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Retrieving difficult aspirated pen caps by balloon catheter with short working-length flexible endoscopy and noninvasive ventilation support in intensive care unit☆,☆☆

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ABSTRACT

Objectives: Aspirated pen cap (APC) is a clinical challenging issue in children because of the difficulty in both making diagnosis and performing extraction. In case of failed retrieval by rigid endoscopy (RE), more invasive surgical approaches are recommended. The objective of this study is to introduce a new retrieval technique of APC by using laser and balloon catheter (BC) guided with flexible endoscopy (FE) and supported by a novel non-invasive ventilation (NIV) in the intensive care unit (ICU) setting.

Methods: We retrospectively review the charts and FE video records of our pediatric cases with the diagnosis of APC in the past decade, 2004–2014.

Results: Four consecutive cases with bronchial APC which had failed extraction with RE were transferred to our hospital. All of them were under procedural sedation, topical anesthesia, NIV support and ICU monitoring. After FE confirmed the diagnosis and location, a BC parallel to the endoscope was manipulated to pass through the cap hole of the APC. Two APCs required laser pretreatment before retrieval: one debulked the entrenched granulation whereas another enlarged the size of cap hole. Guide wires also were required in three cases to assist the BC to pass through the cap hole. All four APCs were successfully retrieved on their first attempts with no significant complications.

Conclusions: FE assisted by laser, guide wire and BC, with this NIV support and ICU monitoring is a feasible, safe and effective modality for retrieving those difficult bronchial APCs in pediatric cases.

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Abbreviations: AC, Abdomen compression; APC, Aspirated pen cap; BC, Balloon catheter; FE, Flexible endoscopy; IC, Inner channel; ICU, Intensive care unit; GW, Guide wire; NC, Nose close; NIV, Non-invasive ventilation; PhO_2, Pharyngeal oxygen; RE, Rigid endoscopy; SpO_2, Oxygen saturation by pulse oximetry; TB, Tracheobronchial.

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What is already known?

"Traditionally, failure in retrieving aspirated pen cap from the tracheobronchial lumen in pediatric patients by rigid endoscopy will inevitably result in open surgery, which is more invasive and traumatic technique."

What is new?

"Short working-length flexible endoscopy with a strong balloon catheter under a novel non-invasive ventilation and ICU facility support is a safe and effective modality for retrieving difficult aspirated pen cap."

1. Introduction

Aspirated pen cap (APC) is a rare aspirated foreign body, accounting for 1.52–8.0% of all cases detected in tracheobronchial (TB) lumens, and has posed a challenging problem not only on diagnosis and extraction but also due to its associated high morbidity [1,17,18]. It is impossible to directly break the APC due to the stiff material and slippery surface. The external circular shape may also completely occlude the TB lumen, causes local mucosal edema and granulation formation, both of which may further entrap or even embed the APC. In addition to the diagnostic puzzle, the retrieving procedures are also technically difficult and require more diligent performance.

Traditionally, rigid endoscopy (RE) in the setting of general anesthesia by using endoscopes of larger bore, the ancillary instruments such as regular and reverse grasping forceps [1,3,5,8], or balloon catheter (BC) [4,9,10], have been the recommended methods for APC extraction. In some more difficult cases when the APCs are too big or tightly lodged around the vocal cords or inside the TB lumens, the above RE procedures may fail and more invasive open surgical approaches such as tracheotomy or thoracotomy with bronchotomy become necessary [2,3,6,11]. However, both RE and surgery are quite traumatic, expensive and inevitably associated with more complications.

The aims of this paper are to introduce a novel retrieving technique of the APC by using short working-length flexible endoscopy (FE), BC and even laser with a novel non-invasive ventilation (NIV) support in intensive care unit (ICU) facility. We have retrospectively reviewed the outcomes of our treated cases in the past decade.

2. Materials and methods

2.1. Preparation

Flexible endoscopies were performed in our endoscopy room which is located in pediatric ICU with full access of equipment necessary for cardiopulmonary monitoring and resuscitation. Short working-length flexible endoscopes of 30–35 cm were used for both diagnostic and subsequent retrieving procedures.

