Foreign body aspiration: clinical utility of flexible bronchoscopy

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Foreign body aspiration is a worldwide health problem which often results in life threatening complications. More than two thirds of foreign body aspirations occur among children younger than 3 years. Organic materials such as nuts, seeds, and bones are most commonly aspirated. There is a wide range of clinical presentation, and often there is not a reliable witness to supply the clinical history, especially in children. Maintaining a high index of suspicion is therefore necessary for the diagnosis. None of the imaging methods employed in such cases are diagnostic, and bronchoscopy is frequently necessary for the diagnosis as well as the treatment. In adults, removal of the foreign body can be attempted during diagnostic examination with a fibroptic bronchoscope under local anaesthesia, which may help to avoid any further invasive procedures with more complications. When diagnosis is delayed, complications of a retained foreign body such as unresolving pneumonia, lung abscess, recurrent haemoptysis, and bronchiectasis may necessitate a surgical resection. However, some of the late complications may resolve completely after the retrieval of the foreign body, therefore, a preoperative flexible bronchoscopy should always be considered in suitable cases.

PATHOGENESIS

FBA occurs most commonly among toddlers. There is a bimodal age distribution, with a second peak around age 10. The younger group is more vulnerable because of the lack of adequate dentition and immature swallowing coordination. Additionally, among children of this age, introducing objects into their mouths is their way of exploring the world. In adults, FBA is caused mostly by the failure of airway protective mechanisms, such as alcohol intoxication, poor dentition, sedative or hypnotic drug use, senility, mental retardation, primary neurological disorders with impairment of swallowing or mental status, trauma with loss of consciousness, seizure, and general anaesthesia. Less frequently, accidental aspiration of any material (food parts, small toy parts, etc) in the mouth during laughing, crying, or sneezing can occur in all age groups.

In adults, the right bronchial system is more likely to be obstructed by aspirated foreign bodies. However, the preponderant right sided location of the foreign body is not found in children because the left mainstem bronchus is closer in size to the right mainstem bronchus; in addition, the left mainstem bronchus does not branch at the same acute angle as in adults. Two thirds of aspirated objects lodge in the main stem bronchi rather than in the distal bronchi.

Prevention of aspiration is most important and caregivers must be educated to keep small objects away from children. Most of the FBAs in adults are seen in the sixth or seventh decade of life when airway protective mechanisms function inadequately. When diagnosis is delayed because of an initially silent foreign body aspiration, complications ranging from recurrent haemoptysis to irreversible damage of the obstructed airways or parenchyma, which often necessitate surgical resection, may develop.

CLINICAL PRESENTATION

The severity of the symptoms during the presentation of an aspirated foreign body can vary depending on the site of impact as well as the nature of the foreign body. Even though it is not common, occlusion of the larynx with an aspirated large object can cause an acute and dramatic presentation, and a brief period of choking and gagging may be associated with hoarseness, aphonia, and cyanosis. The Heimlich manoeuvre is recommended for these instances. If the
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The most common findings in physical examination of FBA cases include tachypnoea, stridor, unilateral or bilateral decreased breath sounds, localised wheezing and/or crackles, and sometimes fever. Unusual presentations consist of pneumomediastinum, subcutaneous emphysema, and/or pneumothorax. Tracheobronchitis, asthma, recurrent pneumonia, and tuberculosis are the most common diagnoses considered in the differential diagnosis.

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types of aspiration. For instance, turban pin aspiration was reported in Muslim females who held the pin between their lips while attaching their head scarf.\(^{25}\)

**DIAGNOSTIC EVALUATION**

Although most of the foreign bodies are radiolucent, a standard radiological work-up, including a posteroanterior and a lateral chest film, and a lateral soft tissue neck radiograph should be performed in cases with suspected FBA.\(^{26}\) One should remember that chest radiographs may be normal in the first 24 hours, and initial radiological findings which show unilateral or segmental hyperaeration can be better seen on expiratory radiographs.\(^{27}\) Other imaging tests are seldom reported to be of further help. Frequently, flexible/rigid bronchoscopy is required for the diagnosis of FBA.\(^{28-32}\)

