

Anesthetic management in a 1-year-old child undergoing removal of a large metal tracheobronchial foreign body

Yi Ren | Jianmin Zhang | Zhong Xin

Department of Anesthesiology, Beijing Children's Hospital, Capital Medical University, National Center for Children's Health, Beijing, China

Correspondence

Zhong Xin, Department of Anesthesiology, Beijing Children's Hospital, Capital Medical University, National Center for Children's Health, Beijing 100045, China.
Email: xzlx321@163.com

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ABSTRACT

Introduction: Pediatric tracheobronchial foreign body aspiration can be a life-threatening emergency, especially in young children because of their decreased respiratory reserve and smaller-diameter airways.

Case presentation: We herein present a case in which a 1-year-old female child aspirated a 9-cm long metal chain into the lower trachea and right main bronchus. The chain was removed via low tracheotomy and rigid bronchoscopy under general anesthesia. An intravenous anesthetic alone with a muscle relaxant was used to ensure an immobile airway during surgery instead of the more commonly used inhalation anesthetics with spontaneous ventilation.

Conclusion: The case re-affirms that the removal of some large and irregular airway foreign bodies is a challenging procedure that requires a proper anesthetic plan and coordination with surgeons.

KEYWORDS

Foreign bodies, General anesthesia, Pediatric

INTRODUCTION

Pediatric tracheobronchial foreign body (FB) aspiration is an important cause of accidental death in pre-school-aged children.¹ Common signs and symptoms may include coughing, choking, dyspnea, and inspiratory stridor. The presentation varies depending on the location, size, and chronicity of the FBs.¹ To avoid complications caused by long-term retention of FBs, the optimal time frame for retrieval of FBs falls within 24 hours after aspiration.² The gold standard for diagnosing and managing FB aspiration is rigid endoscopy under general anesthesia.^{3,4} In doubtful cases, flexible bronchoscopy can be used to exclude the presence of FB in the distal airways.⁵ A tracheotomy⁶ or open chest surgery⁷ may be required when conventional bronchoscopy fails to extract the FB or in resource-limited settings where rigid bronchoscopy is not available. In this case, a long sharp chain was aspirated by a 1-year-old child and removed by bronchoscopy and tracheotomy

jointly under general anesthesia.

CASE REPORT

The patient's legal guardians provided written informed consent and permission for publication of the report. A 1-year-old girl weighing 11 kg, with a history of metal chain aspiration that had occurred 24 hours previously was admitted to our institution. Physical examination showed wheezing, biphasic stridor, suprasternal retractions, and bilaterally decreased breath sounds. A chest radiograph revealed a radiopaque FB in the lower trachea and right main bronchus.

Prior to the operation, the patient's respiratory rate (RR) was 36 breaths/min, oxygen saturation (SpO₂) was 90% to 93% on room air, heart rate was 130 beats/min with no arrhythmia, and blood pressure was 85/50 mm Hg. After the patient had been preoxygenated with 100% oxygen

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for 5 minutes to allow denitrogenation, she received intravenous atropine (0.02 mg/kg), remifentanyl (1 µg/kg), propofol (3 mg/kg), and rocuronium bromide (0.5 mg/kg). When an adequate oxygen reserve and proper anesthesia depth had been attained, a 4.0-mm rigid bronchoscope was delivered through the glottic opening. To allow ventilation, the anesthesia circuit was connected to the side arm of the bronchoscope. A tidal volume (TV) of 150 mL and RR of 25 breaths/min were set. Anesthesia was maintained with propofol infusion at a rate of 0.15 mg/(kg · min) alone with remifentanyl at 0.25 µg/(kg · min). The long sharp FB was lodged in the lower trachea and right main bronchus. After multiple failed attempts to remove the FB, the surgeons decided to perform a low tracheotomy with bronchoscopy.

Another 0.15 mg/kg dose of rocuronium bromide was administered. The propofol infusion was increased to 0.25 mg/(kg · min), and the remifentanyl infusion was increased to 0.3 µg/(kg · min). A vertical incision was made on the third to sixth tracheal rings. The patient was then ventilated via the rigid bronchoscope, which was placed above the FB with TV of 200 to 300 mL/min and RR of 40 to 50 breaths/min.

Manual positive pressure ventilation was applied when necessary to keep the SpO₂ at >80%. It took a total of 10 minutes for the complete removal of the FB, which was a 90-mm × 6-mm metallic chain with multiple spikes. During the procedure, the patient's heart rate was 130 to 140 beats/min, mean arterial pressure was 42 to 50 mm Hg, and SpO₂ was 75% to 85%. Upon removal of the bronchoscope, a 4.0-mm oral trachea cannula was placed and connected to the breathing circuit. The patient's end-tidal carbon dioxide (PETCO₂) was 55 to 60 mm Hg and SpO₂ was 82%. We set the TV at 120 mL/min and RR at 30 breaths/min. After 10 minutes of ventilation, the PETCO₂ decreased to 35 to 40 mm Hg and the SpO₂ was 100%.

