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Retrieval of tracheobronchial foreign bodies by short flexible endoscopy in children

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ABSTRACT

Objectives: Flexible endoscopy (FE) is frequently used to diagnose tracheobronchial foreign bodies (TBFB). However, it is still controversial for retrieval of TBFB in pediatric field. This study aims at reporting and evaluating our experiences of using short-length FE with a non-invasive ventilation (NIV) technique and intensive care unit (ICU) support in retrieving pediatric TBFB.

Methods: A retrospective review of the hospital database and FE videos of pediatric patients aged less than 18 year-old who were diagnosed of TBFB and managed in our hospital over a 17-year period (1999–2015). The demographic data were collected and analyzed. A NIV technique of providing nasopharyngeal oxygen with intermittent nose closure and abdominal compression was routinely performed in procedural sedated patients throughout the whole FE procedures.

Results: Sixty-six consecutive patients with 76 TBFB were enrolled. Among them, 72 (94.7%) TBFB in 64 patients were successfully retrieved at the first attempt of FE immediately after the diagnosis was made. There were 13 iatrogenic TBFB in patients who already had coexisting airway problems. The median age was 16 months (range 1.5 months–17 years) and the median body weight was 10.5 kg (range 3.5–48.5 kg). Seventy (70/72, 97.2%) TBFB were retrieved by short-length FE and among them, 55 procedures (55/72, 76.4%) used FE with no working channel. No significant acute or late adverse effects were noted. The mean retrieval procedural time was 23.6 ± 15.1 min.

Conclusion: Using short-length FE with this NIV technique, appropriate sedation and ICU support is a safe, simple and effective modality for the retrieval of TBFB immediately after confirming the diagnosis in pediatric patients.

1. Introduction

Tracheobronchial foreign bodies (TBFB) in children often result in significant morbidity and life-threatening emergency [1–5] that makes the early recognition and prompt retrieval essential. Traditionally, flexible endoscopy (FE) is mainly used for diagnostic purpose, whereas the rigid endoscopy (RE) serves for retrieval [5,6]. RE requires specialized facilities that may prevent timely management in emergencies and is not applicable for obstructed upper airway, restricted cervical motion, and distal airway approach. Therefore, FE has been increasingly used as an alternative for TBFB retrieval in adult [7–11]. However, controversies of using FE persist in the pediatric population [12] because their inherent narrow airways challenge the accommodated instrumentation of FE itself, artificial airway and accessories within those small lumens. Additionally, lack of adequate size of working channel (WC) and retrieval instruments also hamper FE use in these vulnerable infants and small children.

With advances in techniques and instruments, successful TBFB retrieval by FE in pediatrics has gradually increased [13–16], showing that diagnose and removal of objects can be carried out in the same FE sessions, saving both time and labor. However, the existing reports have used the classical flexible endoscopes of long-length 60 cm and may require the artificial airway and ventilator support. In our hospital for more than two decades, we have been using a different approach by using short-length flexible endoscopes with a non-invasive ventilation (NIV) based on nasopharyngeal oxygen with intermittent nose closure and abdominal compression (termed "PhO_2-NC-AC" ventilation) [17], without any

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artificial mask, bag, airway or ventilator. The diagnosis was made and TBFB were retrieved in procedural sedated patients in the same FE sessions in pediatric intensive care unit (ICU).

This study aims at analyzing and reporting our experiences of the diagnosis and retrieval of TBFB with the modality of using short-length FE with this NIV, appropriate sedation and ICU support in our pediatric patients.

2. Methods

This is a retrospective study at our hospital, a tertiary pediatric referral center, from 1999 to 2015. Patients with age less than 18 year-old, diagnosed of TBFB aspiration and managed by FE were enrolled. Their medical records and FE videos of the retrieval procedures were reviewed and analyzed. This study was approved by the Committee for the Protection of Human Subjects in Research (VGHIRB number: 2014-07-003AC).

The following data were collected and analyzed: (1) demographic data of gender, age, and body weight at time of procedures; (2) types and locations of TBFB; types of flexible endoscopes, retrieving instruments and sedative medications; (3) total procedure times, complications and outcomes.

Significant procedure-related adverse events were recorded. Significant asphyxia was defined as any requirement for traditional resuscitation of endotracheal intubation, cardiac compression or intravenous adrenergic drugs. Airway spasm was defined as laryngeal or tracheobronchial (TB) lumen contraction causing difficulty in advancing the FE or removing TBFB. Significant bleeding was defined as the need for ice-cold saline lavage or transfusion or beyond.

