Removal of Tracheobronchial Foreign Bodies in Adults Using a Flexible Bronchoscope: Experience with 200 Cases in China

Yu-Chao Dong, Guo-Wu Zhou, Chong Bai, Hai-Dong Huang, Qin-Ying Sun, Yi Huang, Yi-Ping Han and Qiang Li

Abstract

Objective  Tracheobronchial foreign bodies (FBs) are frequently present in adults. This study reports our experience with the managements of FB and FB-related complications using flexible bronchoscopy.

Methods  We retrospectively reviewed the adult patients with FBs treated between 2001 and 2011 in China. The demographic and endoscopic data were collected and analyzed.

Results  A total of 200 adult patients (136 men and 64 women) with an average age of 51 years were analyzed. The most common FBs included bones (51.0%), nut shells (15.0%), food boluses (7.0%), plastic toys or pen caps (6.5%). After FB aspiration occurred, only 11.0% were diagnosed within three days, while more than half of the patients (58.0%) delayed the diagnosis by more than one month. The incidence of FB-related complications was 79.5%, including granulation formation (76.5%), obstructive pneumonia (22.0%), hemorrhage (14.5%), atelectasis (10.0%) and endobronchial stenotic scarring (8.0%). In 96.5% of the patients, the FBs were successfully removed under flexible bronchoscopy. A total of 53 out of the 153 patients with granulation (34.6%) were managed by argon plasma coagulation (APC) or cryotherapy; two out of the sixteen patients with endobronchial stenotic scars were treated by balloon dilation under flexible bronchoscopy.

Conclusion  A high incidence of FB-related complications occurs, likely as a result of the long delay between aspiration and diagnosis, a proportion of which require endoscopic intervention. The removal of FBs under flexible bronchoscopy has a high success rate and therefore should be recommended for adults.

Key words: foreign body, adults, flexible bronchoscopy, removal, complication

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Introduction

Foreign body (FB) aspiration into the airway can be a life-threatening emergency, and prompt extraction might result in rapid recovery. However, a history of FB aspiration might not be obvious, and the related symptoms, such as chronic cough, dyspnea and hemoptysis for most adult patients could remain unnoticed for months to years (1, 2). The delayed diagnosis of FBs may lead to serious complications such as granulation formation, recurrent pneumonia, atelectasis and endobronchial stenotic scarring (3-5). As a result, successfully extracting the FB is not the end of the story for adult patients. FB-related complications should be carefully treated as well. The extraction of FBs using a flexible bronchoscope is one of the most commonly used techniques (3, 6, 7). A few published studies have described the clinical features and endoscopic management of tracheobronchial FBs (2, 3, 5-10). However, the sample sizes of these studies were small, and few of them reported the management of the complications of FBs aspiration. The aim of this retrospective study was to report our experience using flexible bronchoscopy for the removal of FBs and the management of complications of FBs aspiration in 200 con-
Table 1. Characteristics of the Patients with Tracheobronchial Foreign Bodies (FBs)

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>No. of patients</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, y</td>
<td></td>
<td></td>
</tr>
<tr>
<td>14-19</td>
<td>12</td>
<td>6.0</td>
</tr>
<tr>
<td>20-55</td>
<td>100</td>
<td>50.0</td>
</tr>
<tr>
<td>≥56</td>
<td>88</td>
<td>44.0</td>
</tr>
<tr>
<td>Sex</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>136</td>
<td>78.0</td>
</tr>
<tr>
<td>Female</td>
<td>64</td>
<td>32.0</td>
</tr>
<tr>
<td>Symptoms</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cough</td>
<td>117</td>
<td>58.5</td>
</tr>
<tr>
<td>Sudden choking</td>
<td>46</td>
<td>23.0</td>
</tr>
<tr>
<td>Dyspnea</td>
<td>22</td>
<td>11.0</td>
</tr>
<tr>
<td>Hemoptysis</td>
<td>22</td>
<td>11.0</td>
</tr>
<tr>
<td>Fever</td>
<td>16</td>
<td>8.0</td>
</tr>
<tr>
<td>Chest pain</td>
<td>4</td>
<td>2.0</td>
</tr>
<tr>
<td>None</td>
<td>8</td>
<td>4.0</td>
</tr>
<tr>
<td>Total</td>
<td>200</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Materials and Methods

Patients

Between January 2001 and July 2011, a total of 200 adult patients with foreign body aspiration were admitted to the Respiratory Endoscopy Center of Changhai Hospital, Second Military Medical University, Shanghai. Prior to flexible bronchoscopy, a medical history, physical examination and chest radiograph were obtained, and suggested the possibility of FB aspiration. All patients were followed up until removal of FBs or elimination of complications. This retrospective study was approved by the Ethics Committee of Changhai Hospital, Second Military Medical University, Shanghai.

