Adult with mass burnt lime aspiration: A case report and literature review

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Abstract
BACKGROUND
Foreign body aspiration mainly occurs in children, which can cause a severe concurrent syndrome and even death without timely treatment. As a rare foreign body, aspiration of lime is seldom reported, and most cases involve a small amount of hydrated lime. Although the symptoms are usually severe, the prognosis is good after suitable treatment. Experience of treatment for lime aspiration is lacking, and this report provides novel evidence for treatment of mass burnt lime aspiration using bronchoscopy.

CASE SUMMARY
We report an adult with a large amount of burnt lime aspiration. Because of delay in clearance of the inhaled lime in the trachea and bronchus at the local hospital, he suffered several severe complications, including complete occlusion of the right primary bronchus, aeropleura, aerodermectasia, pneumomediastinum, secondary infection and hypoxemia at 4 d after injury. After transferring to our department, bronchoscopy was immediately carried out to clear the lime in the major airway, using foreign body forceps, biopsy forceps, puncture needle, and hairbrush. The patient’s condition recovered rapidly and at 3-months’ follow-up, he demonstrated good recovery of the bronchus and lung parenchyma.

CONCLUSION
After mass lime aspiration, flexible fiberoptic bronchoscopy is suggested as early as possible, using clamping, flushing or cryotherapy.

Key Words: Burnt lime; Aspiration; Bronchial obstruction; Flexible fiberoptic bronchoscopy; Computed tomography; Case report

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Core Tip: Aspiration of lime is seldom reported, especially in adults, and most cases involve small amounts of hydrated lime. We report an adult with a large amount of burnt lime aspiration. Because of delay in clearance of the inhaled lime in the airway, he suffered severe complications. Bronchoscopy was immediately carried out to clear the lime by mechanical methods such as clamping, washing and freezing. The treatment target was to release airway obstruction. After removal of most of the lime, the condition improved rapidly, and follow-up showed good recovery.

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INTRODUCTION

Foreign body aspiration mainly occurs in children, and can cause a severe concurrent syndrome and even death without timely treatment. As a rare foreign body, aspiration of lime is seldom reported, and most cases involve a small amount of hydrated lime. Although the symptoms are usually severe, the prognosis is good after suitable treatment. We report an adult with a large amount of burnt lime aspiration. Because of delayed clearance of the inhaled lime in the trachea and bronchus at the local hospital, he suffered several severe complications, including complete occlusion of the right primary bronchus, aeropleura, aeroderectasia, pneumomediastinum, secondary infection and hypoxemia at 4 d after injury. After transferring to our department, bronchoscopy was immediately carried out to clear the lime by mechanical methods such as clamping, washing and freezing. After removal of most of the lime in the airway, the condition improved rapidly, and follow-up showed good recovery. There is a lack of experience of treatment for lime aspiration. To our knowledge, searches of databases, including PubMed, Wanfang and China National Knowledge Infrastructure (CNKI), have only revealed six reports including eight cases (seven adolescents and one adult) who suffered lime aspiration, and most of them inhaled hydrated lime. Bronchoscopy is suggested as early as possible after mass lime aspiration, and the treatment target is mainly to clear the airway. Moreover, electroexcision or laser dissection should be avoided to clean the lime. Instead, we suggest combining several mechanical methods, such as clamping, flushing and cryotherapy. The prognosis is usually good when treatment is timely.

CASE PRESENTATION

Chief complaints
A 24-year-old man was transferred to our department with the complaint of dyspnea for 5 d after burnt lime aspiration after an accidental high fall.

