

Removal of an Aspirated Foreign Body With a Flexible Cryoprobe

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Introduction

Foreign-body aspiration is a common problem in children and adults worldwide. Foreign-body aspiration is more frequent in children than in adults; approximately 80% of recognized cases occur in patients younger than 15 years of age.¹ However, especially elderly and nursing home patients often present with lung complications after unseen foreign-body aspiration. Typical symptoms of foreign-body aspiration are sudden onset of dyspnea, cough, choking, and vomiting. However, these symptoms vary, and in most cases they are even absent, and acute presentation in adults is rare. Moreover, the relatively low diagnostic accuracy of chest radiography often delays accurate diagnosis. No prospective study has evaluated the diagnostic utility of clinical and radiographic abnormalities in adults with suspected foreign-body aspiration. Furthermore, the often false assumption of community-acquired pneumonia and subsequent initiation of antibiotic treatment wastes time and increases mortality in these patients.

In 1897, Gustav Killian started the era of bronchoscopy when he extracted a pork bone from the trachea of a German farmer, using an esophagoscope.² Since that time, and because of ongoing technical achievements, fiberoptic bronchoscopy has become the cornerstone of the diagnostic evaluation of adults and children with suspected foreign-body aspiration. Rigid bronchoscopy remains the standard of care for removal of foreign bodies, except in selected situations.

The case reported below shows typical clinical findings of a delayed diagnosis of foreign-body aspiration and in-

roduces the flexible cryoprobe as a new technique for foreign-body removal. The flexible cryoprobe we used (Erbokryo, ERBE Cryosurgery, Tübingen, Germany, Fig 1A-D) can be used with a rigid bronchoscope under general anesthesia, but also with the flexible technique in combination with a 7.5-mm or 8.5-mm flexible tube (Bronchoflex, Rusch/Teleflex Medical, Germany) that has separate oxygen tubing, under local anesthesia and sedation. Freezing of the cryoprobe's tip is achieved with the Joules-Thomson effect: nitrous oxide is decompressed at the tip of the probe, which generates immediate cooling of the tip, theoretically to -89°C . In general we use the following interventional technique:

1. The cryoprobe is introduced via a flexible bronchoscope.
2. The cryoprobe tip is placed on the foreign body or pushed into the tissue to be sampled. Freezing is maintained for 3–5 s (using a footpad).
3. The cryoprobe, together with the flexible bronchoscope, is removed and the foreign body or tissue sample (of up to 10 mm) is frozen to the tip of the cryoprobe and easily extracted.
4. Rapid thawing of the extracted material is induced in a water bath.

Case Summary

A 70-year-old male patient with known Parkinson's disease, and from a nursing home, presented at our hospital with increasing cough, fever, and dyspnea for 2 days. Before admission, community-acquired pneumonia had been suspected, and he received antibiotics (amoxicillin/clavulanate) prescribed by his general practitioner. As his health dramatically worsened within 2 days, with persistent high fever, thoracic pain, and confusion, he was referred to the hospital.

On admission, auscultation revealed coarse crackles on the right and mild expiratory wheeze. He was confused. He had normal systolic and diastolic blood pressure, and his respiratory rate was < 30 breaths/min. He had an increased risk of death according to the CRB-65 (confu-

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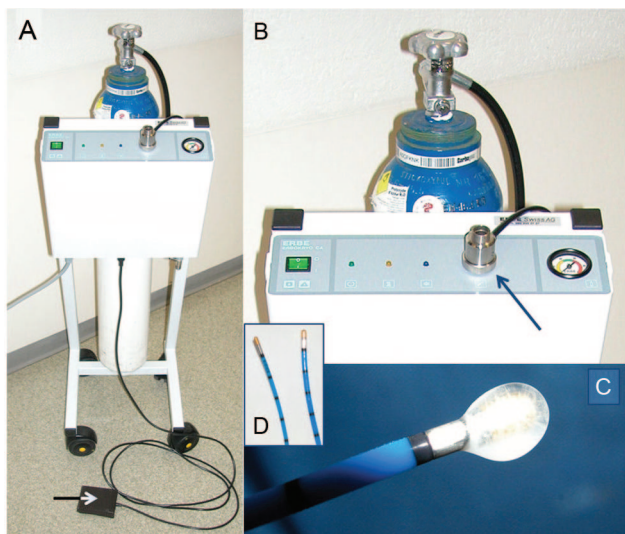


Fig. 1. A: The cryoprobe system and nitrous oxide bottle. The arrow points to the pedal that controls the freezing time. B: Cryoprobe system. The arrow points to the probe plug. C: Large-diameter cryoprobe with frozen water on probe tip (freezing time approximately 3 s.) D: Cryoprobes with diameters of 1.9 mm and 2.4 mm.