Endoscopic procedures

The majority (97%) of patients received 1 mg atropine and codeine phosphate sublingually as premedication 20-30 minutes before the procedure. Topical anesthesia was given intranasally using 2-4% lidocaine and with 2% lidocaine endobronchially. Sedation with intravenous diazepam was used when necessary. Another 3% of patients with a high risk of hemorrhage and asphyxia underwent the procedure under general anesthesia. Flexible bronchoscopes (P240, P260, 1T240, 1T260, or F260) (Olympus, Tokyo, Japan) were used in all patients. The accessories used to remove the FBs included FB forceps (FG-26C-1, FG-32C-1, Olympus, Tokyo, Japan), biopsy forceps (FB-21C-1, FB-52C-1, Olympus, Tokyo, Japan), snares (SD-7C/18C-1, Olympus, Tokyo, Japan; AF-1815GJ, Alton, Shanghai, China), FB baskets (FG-16C-1, Olympus, Tokyo, Japan) and aspirators. The techniques used to eliminate granulation included argon plasma coagulation (APC) and cryotherapy. Norepinephrine was sprayed locally to stop an bleeding when necessary.

Data collection and analysis

The patient demographic data, including age, sex, and symptoms; endoscopic findings including the types, number, and location of FBs; FB-related complications; time of diagnosis (which was measured as the time between symptom onset and diagnosis for the patients without a history of aspiration, or the time between FB aspiration and diagnosis for those with an aspiration history); endoscopic methods used to remove the FBs, and accessory devices used were collected and analyzed.

Results

Patient characteristics

As shown in Table 1, of the 200 patients, 78.0% were men and 22.0% were women. The patients’ ages ranged from 14 to 92 years, with a median age of 53 years old. The percentages of adult patients at the student age (14-19 years old), working age (20-55 years old), and retired age (≥56 years old) were 6.0%, 50.0%, and 44.0%, respectively.

A compatible history suggestive of FBs aspiration was found in 42.0% of the patients. The main presenting symptoms were cough (58.5%), sudden choking (23.0%), dyspnea (12.0%), hemoptysis (11.0%), fever (8.0%) and chest pain (2.0%). Eight patients (4.0%) were found to have FBs incidentally during a check-up, and did not have any symptoms.

Only 22 out of 200 patients (11.0%) were diagnosed within three days of aspiration. Sixteen (8.0%) patients were diagnosed between three days and one week (including one week), and forty-six patients (23.0%) were diagnosed between one week and one month (including one month) after aspiration or development of symptoms. More than half of the patients (58.0%) delayed the diagnosis until more than one month after aspiration or the development of symptoms. The longest delay was 40 years, and fourteen patients (7.0%) were diagnosed five years after aspiration or the development of symptoms.

Foreign bodies

The nature of the FB was confirmed visually under bronchoscopy. The types of FBs mainly included bones (51.0%) (animal bones (44.5%) and fish bones (6.5%)), nut shells (15.0%), nut meat (5.5%), food boluses (7.0%), plastic toys or pen caps (6.5%), metallic objects (4.5%), dental prostheses (3.5%), shrimp (3.5%), beans (2.0%), needles (1.0%), and glass (0.5%) (Fig. 1). Plastic toys or pen caps were the most common FBs in patients of the student age (66.7%), while bones were the most common FB in patients of the working (52.0%) and retired ages (54.5%) (Table 2).

The majority of the FBs were located in the intermediate bronchus (26.5%), left main bronchus (18.5%) and the basal
FB-related complications

As shown in Table 3, the overall incidence of FB-related complications was 79.5%, including granulation formation (76.5%), obstructive pneumonia (22.0%), bleeding (14.5%), atelectasis (10.0%) and endobronchial stenotic scarring (8.0%). The incidence of complications was associated with the duration the FBs stayed in the airway. The incidence was 31.8% when the FB was removed within three days, while it reached up to 62.5-89.7% (with an average incidence of 85.4%) when FBs removal was delayed to more than three days after aspiration (Table 3).

Endoscopic procedure and accessory devices

The overall success rate for removal was 96.5%. Bronchial bleeding was the most common procedure-related complication (5.0%).