**FOREIGN BODY REMOVAL AND UTILITY OF FLEXIBLE BRONCHOSCOPY**

At present, foreign body removal usually relies on bronchoscopic techniques. The first report of foreign body removal with a rigid bronchoscope was published in 1897, and Chevalier Jackson in 1936 reported the successful removal of bronchial foreign bodies with his new bronchoscopic system.\(^{22,24}\) The flexible fibreoptic bronchoscope was developed in 1968 by Ikeda, and the initial reports of foreign body removal with flexible bronchoscope were published in the 1970s.\(^{22,26}\) Subsequently, animal studies showed the removal of various foreign bodies from the animals’ bronchial system using newly developed grasping forceps through a fibreoptic bronchoscope.\(^{22}\) Since then, a number of studies on the removal of foreign bodies with flexible bronchoscope have been published (table 1).\(^{22,28-32}\)
Table 1 Case series of bronchofiberoptic foreign body removal

<table>
<thead>
<tr>
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<th>No</th>
<th>Success (%)</th>
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<tbody>
<tr>
<td>Cunanan et al</td>
<td>300</td>
<td>89</td>
</tr>
<tr>
<td>Hsu et al</td>
<td>33</td>
<td>97</td>
</tr>
<tr>
<td>Limper and Prakash</td>
<td>23</td>
<td>61</td>
</tr>
<tr>
<td>Chen et al</td>
<td>43</td>
<td>74</td>
</tr>
<tr>
<td>Debeljak et al</td>
<td>58</td>
<td>97</td>
</tr>
<tr>
<td>Total</td>
<td>457</td>
<td>83.6</td>
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Despite the advances in optical technology, proper training and experience is crucial to optimise the outcome and minimise the risk of complications in tracheobronchial foreign body removal by a bronchoscope. Although the rigid bronchoscope is still considered as the safest instrument in most paediatric centres, there is no doubt that the fibreoptic bronchoscope is the preferred tool for the initial diagnosis of a foreign body in adult patients. Present flexible bronchoscopes in different sizes are available for different age groups. The bronchoscopes with 4.9 mm outer diameter and a 2.2 mm diameter working channel are used in patients older than 12 years of age. Although bronchoscopes with 3.5 mm or 2.7 mm outer diameter with 1.2 mm diameter working channels are available for younger patients, using the flexible bronchoscope under local anaesthesia in a very young patient is a very difficult procedure. In such cases, rigid bronchoscopy under general anaesthesia is probably the safest procedure. Using a short acting agent such as propofol for general anaesthesia may increase the safety by allowing jet ventilation or manually assisted spontaneous ventilation since the procedure rarely exceeds 10 minutes. In fact, a rigid bronchoscope provides greater access to the subglottic airways, ensuring correct oxygenation and easy passage of the telescope and grasping forceps during the extraction of a large foreign body. Furthermore, a rigid bronchoscope allows a very efficient airway suctioning in case of a massive bleed.

In adult patients, however, a flexible bronchoscope has many advantages over a rigid bronchoscope in the initial diagnosis of a foreign body. First, flexible bronchoscopy is a relatively easy and a safe procedure in experienced hands. Second, with the use of a flexible bronchoscope under local anaesthesia for the visualisation of airways, removal of the foreign body can be attempted and avoids the added cost, risk, and morbidity of a secondary invasive procedure such as rigid bronchoscopy under general anaesthesia. Third, fibreoptic bronchoscopy is superior to rigid bronchoscopy in cases of distally wedged foreign bodies, in mechanically ventilated patients or in cases of spine, jaw, or skull fractures preventing rigid bronchoscope manipulation. The success rate of the flexible bronchoscope in removing foreign bodies can be as high as 100% in experienced hands when a careful case selection is made.  

The success rate of the flexible bronchoscope in removing foreign bodies is one of the most important complications of a long retained foreign body. Proper training and experience is crucial to optimising the outcome and minimising the risk of complications in tracheobronchial foreign body removal.

Box 5: Foreign body removal
- Bronchoscopy is the preferred tool in the further evaluation of a suspected foreign body.
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- A rigid bronchoscopy is still considered the safest instrument in most paediatric centres.
- In adults, flexible bronchoscope is superior to rigid bronchoscope and should be the preferred instrument for the diagnosis and the removal of airway foreign bodies in suitable cases.
- Proper training and experience is crucial to optimising the outcome and minimising the risk of complications in tracheobronchial foreign body removal.

