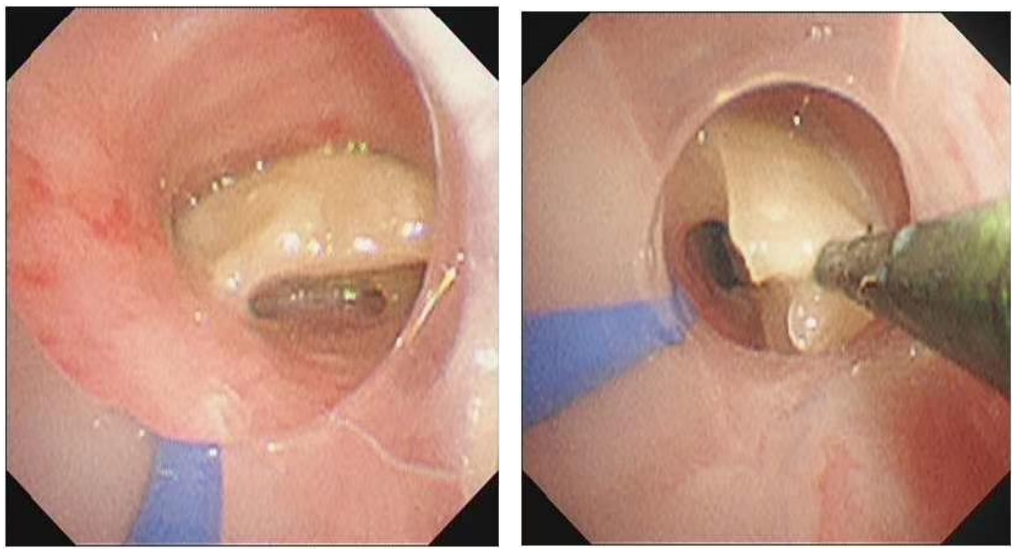

Fig.2 Brochoscopical images. Those images showed that a foreign body was embedded in the distal lumen of the trachea, and the cavity was nearly blocked.

3. Discussion

Aspiration of AFBs in children is a common problem worldwide. The flexible bronchoscope was introduced by Ikeda in 1966, and removal of an AFB using this

instrument was reported during the 1970s[6] . With the development of bronchoscopic

techniques for removing AFBs, the mortality rate began to plummet. When an inhaled

AFB is firmly lodged in the tracheal carina, however, asphyxiation due to the foreign

body is a life-threatening reality and may result in death of the child[7] , especially those under 1 year of age[8] . Intraoperative anesthetic management for these patients is

extremely challenging[5]. Children with AFB typically present with dyspnea, coughing, cyanosis, wheezing, and/or stridor[9]. For the patient who presents with these symptoms, it is critical to ask about the history of the presented situation. Does it suggest an AFB? A suggestive history is important for diagnosing a foreign body as it is often difficult to make a definitive diagnosis based on an abnormal physical examination or radiological studies alone. In our case, the parent witnessed a choking episode by the child after he fell while eating peanuts—which was highly suggestive of acute aspiration of an AFB.

Early diagnosis of AFBs is critical and may avoid progression to a life-threatening situation, such as asphyxiation due to severe airway obstruction. If an AFB is suspected because of typical symptoms and a suggestive history, CT is recommended to assess the severity of the tracheal obstruction as soon as possible, if feasible. The assessment should determine when the aspiration occurred, where the aspirated AFB has lodged, and what was aspirated. If the AFB is in a child's tracheal carina, which causes severe airway obstruction, emergency endotracheal intubation and AFB removal via endotracheal intubation under general anesthesia should be performed immediately to avoid sudden death due to severe asphyxia.

In our case, blood gas analysis before emergency endotracheal intubation showed a high PCO2 (79 mmHg). The patient was intubated immediately, followed by invasive mechanical ventilation for 2 h, at which time a second analysis showed that the PCO2 had suddenly increased to 157 mmHg, which suggests that invasive mechanical ventilation after simple endotracheal intubation did not prevent continuous deterioration of the PCO2. Hence, the only feasible and effective method to resolve the airway obstruction was to remove the foreign body as rapidly as possible. In this case, removal of the AFB via fiberoptic bronchoscopy under general anesthesia completely relieved the airway obstruction. To ensure

alleviation of the high PCO2 after removing the AFB, the patient remained on mechanical ventilation for 20 min until his ETCO2 decreased to a normal level.