3. Results

Seventy-six TBFB in 66 consecutive children (37 boys) were enrolled (Fig. 1). Among them, 72 (94.7%) TBFB were successfully retrieved from 64 children (35 boys) immediately after confirming the diagnosis in the first FE sessions. Their median age was 16 months (range 1.5 months–17 years) and the median body weight was 10.5 kg (range 3.5–48.5 kg). Thirteen patients had coexisting pulmonary problems: 5 with TB metallic stent, 5 with TBFB-associated pneumonia, 2 infants undergoing recent laser supraglottoplasty 2 days before for their severe laryngomalacia [18] and one infant with severe upper airway obstruction due to a huge tongue tumor and depending on tracheostomy tube. All FE were smoothly performed with patients under procedural sedation and this NIV support. The mean dosages of associated medications were intravenous midazolam 0.6 ± 0.2 (range 0.3–1.0) mg/kg, ketamine 2.7 ± 0.6 (range 1.0–4.0) mg/kg, and topic Xylocaine 4.7 ± 1.4 (range 4.0–6.5) mg/kg.

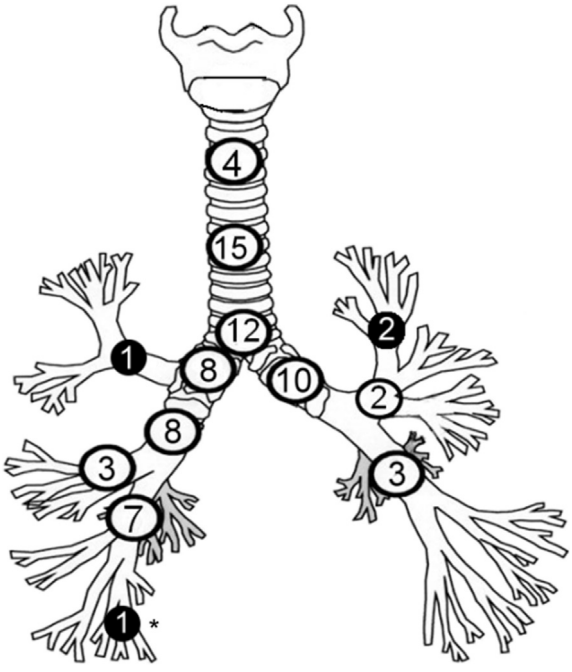

Fig. 1. Numbers and locations of the 76 tracheobronchial foreign bodies: white circles, retrieved and black circles, failed.
*iatrogenic metal fragment.

Four TBFB in 3 patients were not retrievable because of difficulty in approaching the foreign bodies with FE. Three of them were located at upper bronchi and one at distal right lower bronchi. They were all remnants after their main parts had already been removed at approachable sites. No further retrieval with RE or surgery was attempted afterward and there had been no associated sequel for more than 5 years during follow-up.

Four flexible endoscopes had been used as shown in Table 1. Both endoscopes I and II are short-length without WC which had retrieved 55 TBFB. Endoscopes III and IV have one WC and had retrieved 17 TBFB. The WC could accommodate a tiny flexible basket or forceps. Among the 72 successful retrievals of TBFB, 70 (97.2%) used short-length FE and 55 (76.4%) used endoscopes without WC. When using the endoscopes without a WC, the selected retrieve instrument was orally introduced into the TB lumen (Fig. 2) and followed by nasal insertion of the FE alongside and proximal to the TBFB (Fig. 3). Then, under visual control of the FE, endoscopist preceded various retrieval manipulations (Fig. 4).

Only one single TBFB was found in 57 patients, 2 TBFB in 6 patients (the trachea and right main bronchus in 2 patients, both right and left bronchi in 4 patients) and 3 TBFB (one in the trachea and 2 in the right bronchi) in one patient. Thirty-six TBFB were retrieved solely by the basket, 22 solely by forceps and 14 requiring both balloon and forceps.

Types, numbers and locations of TBFB are shown in Table 2. Peanuts, beans and seeds were the leading aspirated objects. Further, four patients had pen caps aspiration, three at the right intermediate bronchus and one at the left main bronchus. These four patients were all transferred from other hospitals after RE failed. All these aspirated pen caps were successfully extracted in our first FE attempts [19].

In the 13 (17.1%) iatrogenic TBFB, 12 were successfully retrieved, which included 7 metallic mesh stents, 3 silicon tracheostomy tubes, 2 aluminum foil tapes, and 1 forceps fragment (the failed retrieval). Of the metallic stents, 4 were full-structured stents. Two stents were urgently removed from the left bronchus just following the premature dislodgement during placement, one was removed from the trachea due to stent migration two days after placement, and one was electively removed from the left main bronchus one year later. Another 3 were residual stent fragments which were retrieved during follow up FE after their main stent portion had already been removed by RE. Three silicon tracheostomy tubes accidently dropped into the carina during manipulation and they were all immediately retrieved by forceps with FE from the tracheostomy stoma. Two rolls of aluminum foil tape were originally wrapped over endotracheal tube to avoid laser burns during supraglottoplasty. Both unexpectedly remained in the tracheal lumen after extubation and were retrieved at follow-up FE [18]. A failed retrieval TBFB was a metallic fragment of a reverse-grasping forceps tip after RE in the referring hospital failed to remove an aspirated pen cap in a 9 year-old boy but left this fractured instrument inside the right distal bronchus. After the successful