A NIV technique of "*nasopharyngeal oxygen with intermittent nose-close and abdomen-compression, PhO_2-NC-AC*" was routinely applied for oxygenation, airway and ventilation support throughout the entire FE procedure. Detailed description of this NIV during the FE has been reported recently [12]. Briefly speaking it started with giving a basic pharyngeal pure oxygen flow via a nasopharyngeal catheter at 0.5 L/kg/min, which was escalated up to the oxygen flow at 1.0 L/kg/min (maximum 10.0 L/min) if required. Then the bronchoscopist intermittently did nose-closure for one second as an assisted inspiration followed by a release (Fig. 1). Simultaneously the assistant performed abdomen-compression during the nose-release phase as an assisted expiration. When the patient's condition was stable, this supportive-NIV was given optionally, even when the endoscope was inside the airway, at a rate around 5–10 cycles/min. When the patient 's heart rate dropped below 85 beats/min or oxygen saturation by pulse oximetry (SpO_2) stayed less than 85% for more than 10 s, the active-NIV was initiated as follows: the endoscope was removed, oxygen flow was increased to 1.0 L/kg/min (maximum 10.0 L/min) and more aggressive maneuver was performed at a rate around 15–20 cycles/min which was age-dependent. Upon the case's vital signs returning to the acceptable levels (heart rate >90 beats/min and SpO_2 >90%) for more than 10 s, the endoscopic procedure was then resumed. If the above two parameters persisted below the target levels (HR of 85 beats/min and SpO_2 of 85%) after more than one minute of active-NIV management, then the traditional resuscitative technique was executed following the American Heart Association's Pediatric Advance Life Support Guidelines. In this teamwork, the bronchoscopist was responsible for manipulating the endoscope and extraction instrument, as well as performing the nose-closure part of the NIV support.

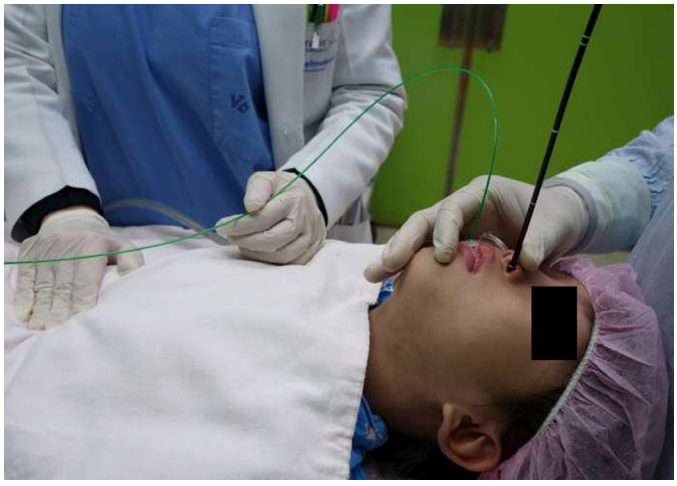

Fig. 1. A short working-length flexible endoscope is inserted via left nose, oxygen catheter via right nose, a selected balloon catheter via mouth, assistant's hand over abdomen and operator's fingers around nose. There is no mask or artificial airway such that it is easier for doing NIV and manipulating instrument during flexible endoscopy.

With respect to the procedural sedation, intravenous midazolam (0.5–1.0 mg/kg) and ketamine (1.0–2.0 mg/kg) were titrated to minimize movement. Topical anesthetic of 2% lidocaine was also administrated into upper and lower airways. In the lower airway, 0.2 ml/kg of intra-tracheal lidocaine was given through one of the following three routes: via inner channel (IC) of endoscope, by a syringe catheter inserted directly into the trachea through oro-laryngeal approach, or by a needle puncturing through the anterior neck surface into the intra-tracheal lumen. The latter two methods were only applied when the endoscope used was without IC. To anesthetize the upper airway, 0.1 ml/kg of lidocaine was instilled into both nostrils. After adequate sedation was achieved, FE was initiated.

3. Diagnostic procedure

Endoscope was introduced nasally into the tracheobronchial lumen. Any purulent materials or excessive secretions noted in the TB lumen were directly sucked out via the IC of the scope (Fig. 2a) When a scope without IC was used, it was temporarily withdrawn and a big bore 12 F suction catheter (ID 2.7 mm) was inserted trans-orally via direct laryngoscope into the mid-tracheal lumen.