We thus believe that if an AFB is firmly lodged in the tracheal carina and is causing severe airway obstruction, emergency endotracheal intubation and AFB removal via endotracheal intubation under general anesthesia should be performed immediately to avoid sudden death in children due to severe asphyxia. Remifentanil was the anesthetic used for AFB removal in our case. After intravenous administration of 10 μg of remifentanil, it was infused intravenously at a rate of 0.2 μg/kg/min for maintenance. Anesthesia was maintained also using 3%–6% sevoflurane in fresh gas at 4 L•min-1 with the bispectral index score at 40–60 (100 = fully awake; 40 = deep hypnotic effect). These two anesthetics were chosen owing to their rapid onset, short duration of action, and quick recovery time[10-11]. Thus, they not only maintain enough anesthesia depth to prevent intraoperative awareness, they allow quick recovery after successful removal of an AFB.

Intraoperative anesthetic management for these patients is extremely challenging. The time of the patient's meal prior to his aspirating an AFB should be established to assess the risk of aspiration during AFB removal. In this case, the child had ingested milk and other foods 4 h before he underwent endotracheal intubation, which placed him at increased risk of reflux malabsorption. Nevertheless, considering the clinical manifestations of severe airway obstruction in this child, the danger of delayed AFB removal outweighed the risk of a full stomach, especially with his well-conducted anesthesia. We therefore chose not to wait through a sufficient fastingtime before removing the dangerous AFB. Emergency AFB removal under general anesthesia was performed immediately. No reflux malabsorption occurred throughout the anesthesia and surgery. Therefore, it should also be noted that, generally, when planning surgery, we wait for gastric emptying to avoid intraoperative aspiration of gastric contents. However, when the danger posed by delaying AFB removal outweighs the risk of a full stomach in cases in which there is well-conducted anesthesia, emergent AFB removal is preferable.

Close communication and cooperation between the anesthesiologist, bronchoscopist, and assistants are essential as the surgeon and anesthesiologist share management of a potentially obstructed airway. In this case, the flexible bronchoscope used for AFB removal had a 2.8-mm external diameter. In our hospital, general anesthesia is used for clinical AFB removal. A laryngeal mask airway is inserted, and the AFB is removed under general anesthesia via the laryngeal mask airway[12] . The minimum inner diameter of the tracheal

tube used is 4.5 mm, even for children undergoing tracheal foreign body removal under general anesthesia via tracheal intubation. In this case, we inserted a size 4.0 endotracheal tube, which suggests that a standard pediatric bronchoscope (2.8 mm outer diameter) can be inserted successfully via a size 4.0 endotracheal tube for AFB removal. Emergency removal of AFBs should be undertaken by an experienced senior pediatrician. In the present case, when the pediatrician removed the endotracheal tube from the airway along with a foreign body basket via flexible fiberscope bronchoscopy, the experienced senior anesthesiologist immediately re-intubated the patient with another endotracheal tube via laryngoscopy to minimize the risk of gastric aspiration.

4. Conclusions

We would urge caution that If an AFB is suspected, and PCO2 dramatic increased after invasive mechanical ventilation, emergency FAB removal should be performed immediately to avoid sudden death due to severe asphyxia. when the danger posed by delaying AFB removal outweighs the risk of a full stomach, emergent AFB removal is preferable A standard pediatric flexible bronchoscope (2.8 mm outer diameter) can be inserted successfully via a size 4.0 endotracheal tube for AFB removal. Close communication and cooperation between the anesthesiologist, bronchoscopist, and

assistants are essential for the operation.

Consent

Written informed consent was obtained from the patient's guardians for the publication of this case report and any accompanying images. A copy of the written

consent is available for review by the editor of this journal.

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