The patient was transferred to the intensive care unit with a tracheal catheter. The respirator was evacuated 12 hours later. She was discharged home on postoperative day 5. At the 3-month follow-up visit, the child was completely asymptomatic. Flexible bronchoscopy showed full recovery of the tracheobronchial tree.

DISCUSSION

Tracheobronchial FB aspiration remains a significant cause of childhood morbidity and mortality.¹ In this unusual case involving aspiration of a 90-mm × 6-mm metal chain with sharp edges into the lower trachea of a child, the FB was successfully managed via rigid bronchoscopy and tracheotomy. Such procedures are challenging with respect to anesthetic management because of the lack of cooperation by pediatric patients, the patients' narrow airway lumens, and the need for the surgeon and

anesthesiologist to share the airway.⁸

The preoperative assessment must include a detailed history of the aspiration and an examination for signs of respiratory distress. In the present case, the FB did not cause complete airway obstruction because it was a chain with gaps between its spikes. Pre-anesthetic fasting is important to protect the airway against aspiration.⁹ In this case, the child did not show severe symptoms such as expiratory dyspnea, high fever, subcutaneous emphysema, pneumothorax or mediastinal emphysema; therefore, a preoperative examination was performed and pre-anesthetic fasting was completed.¹⁰ If bronchoscopy is urgently needed despite the presence of a full stomach, rapid sequence induction can be performed and a large-bore gastric tube can be used to aspirate the stomach contents.⁹

Before anesthetic induction, the patient in this case was spontaneously breathing (fraction of inspired oxygen = 1) for 5 minutes to extend the tolerable apnea time.¹¹ Dexamethasone (0.25 mg/kg) was given to reduce airway edema and inflammation. The epiglottis, larynx, and vocal cords were sprayed with 1% topical lidocaine to minimize hemodynamic and airway reactions.

Although inhaled anesthesia with spontaneous ventilation is the most common approach in the management of FB removal, either intravenous^{8,12} or inhaled¹³ drugs or a balanced anesthetic¹⁴ could be applied to such patients. Children are prone to develop airway spasm, breathing-holding and even hypoxic cardiac arrest during retrieval of the object. A deep plan of anesthesia should be obtained before airway instrumentation. In this case, the procedure was expected to last a long time with deeper insertion of the bronchoscope. Therefore, the anesthesia was induced with remifentanyl, propofol, and rocuronium bromide and maintained with propofol-remifentanyl infusion. To prevent coughing and enable the surgeon to work effectively, the patient's mobility and reflexes were suppressed by neuromuscular blockers.¹⁵ This was a joint decision by the anesthesiologist and surgeons. With paralysis of the patient, controlled ventilation was used to ensure oxygenation and provide an immobile airway.¹⁵ Spontaneous ventilation may be used for cases involving shorter and easier FB removal, but not for complex procedures such as that in our case.

Endoscopic removal of the herein-described sharp metallic chain stuck in the lower trachea and right main bronchus might have led to serious complications including bleeding and laceration of the tracheal wall. Therefore, the surgeons decided to remove the FB by a low tracheotomy from the third to sixth rings over the bronchoscope, unlike a conventional tracheotomy, to remove the FB and avoid bleeding and laceration of the tracheal wall.¹⁶ Therefore, good sedation, analgesia and muscular relaxation were needed to ensure that the patient tolerated the surgical

procedure and to avoid movement and bucking of the body. After anesthesia had been deepened by incremental increases in the intravenous anesthetic, the patient's hemodynamic parameters were satisfactory. It took 8 minutes to remove the FB. Although a high gas flow, high frequency, and high TV ventilation was used, the relatively long surgical procedure and hypoventilation caused carbon dioxide accumulation. The PETCO₂ was 60 mm Hg after intubation. However, it decreased to 35 mm Hg with adequate hyperventilation. Inpatient monitoring is advised in children with a complicated operative course¹⁷; thus our patient was transferred to the intensive care unit.

The present report describes a case in which a large metal chain was inhaled, endangering the life of a 1-year-old child. Removal of the object was a challenging procedure requiring well-planned anesthesia and excellent intercommunication between the anesthesiologists and surgeons. No consensus has been reached regarding the superiority of inhaled or intravenous anesthesia or spontaneous versus controlled ventilation. The choice is made case by case. Techniques that reduce the risks of complications, morbidity, and mortality are the most suitable.

CONFLICT OF INTEREST

None.

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