The commonly used accessory devices were FB forceps (90.0%), biopsy forceps (7.0%), FB baskets (3.5%), snares (3.5%), and aspirators (2.5%). More than two kinds of accessory devices were used in ten patients (5.0%). FB forceps can be used for all types of FBs, especially for relatively large and long objects, with a success rate of 90.6%. The biopsy forceps were mainly used for small and thin objects, with a success rate of 92.9%. FB baskets and snares were the most commonly used alternative accessory devices, mainly for the fragile and smooth nut meats or beans. The aspirator was mainly used to suck the food pieces out of tracheobronchial tree. Furthermore, a laser was used in one patient with a bone located in the right lower lobe. Both ends of the bone were trapped in the bronchial wall and could not be removed after repeated attempts using FB forceps until it was cut in half by the laser. The two halves were then pulled out separately.

Among the FB-related complications, granulation and endobronchial stenotic scars were treated under flexible bronchoscopy. Balloon dilation was used in two patients (out of 16) with endobronchial stenotic scars. Among the 153 patients with granulation, 53 patients (34.6%) in whom granulations blocked the FBs or obstructed the airway needed management. APC and cryotherapy were applied in 30 and 29 patients, respectively, and six patients were treated by both techniques. Importantly, the pre-operation incidence of obstructive pneumonia and atelectasis in patients treated for granulation than that in patients who did not require treatment for granulation (43.4% vs. 25.2%).

Cases of endoscopic failure

In seven patients (3.5%), the endoscopic procedures failed to remove the FBs. The FBs were bones in six cases and a metal object in one case. Three of the FBs were located in the intermediate bronchus, two in the basal segment of the left lower lobe and two in the basal segment of the right lower lobe. All these FBs had been in the airways for more than one month. The reasons of failure included that both ends of the FBs were tightly trapped in the bronchial wall in four patients, serious granulation leading to bronchial atresia were present in two patients, and serious hemorrhage occurred in one patient. All of these patients underwent surgery for the removal of the FB.
The Time of Diagnosis and Incidence of Foreign Body-related Complications

<table>
<thead>
<tr>
<th>Time</th>
<th>Samples</th>
<th>Granulation</th>
<th>Pneumonia</th>
<th>Atelectasis</th>
<th>Hemorrhage</th>
<th>Others</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤ 3d</td>
<td>22</td>
<td>5</td>
<td>27.3%</td>
<td>0</td>
<td>0.0%</td>
<td>1.45</td>
<td>4.5%</td>
</tr>
<tr>
<td>&gt; 3d</td>
<td>16</td>
<td>10</td>
<td>62.5%</td>
<td>1</td>
<td>6.3%</td>
<td>6.3%</td>
<td>0.0%</td>
</tr>
<tr>
<td>≤ 1w</td>
<td>46</td>
<td>34</td>
<td>73.9%</td>
<td>14</td>
<td>30.4%</td>
<td>19.6%</td>
<td>6.8%</td>
</tr>
<tr>
<td>&gt; 1w</td>
<td>116</td>
<td>104</td>
<td>89.7%</td>
<td>29</td>
<td>25.0%</td>
<td>7.8%</td>
<td>19.0%</td>
</tr>
<tr>
<td>Total</td>
<td>200</td>
<td>153</td>
<td>76.5%</td>
<td>44</td>
<td>22.0%</td>
<td>10.0%</td>
<td>29.0%</td>
</tr>
</tbody>
</table>

Numbers or percentages of patients with at least one complication

One patient had emphysema, four patients had endobronchial stenotic scarring

Twelve patients had endobronchial stenotic scarring

Discussion

Tracheobronchial FBs are relatively rare in endoscopists’ practices. The largest series of adults with FBs in the existing studies included 100 cases in Vietnam (6). The present study consisted of 200 adult Chinese patients with FBs who were treated in the past 10 years. The age and sex distributions were similar to those in the previous studies (3, 5-10).

FBs can occur at any age, although they are usually more common in children, and are relatively rare in adults. Several studies in Europe explored the risk factors for FB aspiration in adults, and suggested that populations with various neurological and neuromuscular diseases, as well as head trauma and alcohol abuse, may have a higher risk of FB aspiration (3, 11). However, in our study, few of FB aspirations occurred in such patients, and most were in previously healthy adults. The occurrence of FB aspiration in healthy Chinese adults may be associated with the use of chopsticks, which requires a suction generated by an inspiratory effort, consequently leading to a high risk of aspiration. This may also explain the high incidence of bone and food aspiration in Chinese adults.

The most common FBs in our study included bones, nuts/nut shells, and food boluses. These findings were consistent with previous Chinese or south Asian studies (6-8), and are related to the local eating habits and customs. However, there were differences between the different age groups. Our study grouped the patients into three age groups, and found that the predominant FBs in patients of the student age were plastic toys and pen caps, not food or food-related items. Because students sometimes put something in their mouths when they are bored or lost in thought in class, they have a higher risk of aspirating these items.

