



Case Report

Extraction of large foreign bodies from the airway by gastrointestinal endoscopy

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ABSTRACT

Foreign body aspiration is a worldwide health problem that often results in life-threatening complications. Although flexible bronchoscopy is a safe procedure for removal of foreign bodies, it is usually unsuccessful in removing large foreign bodies from the airway. Gastrointestinal (GI) endoscopy, which is frequently used to remove foreign bodies from the gastrointestinal tract, has not been reported for retrieval of airway foreign bodies. In this report, we described three successful cases of removal of large airway foreign bodies by GI endoscopy. To avoid rigid bronchoscopy, GI endoscopy can be considered if flexible bronchoscopy has failed to remove a large or heavy airway foreign body in adult patients.

1. Introduction

Foreign bodies in the airway can cause various symptoms or complications. Aspiration of dentures with a fixed bridge potentially results in serious morbidity because, in addition to the edge of the bridge traumatizing the mucosa, the object can obstruct the airway [1–3]. Therefore, prompt diagnosis and removal are essential to avoid potential morbidity.

Flexible or rigid bronchoscopy is frequently used to diagnose and remove foreign bodies. Although rigid bronchoscopy is the first choice for both diagnosis and treatment of foreign body aspiration (FBA), the development of the flexible bronchoscope has reduced the need for rigid bronchoscopy [4]. In addition, flexible bronchoscopy is more convenient as the patients only require light sedation [5]. Major complications and mortality after rigid bronchoscopy are rare, though the procedure may be performed in an endoscopy suite with anesthesia available, more appropriately in the operating room, and rarely in the *intensive care unit* [6]. Despite the fact that flexible bronchoscopy has a high success rate for removal of inhaled foreign bodies in adults [7], flexible bronchoscopy is unsuccessful for extraction of foreign bodies in some situations, including foreign bodies that are impacted within extensive granulation tissue or excessive scar tissue, large foreign bodies that cannot be gripped with flexible forceps, asphyxiating foreign bodies, foreign bodies with a smooth margin, sharp foreign bodies, and foreign bodies for which several attempts by flexible bronchoscopy have failed [8]. In these cases, rigid bronchoscopy remains the procedure of choice [7].

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Gastrointestinal (GI) endoscopy is the therapeutic method of choice for relieving food impaction and removing true foreign bodies, and has a success rate of over 95% with minimal complications [9]. In addition, GI endoscopes can be used to completely remove large foreign bodies without any adverse events [10].

This study aimed to present case reports for three patients who were admitted to our hospital due to large airway dental objects that could not be removed using flexible bronchoscopy, and who were successfully treated using GI endoscopy. We demonstrate that the foreign bodies were completely, effectively, and safely removed in all cases by an advanced therapeutic endoscopic technique using GI endoscopes.

2. Case presentation

2.1. Case 1

An 87-year-old male with history of stage 3 chronic kidney disease who had accidentally aspirated his dental bridge during dental treatment was referred to the emergency department. His vital signs were within normal limits, and physical examinations were unremarkable. Chest radiography revealed a radiopaque foreign body in the left main bronchus (Fig. 1A). Computed tomography (CT) of the chest confirmed a foreign body within the terminal left main bronchus (Fig. 1B). Urgent flexible bronchoscopy (BF-260; Olympus; Tokyo, Japan: external diameter, 4.9 mm; channel diameter, 2.0 mm) was performed transorally, using conscious sedation with bolus IV midazolam and topical anesthesia with lidocaine. The dental bridge was tightly impacted at the end of the left main bronchus. Several attempts to remove the dental bridge, including the use of biopsy forceps, a balloon-tipped catheter, and a stone retrieval basket, were unsuccessful. The internal diameter of the distal end of the left main bronchus on the patients' CT scan was approximately 12.6 mm.

Next, we used a GI endoscope (GIF-XQ 260; Olympus: external diameter, 9 mm; channel diameter, 2.8 mm) to remove the dental bridge. The dental bridge was grasped with rat tooth alligator jaw grasping forceps via the GI endoscope and extracted successfully (Fig. 1C). The dental bridge was approximately 10 mm in diameter, 20 mm in length, and 8.958 g in weight (Fig. 1D). The patient received 4.5 g piperacillin/tazobactam intravenously every 8 hours after the procedure and was discharged seven days later without any sequelae.