Box 6: Delayed complications and clinical utility of flexible bronchoscopy
- Bronchiectasis, as in our case, is one of the most important complications of a long retained foreign body that may necessitate a surgical resection in cases with recurrent infections. Bronchiectasis may develop many years after unrecognised aspiration of a foreign body.
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- Although surgery is the only curative treatment of bronchiectasis, there are reports in the literature suggesting the resolution of bronchiectasis and/or bronchial dilatation secondary to FBA after extracting a long standing retained foreign body.
- Flexible bronchoscopy, therefore, should always be considered in cases with localised bronchiectasis or unresolving pneumonia for the possibility of a long retained foreign body to prevent patients from an unnecessary surgical procedure.

CONCLUSION
FBA is a common problem occurring mostly in children under 3 years old. In adult patients fibreoptic bronchoscopy is a safe procedure for the initial diagnosis of foreign body, which avoids unnecessary general anaesthesia, and reduces the hospital costs. The success rate of the flexible bronchoscope in removing foreign bodies can be as high as 100% in experienced hands. Even just localisation of the foreign body of chronic inflammation and ensuing bronchiectasis. Bronchiectasis can develop in animals two to eight weeks after introduction of sterile foreign bodies into the bronchial tree. The exact duration required for the development of bronchiectasis after obstruction in humans is not known. Although medical treatment is sufficient in most of the cases, surgery is the only curative treatment of bronchiectasis. However, there are reports in the literature suggesting the resolution of bronchiectasis, scar changes, or atelectasis secondary to FBA after the extracting of a long standing retained foreign body. Ernst and Mahmud and subsequently Mansour et al described similar cases, with bronchiectasis due to FBA in which complete resolution were provided by the removal of foreign bodies. Pogorzelski and Zebrek described a 13 year old girl with long lasting recurrent pneumonia the main cause of which was a foreign body lodged in the intermediate bronchus. The authors reported that the bronchoscopy revealed scars narrowing the intermediate bronchus, and the scar changes resolved after removing the foreign body. Khatabi et al reported a case of middle lobe syndrome due to FBA in whom removal of the foreign body provided a significant improvement in the patients condition.
during the initial fiberoptic bronchoscopy allows subsequent rigid bronchoscopy to be shorter in duration with fewer complications. FBA should always be considered in the aetiology of recurrent pulmonary infections or haemoptysis, lung abscess, middle lobe syndrome, fibrotic changes such as scar formation, and bronchiectasis, all of which may necessitate a surgical resection. Removal of the foreign body in such cases can achieve the resolution of the parenchymal or bronchial pathology, and prevent unnecessary surgery. Therefore, bronchoscopy should always be considered in such cases before surgery.

REFERENCES


ANSWERS

1. About 75% to 85% of all FBAs occur in children younger than 15 years old; however, most of them are younger than 3 years. Failure of airway protective mechanisms is the most frequent reason of FBAs in adults which is seen mostly in the sixth or seventh decade of life.

2. A standard radiological work-up should include a chest X-ray and a lateral soft tissue neck radiograph in cases with suspected FBA. One should also remember that chest radiographs may be normal in the first 24 hours, and initial radiological findings which show unilateral or segmental hyperaeration can be more visible on either inspiratory radiographs or fluoroscopic examination of the lungs.

3. Visualisation of the tracheobronchial tree with flexible/rigid bronchoscopy is the preferred procedure in the diagnosis of FBA.

4. With the use of a flexible bronchoscope under local anaesthesia for the visualisation of airways, removal of the foreign body can be attempted to avoid the added cost, risk, and morbidity of a second procedure: rigid bronchoscopy under general anaesthesia. Furthermore, fiberoptic bronchoscopy is superior to rigid bronchoscopy in cases of distally wedged foreign bodies, in mechanically ventilated patients or in cases of spine, jaw, or skull fractures preventing rigid bronchoscope manipulation.

5. Unresolving pneumonia, lung abscess, recurrent haemoptysis, lung fibrosis, obstructive emphysema, middle lobe syndrome, and bronchiectasis are the reported late complications of a retained tracheobronchial foreign body.