In adults, the medical history of FB aspiration or choking symptoms was usually negative, and most of the patients presented with chronic or minimal symptoms, such as cough and hemoptysis, which were nonspecific for FB aspiration. They were frequently diagnosed with other pulmonary diseases, such as upper respiratory tract infections, simple pneumonia, and even lung tumors. The average delay between the development of symptoms and the diagnosis of FB aspiration ranged from 10 days to 11 months in previous studies (6, 7, 12) and a longer delay (15 month on average) was observed in our study. This is different from children, in whom a delayed diagnosis is rare (10, 13, 14). This is believed to be related to the fact that FBs lodged in the proximal airways (trachea and main bronchus) are probably more prone to be symptomatic than FBs located in peripheral airways. Most FBs were found in the proximal airways in children but in the distal airways in adults (73.5% in the present study).

The success rate of flexible bronchoscopy is comparable to that using rigid bronchoscopy (90%-98% vs. 95%) (3, 5-7, 11, 15). Both are suitable for the removal of FBs. However, the procedure under flexible bronchoscopy is more acceptable for patients, because it does not require general anesthesia or cause damage to the teeth, vocal cords or bronchial wall. Furthermore, the latter was not universally used in many centers in China because of its relatively high requirements for instruments and skills, although the use of rigid bronchoscopy was one of the major procedures used for foreign body removal in a previous study (16). Our experience showed that the success rate using flexible bronchoscopy for removal of FBs was 96.5%, which was one of the highest success rates that has been reported when only flexible bronchoscopy was utilized (3, 5-7). During the removal of FBs, endoscopists should operate the instrument carefully to prevent the mucous membrane from being injured by sharp FBs. In our study, the endoscopic procedure was shown to be safe, and the procedure-related complication rate was low. New-onset bronchial bleeding with an incidence of 5% was reported in our study. Most of the bleeding was small and controllable under flexible bronchoscopy, except one patient, who had to undergo surgery. There were another six cases in whom the procedure failed. The FBs in the failed cases were bones and a metallic object, both of which were hard and may have a sharp edge. When both of their ends were trapped in the bronchial wall, pulling hard directly using FB forceps may cause serious damage to the bronchial wall, resulting in endobronchial bleeding or asphyxia. Surgery should be the treatment of choice for such situations. However, we successfully removed a trapped bone after cutting it in half using a laser. This may also be...
useful for future patients with difficulty in removing FBs. Nevertheless, for patients with a high risk of bleeding or with failed procedures performed under flexible bronchoscopy, rigid bronchoscopy remains another option (16). In addition, it should be kept in mind that patients with bronchial atresia are not good candidates for endoscopic procedures, as they have a high risk of bronchial perforation or large hemorrhage.

Granulation formation was the most common FB-related complication. We reported a higher incidence of granulation than a previous study (76.5% vs. 62.9%) (5). The longer delay in diagnosis in our study may have led to this difference, as we found that there was an increase in granulation as the delay in diagnosis increased. Few studies have described the management of granulation, which was thought to disappear after a few days of removal of FBs. However, our experiences showed that 34.6% of granulation needed some type of management. Blocking FBs and obstructing airways were the main reasons for these managements. The former made the removal of FBs difficult, leading to repeated endoscopic attempts. The latter seemed to be more important in terms of the post-procedure outcome, because we found that the patients in the groups that required treatment for the granulation had a higher incidence of obstructive pneumonia and atelectasis before the operation than those who did not require such treatment (43.4% vs. 25.2%). Eliminating the obstructive granulation early could therefore help control pneumonia and atelectasis. APC and cryotherapy were used in our study as the standard management for granulation (17, 18), with a satisfactory efficacy and safety profile.

Most of the endobronchial stenotic scarring led to mild bronchial stenosis and did not need management. Only two patients out of sixteen patients with scarring had symptoms. Both of these patients were treated by repeated balloon dilation.

In conclusion, clinicians should be aware of FB aspiration, because it may explain the origin of unknown chronic cough and recurrent pneumonia, especially for patients without an aspiration history. A high incidence of FB-related complications, especially granulation formation, occurs after a long delay in the diagnosis, and a proportion of such patients require endoscopic intervention. However the removal of FBs generally leads to a recovery from obstructive pneumonia and atelectasis. The removal of FBs under flexible bronchoscopy has a high success rate and is therefore recommended for adults.

The authors state that they have no Conflict of Interest (COI).

References