2.2. Case 2

An otherwise healthy 44-year-old male attended the emergency department (ED) after aspirating a dental bridge. His vital signs were normal and a physical examination was unremarkable. Chest radiography and CT scans demonstrated a foreign body in the right bronchus intermedius (Fig. 2A and B). The proximal internal diameter of the right bronchus intermedius was approximately 14.8 mm on a CT scan. The patient consented to conscious sedation with bolus IV midazolam and topical anesthesia with lidocaine, and a GI endoscope (GIF-XQ 260; Olympus) equipped with rat tooth alligator jaw grasping forceps was used to remove the foreign body. The dental bridge was tightly located at the right bronchus intermedius (Fig. 2C). The total duration of the flexible gastroscopic extraction

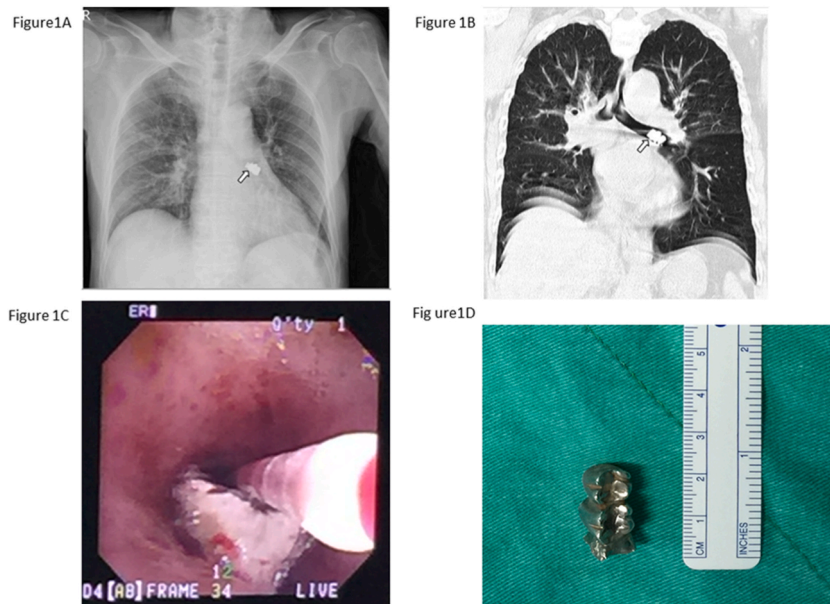


Fig. 1. An 87-year-old male patient was extracted with a large foreign body from the airway by flexible gastrointestinal endoscopy. Chest radiograph showed a radiopaque foreign body in the left main bronchus, as indicated by the white arrow (Fig. 1A). Computed tomography confirmed a foreign body in the left main bronchus, as indicated by the white arrow (Fig. 1B). The GI endoscope image showed the dental bridge in the airway (Fig. 1C). The dental bridge removed from the airway was approximately 10 mm in diameter, 20 mm in length, and 8.958 g in weight (Fig. 1D).

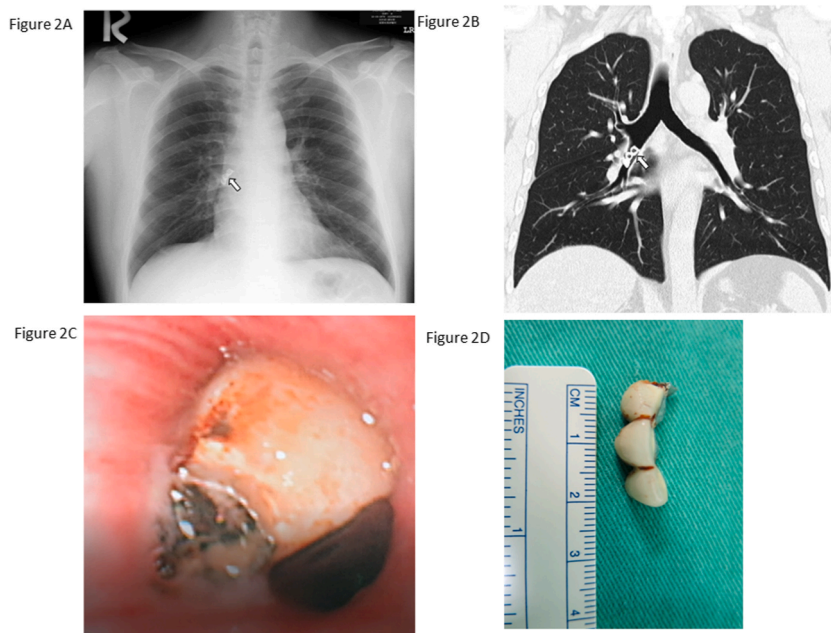


Fig. 2. A 44-year-old male patient was extracted with a large foreign body from the airway by flexible gastrointestinal endoscopy. Chest radiograph showed a radiopaque foreign body in the right bronchus intermedius, as indicated by the white arrow (Fig. 2A). Computed tomography indicated a foreign body in the right bronchus intermedius, as indicated by the white arrow (Fig. 2B). The GI endoscope image showed the dental bridge in the airway (Fig. 2C). The dental bridge removed from the airway was approximately 5 mm in diameter, 20 mm in length, and 2.204 g in weight (Fig. 2D).

procedure was only 6 minutes. The dental bridge was approximately 5 mm in diameter, 20 mm in length, and 2.204 g in weight (Fig. 2D). The patient was discharged 1 day later without complications.