History of present illness
The patient fell head down 5 d before admission from a height of 2 m into a truck of burnt lime and inhaled a large amount. He had severe dyspnea and was immediately admitted to a local hospital. Computed tomography (CT) showed a high-intensity mass in the right principle bronchus, and pneumomediastinum (Figure 1). Blood gas analysis demonstrated severe hypoxemia [partial pressure of oxygen (PaO\textsubscript{2}) 70 mmHg, fraction of inspired oxygen (FiO\textsubscript{2}) 50%]. Bronchoscopy and mechanical ventilation were carried out. Because of limited conditions, clearance of lime from the airway was not performed. The patient’s condition became more severe with additional symptoms such as disturbance of consciousness and fever (maximum 38.0°C). Follow-up CT at 1 d before admission showed a high-intensity mass in the right primary bronchus, right pulmonary atelectasis, right aereopleura, and pneumomediastinum. Blood gas analysis demonstrated severer hypoxemia (PaO\textsubscript{2} 48 mmHg, FiO\textsubscript{2} 100%). He then underwent closed drainage of the right thorax and was transferred to our department.
Figure 1 Computed tomography (CT) manifestation of the patient’s lung with lime aspiration. A: CT after lime aspiration showed a high-intensity mass in the right principle bronchus, and pneumomediastinum; B: Follow-up CT at 1 d before bronchoscopy showed secondary right pulmonary atelectasis, and aeropleura; C: Follow-up CT at 3 mo showed anatomical recovery of the bronchus and lung.

**History of past illness**
The patient had no history of illness.

**Personal and family history**
The patient had no medical history.

**Physical examination**
The patient had dysphoria and was delirious. His body temperature was 39.5°C, respiratory rate 35–40 breaths/min, blood pressure 130/65 mmHg, pulse oxygen saturation (SpO₂) 60% (FiO₂ 100%), missed respiratory sound in the right lung, crude respiratory sound in the left lung, no visible injury of the body skin, and conjunctival suffusion.

**Laboratory examinations**
Blood gas analysis demonstrated severer hypoxemia (PaO₂ 48 mmHg, FiO₂ 100%).
**Imaging examinations**
CT showed a high-intensity mass in the right principle bronchus and pneumomediastinum (Figure 1A). Follow-up CT showed a high-intensity mass in the right primary bronchus, right pulmonary atelectasis, right aeropleura, and pneumomediastinum.

**FINAL DIAGNOSIS**
Aspiration airway injury with respiratory failure caused by burnt lime aspiration.

**TREATMENT**
Bronchoscopy showed that the mucosa of the trachea and left bronchus had hyperemia, edema and erosion; the lime powder was deposited diffusely on the mucosa; and the entry of the right principle bronchus was completely obstructed by the lime (Figure 2A). Using foreign body forceps, biopsy forceps, puncture needle, and hairbrush, the lime deposits were loosened and removed. Three hours later, the right primary bronchus was reopened (Figure 2B), and the patient’s oxygenation immediately improved. Although some lime powder was also deposited on the mucous membrane, we did not clean it in case of membrane impairment. After therapy, hypoxia was immediately recovered as identified by blood gas analysis (PaO₂ 154 mmHg, FiO₂ 50%). After bronchoscopy, methylprednisolone 40 mg/d intravenously was administered for 3 d. At day 2 after admission, the ventilator was removed. At day 8 after admission, re-examination of the blood gas analysis showed PaO₂ 79 mmHg (without oxygen uptake). After extracting the tracheotomy tube, the patient left hospital.

**OUTCOME AND FOLLOW-UP**
Three months after treatment, follow-up bronchoscopy showed cicatricial adhesion at the posterior wall of the pharynx and aryepiglottic fold, restricted abduction of bilateral vocal cords, and disappeared right pyriform sinus and most of the nasal septum. The mucosa at all bronchial levels was smooth and no stenosis or occlusion was found in the bronchi (Figure 2C). Chest CT demonstrated anatomical recovery of the bronchi and lung (Figure 1C).

**DISCUSSION**
To our knowledge, searches of databases, including PubMed, Wanfang and CNKI, have revealed only six reports including eight cases (seven adolescents and one adult) who suffered lime aspiration. Most of them inhaled hydrated lime and all received endoairway treatment within 3 d. The conditions of these cases were severe and seven patients underwent bronchoscopy, endotracheal intubation or tracheotomy with mechanical ventilation[1-6]. Among them, seven cases were treated with bronchoalveolar lavage, and one was also treated with foreign body extraction under rigid bronchoscopy. The postoperative prognosis was good, and only one case developed distal bronchial stenosis.

The present case was different; the adult patient inhaled a large amount of lime powder and received airway intervention after 5 d. The patient was treated with tracheotomy and mechanical ventilation, as well as foreign body forceps, biopsy forceps, puncture needles, brush and repeated alveolar irrigation under bronchoscopy, and dozens of lime particles were removed by forceps. Our treatment target was to keep the airway open and not to completely remove the lime. The prognosis was good.