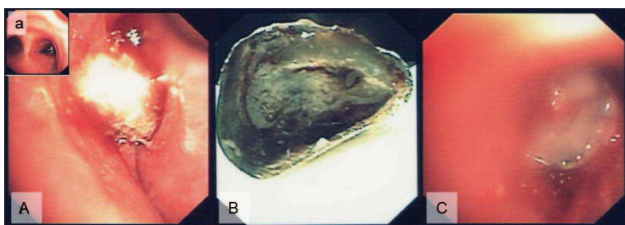


Fig. 2. Removal of a foreign body with a flexible cryoprobe. A: Foreign body, covered with mucus and pus, in the bronchus intermedius. B: Foreign body (gold tooth implant) after removal. C: Drained pus after removal of the foreign body.

sion of new onset, respiratory rate ≥ 30 breaths/min, blood pressure, and age ≥ 65 score (2 points). Laboratory findings indicated a severe inflammatory state: his C-reactive protein was 158 mg/L. A detailed medical history found indices of aspiration of a tooth implant some days before, so we decided that immediate diagnostic bronchoscopy was vital.

Flexible bronchoscopy through an orotracheal tube revealed an airway obstruction in the bronchus intermedius (Fig. 2A,a). There was severe inflammatory alteration of the mucosa, and a shimmering foreign body was detected after flushing with water. Forceps and a 3-wire spiral retrieval failed to remove the foreign body, because the retrieval device repeatedly slipped off the foreign body. With the flexible cryoprobe we removed the foreign body: we moistened the foreign body and touched the cryoprobe's head on the foreign body. After ice formation the embedded foreign body (a gold tooth implant, see Fig. 2B)

was pulled out easily. Subsequently copious pus drained out of the right lower lobe (see Fig. 2C). In the course of treatment, he received antibiotics for an additional 5 days and fully recovered.

Discussion

This case illustrates that delayed diagnosis of foreign-body aspiration in elderly patients can lead to severe pneumonia. Typical "penetration symptoms" such as sudden onset of choking and intractable cough are present in less than approximately half of all cases.³ Only the detailed medical history combined with bronchoscopy led to the correct diagnosis in this case. This confirms the results of a large retrospective study in which 55% of foreign-body aspirations were suspected prior to bronchoscopy based on medical history.³

Chest radiograph should be performed routinely when foreign-body aspiration is suspected, although 86–90% of foreign bodies are radiolucent and approximately 10% of chest radiographs are without any pathologies.^{3–5} However, the current accepted standard treatment is immediate diagnostic bronchoscopy, followed by removal of the foreign body.⁶

For bronchoscopic removal of a foreign body a variety of flexible techniques and equipment exists, although rigid bronchoscopy is still favored by most clinicians. We use the flexible bronchoscope routinely in diagnostic sessions to set up the accurate diagnosis. The procedure for removing the foreign body then depends on its size and location. Most aspirated foreign bodies are located in the central airways, two thirds in the right bronchial system.³ Though rigid bronchoscopy is recommended as the standard therapy for foreign-body removal, many case reports and retrospective studies have described excellent outcomes with flexible bronchoscopy.^{4,6} However, fiberoptic extraction with specialized instruments can be cumbersome, and ultimately rigid bronchoscopy may be required for foreign-body removal. The operator must be aware that, even in patients with stable respiratory status, clinical deterioration may occur during the diagnostic procedure, due to accidental dislodgement of the foreign body. Thus, when foreign-body aspiration is suspected, fiberoptic bronchoscopy should be performed in a room equipped for resuscitation, definitive airway management, mechanical ventilation, and rigid bronchoscopy. In our case, rigid bronchoscopy was not necessary because the foreign body was removed in a single session with the flexible cryoprobe.

The flexible cryoprobe is routinely used to remove soft-tissue obstructions such as tumors, blood clots, and mucoid impactions. By freezing the tissue on the probe's tip, removal is made easy. We have had very good experiences using the flexible cryoprobe for recanalization of malignant airway obstruction and removal of blood clots after

hemorrhage.⁷⁻⁹ The cryoprobe can be used with a flexible technique or in combination with a rigid bronchoscope. The cryoprobe allows fast and safe removal of aspirated foreign bodies, blood clots, and tumors with a suspected size more than 10 mm. In our experience the flexible cryoprobe is an excellent alternative method for removing aspirated foreign bodies.

Aspirated foreign bodies are usually solid, so forceps or spiral retrieval should work. In this case the foreign body was covered with mucus and pus, and the first retrieval instruments we tried always slipped off the smooth surface and thus failed to recover the foreign body. The flexible cryoprobe used the slippery properties of the mucus and pus on the foreign body by freezing it onto the probe's tip. Therefore, we propose the flexible cryoprobe as an alternative and easy technique for foreign-body removal that should be considered early in the assessment of foreign-body removal.

Teaching Points

- Occult foreign-body aspiration can lead to severe pulmonary and systemic complications, including asphyxia, hemoptysis, and post-obstructive infection.
- Since foreign bodies are often radiolucent, immediate bronchoscopy with removal of the foreign body should be considered. The choice of retrieval instrument depends on the size, localization, and consistency of the foreign body.
- Because of the physical properties of most foreign bodies, the flexible cryoprobe is a powerful alternative to many types of ancillary equipment (including forceps, grasping claws, snares, balloon-tipped catheters, and

magnets). The cryoprobe uses the Joules-Thomson effect to achieve cooling of the probe's tip. This makes freezing and extraction of the foreign body possible. Because the contact between the probe and the foreign body is made by freezing a small amount of fluid already surrounding the foreign body, only very limited contact is necessary, which diminishes the risk of foreign-body dislocation.

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