2.3. Case 3

A 63-year-old male with a history of moderate COPD, hypertension, a duodenal ulcer, and iron-deficiency anemia presented to the outpatient department with an intermittent productive cough that had lasted 7 weeks. He had received dental treatment 7 weeks ago, when a small screw had accidentally fallen into his trachea. The foreign body not been located until a chest radiograph at our outpatient department proved the screw had been aspirated (Fig. 3A and B). The patient was treated using a GI endoscope (GIF-XQ 260; Olympus) under conscious sedation with bolus IV midazolam and topical anesthesia with lidocaine. The small screw was found to be tightly positioned at the right bronchus intermedius (Fig. 3C). We used a rat tooth alligator jaw grasping "cook" sonnet polypectomy snare to remove the small screw (Fig. 3D), which was approximately 9 mm in diameter, 28 mm in length, and 3.522 g in weight. The patient was discharged the next day without complications.

3. Discussion

At present, removal of foreign bodies usually relies on bronchoscopic techniques [11]. Rigid or flexible bronchoscopy can be performed when FBA is suspected, though debate on the optimal procedure remains. Many bronchologists consider rigid bronchoscopy to be the treatment of choice, since it is extremely effective and has a low risk of complications [12]. The advantages of flexible bronchoscopy over rigid bronchoscopy are that flexible bronchoscopy can be performed under local anesthesia, can access smaller peripheral airways, and is more easily and safely performed for patients with deformities of the cervical spine or pharynx [13]. For example, Lan et al. [14] reported a success rate of 97% for foreign body removal via flexible bronchoscopy, with low rates of mortality and morbidity. A separate report by Debeljak et al. [15] indicated that flexible bronchoscopy can be used to remove foreign bodies, especially if the foreign bodies are small and peripheral. Thus, the flexible bronchoscope has almost completely supplanted the rigid bronchoscope for such cases [13]. Although flexible bronchoscopy may be considered the treatment of choice for FBA, there are few reports on effective extraction of dental prostheses from the airway. The irregular surface and hard composition of dental prostheses make them particularly difficult to grasp and extract using normally effective instruments, such as biopsy forceps, Fogarty balloon catheters, alligator forceps, or wire baskets. Moreover, their sharp edges can facilitate impaction [16]. Rigid bronchoscopy is recommended when flexible bronchoscopy fails. The rigid bronchoscope is typically used when the foreign body is large, located in central bronchi or the trachea, firmly embedded in scar tissue, or to minimize mucosal trauma during removal of sharp objects that need to be maneuvered [15].

Rigid bronchoscopy may be performed in the operating room with general anesthesia available. Although major complications after rigid bronchoscopy are rare, the technical procedures may be harmful and anesthesia can cause problems [17]. Some anesthesia-related complications, such as a sore throat and dental damage, can cause significant distress to patients. Moreover, cardiac, respira-

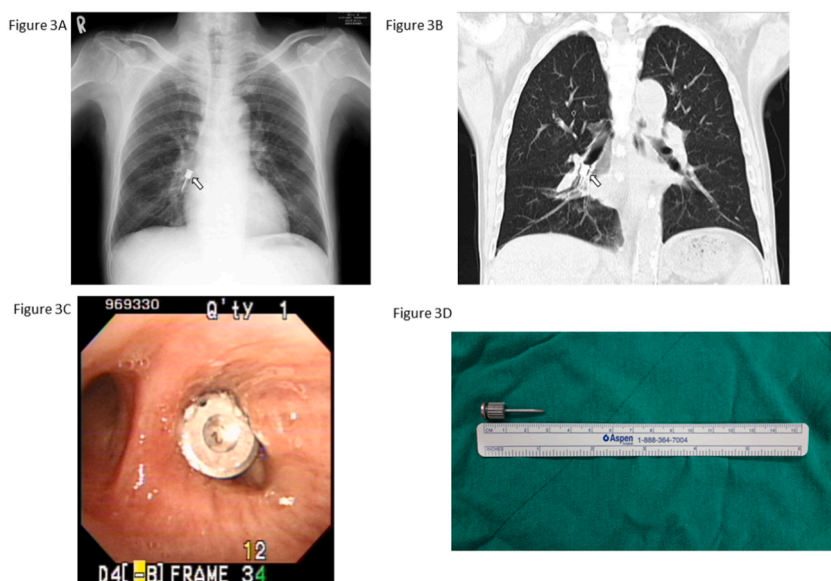


Fig. 3. A 63-year-old male patient was extracted with a large foreign body from the airway by flexible gastrointestinal endoscopy. Chest radiograph showed a metallic foreign body in the right bronchus intermedius, as indicated by the white arrow. (Fig. 3A). Computed tomography indicated the metallic foreign body in the right bronchus intermedius, as indicated by the white arrow (Fig. 3B). The GI endoscope image showed the small screw in the airway (Fig. 3C). The small screw removed from the airway was approximately 9 mm in diameter, 28 mm in length, and 3.522 g in weight (Fig. 3D).

tory, and renal perioperative complications have been associated with long-term morbidity and mortality. All of these complications increase the costs to both patients and the health system [18].