The consequence of lime aspiration is different from those of normal one, especially for burnt lime. The reaction from CaO (burnt lime) to CaO(OH) (hydrated lime) can generate a large amount of heat, which could impair the bronchial mucosa, increase gland secretion, and even cause necrotizing fasciitis. The secretions, indeciduous necrotizing fasciitis and lime blocks are easy to obstruct the airway, causing lethal conditions, which frequently occur at 3-5 d after aspiration[3]. As a result, for patients with large amounts of lime aspiration (especially burnt lime), early tracheoscopy and
After aspiration of some chemicals (such as ammonia and oil-based substances), the methods for removing foreign bodies using bronchoscopy are varied depending on the characteristics of the foreign bodies. According to the size, shape and texture of the foreign body, various forceps, fetching baskets, and balloon catheters can be selected. For soft and fragile foreign bodies, frozen electrodes are often used. Different interventional treatment techniques can be used according to different chemical characteristics of the foreign bodies. For example, inhalation of tablets often causes local airway inflammation and airway obstruction, so balloon dilatation, argon plasma coagulation and airway stents are often used to relieve airway obstruction. Airway burns can be caused by high temperature physical burns and chemical injuries, and are often diagnosed by bronchoscopy and early alveolar lavage. For airway stenosis caused by chronic granulomatous changes caused by long-term foreign body residues, airway dilatation can be performed by foreign body forceps, holmium laser, freezing, balloon dilatation and other techniques. Some rare benign airway diseases, such as tracheobronchitis, are complicated by severe airway stenosis and recurrent obstructive infection, endoscopic excision and laser ablation are often used to release the airway obstruction. Because of the chemical reaction properties of burnt lime, electroexcision and laser dissection are not suitable. Because the texture of the lime particles in the bronchi was soft, it was hard to clamp the particles. Instead, we loosened the lime particles using a puncture needle, cryotherapy and a brush, then clamped the large particles using biopsy and foreign body forceps, and flushed and removed the small particles. The aim of treatment was only to release the airway obstruction. Because of the chemical reaction properties of burnt lime, electroexcision and laser dissection are not suitable. Because the texture of the lime particles in the bronchi was soft, it was hard to clamp the particles. Instead, we loosened the lime particles using a puncture needle, cryotherapy and a brush, then clamped the large particles using biopsy and foreign body forceps, and flushed and removed the small particles. The aim of treatment was only to release the airway obstruction; therefore, there was no need to remove all the lime particles on the mucosa, which would fall off naturally and be discharged by coughing.

After aspiration of some chemicals (such as ammonia and oil-based substances), pulmonary fibrosis is generated. In the present case, although edema and erosion were seen in the bronchial mucosa at the acute stage, the mucosa recovered completely and showed no pulmonary fibrosis during 3 months’ follow-up. Chlorine clearance of the lime, the right primary bronchus was reopened; C: Three months later, the mucosa at all bronchial levels was smooth and no stenosis or occlusion was found in the bronchus.
Inhalation can cause airway inflammation, airway remodeling and stenosis[30]. In the eight previous reports, only one 2-year-old child suffered stenosis of the right middle–lower lobar bronchus[3], which indicates that the bronchi are more susceptible to foreign body aspiration than in adults.

For patients with suspected airway foreign bodies, CT is currently recommended to diagnose and determine the location and size of the foreign bodies[31,32]. For patients with airway foreign bodies complicated with respiratory failure, it is essential to ensure ventilation. Some patients were treated with bronchoscopy under laryngeal mask general anesthesia[33]. Most patients were treated with endotracheal intubation or tracheostomy ventilation combined with endotracheal interventional therapy, and some patients were even treated with endotracheal interventional therapy assisted by extracorporeal membrane oxygenation[34].

CONCLUSION

Flexible fiberoptic bronchoscopy is suggested as early as possible after lime aspiration, and the treatment target is mainly to keep the airway open and not to completely remove the lime. Moreover, electroexcision or laser dissection should be avoided to remove the lime. Instead, we suggest combining several mechanical methods, such as clamping, flushing and cryotherapy. The prognosis of the patients is usually good when treatment is timely.

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