Although flexible bronchoscopy in concert with a large wire loop snare was used to remove central bronchial-located dental prostheses without a rigid bronchoscope or fluoroscopy, rigid bronchoscopy was necessary to extract single molar or premolar teeth (with a rounded shape) that were lodged in the airway [16].

GI endoscopy is the standard technique for the removal of foreign bodies from the gastrointestinal tract [19]. The GI endoscope is preferred for removing foreign bodies because of its high success rate (> 90%), low complication rates, and patient comfort. In adults, the conventional GI endoscope (9.8 mm external diameter with a 2.8-mm diameter single channel) is widely accepted and efficacious [20]. Compared to the flexible bronchoscope, the GI endoscope may represent a useful tool for removing larger or heavier foreign bodies from airways with a large lumen [20].

The choice of retrieval device is determined by the size and shape of the foreign body. The retrieval forceps used for grasping hard objects have a large variety of jaw configurations: rat-tooth, alligator-tooth, or shark-tooth. Retrieval graspers with two to five prongs can be useful for retrieving soft objects, but not hard or heavy objects because their grip is not secure enough. Endoscopic baskets may be useful for round objects, and retrieval nets or bags can provide a more secure grasp for some foreign bodies—such as coins, batteries, and magnets—and for *en bloc* removal of food boluses [20,21].

In our cases, chest CT was used to indicate the size, shape, location, and depth of the impacted foreign bodies and visualize the surrounding tissue. CT is also important when determining treatment options and evaluating the risks of endoscopic management [21].

According to a previous report, the coronal and sagittal diameters of the upper trachea are 1.8 ± 0.24 and 2.06 ± 0.27 cm for men and 1.48 ± 0.20 and 1.49 ± 0.24 cm for women, respectively. The lower part of the trachea has coronal and sagittal diameters of 1.8 ± 0.23 and 1.86 ± 0.27 cm in men and 1.51 ± 0.18 and 1.46 ± 0.23 cm in women, respectively. The right and left mainstem bronchi diameters are 1.16 ± 0.17 and 1.02 ± 0.22 cm for men and 0.93 ± 0.13 and 0.81 ± 0.13 cm for women, respectively [22]. Thus, GI endoscopes appear to be suitable instruments for extraction of FBA from the trachea or bilateral main bronchi of adults. Furthermore, chest CT scans can be obtained to determine the diameters of the tracheobronchial tree in individual patients before removing a foreign body using a GI endoscope [23].

In our first case, we tried in vain to remove the foreign body with a flexible bronchoscope, but the interventional instruments including forceps and a snare were too small to remove the foreign body. We measured the diameter of the bronchus from the trachea to the left main bronchus by CT of the chest, and determined the narrowest diameter of the bronchus before the foreign body was 12 mm. The GI endoscope [Olympus, XQ260] has a diameter of 9 mm and thus could be used for removal of the large foreign body instead of a flexible bronchoscope. During the procedure, we used *rat tooth alligator jaw* grasping forceps to remove foreign body. Compared to flexible bronchoscopes, GI endoscopes are more effective for removing large or heavy airway foreign bodies. However, if the patient has already undergone tracheal intubation, it will not be possible to use a GI endoscope to remove foreign bodies as the caliber of the patient's trachea will be too small.

4. Conclusions

GI endoscopy can be considered if flexible bronchoscopy has failed to remove a large or heavy airway foreign body in adult patients. Using GI endoscopes to remove a foreign body is a safe procedure with a high success rate in experienced hands, and avoids unnecessary general anesthesia and reduces hospital costs.

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Author contributions

Conceptualization: Kuo-An Wu, Yung-Hsi Kao, and Geng-Chin Wu; methodology: Chia-Jen Hsiao, Chu-Ching Lee, and Ting-Hsuan Su; investigation: Chia-Jen Hsiao, Chu-Ching Lee, and Ting-Hsuan Su; writing—original draft preparation: Kuo-An Wu and Geng-Chin Wu; writing—review and editing: Kuo-An Wu, Yung-Hsi Kao, and Geng-Chin Wu; visualization: Yung-Hsi Kao. All authors have read and agreed to the published version of the manuscript.

Declaration of competing interest

The authors have no conflicts of interest to declare.

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