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**Original Research Article**

# Overview of longstanding bronchial foreign bodies and role of virtual bronchoscopy

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## ABSTRACT

**Background:** Virtual bronchoscopy (VB) is a software based, three-dimensional visualization format created from non-invasive medical imaging methods such as CT and magnetic resonance imaging, with the goal of creating views similar to minimally invasive bronchoscopy procedure. The aim of the study was to find the usefulness of VB in diagnosing vegetative and non-vegetative longstanding intra bronchial foreign bodies (FB).
**Methods**: This was a retrospective and prospective cross-sectional study conducted in the department of otorhinolaryngology M. G. M. M. C and M. Y. hospital Indore for a period of 5 years. The medical records of patients with FB aspiration from august 2006 to September 2015 were reviewed. Data was collected regarding their clinical presentation examination and chest x-ray findings. Patients with suspected FB aspiration were subjected to VB and rigid bronchoscopy was performed.
**Results:** In the subjects, we observed that chest radiograph were normal in as many as 40% cases. Hence negative chest radiographs do not rule out FB. In 48 patients with FB aspiration, which was detected by VB, 46 patients were diagnosed to have FB on rigid bronchoscopy. This amounts to a positive predictive value of 98%, which was similar to the gold standard, which is rigid bronchoscopy which had a positive predictive value of 99%.
**Conclusions:** VB is the only imaging modality which gives 99.9% reassurance about the presence or absence of a FB, because of its high sensitivity and specificity, hence proves to be a lifesaving tool.

**Keywords:** Long standing FB, Virtual bronchoscopy, Bronchial foreign bodies

## INTRODUCTION

FB aspiration in tracheobronchial tree is a dangerous and quite common medical emergency in childhood, with serious and potentially lethal consequences, if not diagnosed and managed promptly and properly. In some situation aspirated FB goes unrecognised and in due course present as pneumonia. In such situation a high index of suspicion is required. Rigid bronchoscopy is the gold standard as diagnostic and therapeutic tool but preoperative CT chest with VB picture gives a better non-invasive option in diagnosing these cases. VB is a software based, three-dimensional visualization format created from non-invasive medical imaging methods such as CT and magnetic resonance imaging, with the goal of creating views similar to minimally invasive bronchoscopy procedure. This technique offers a detailed view of the airways, with reduced risk of infection or perforation and facilitates preoperative planning for airway interventions that would otherwise not be possible Bauer et al.[3] The radiographic features depend upon the size, location, duration and nature of FB.

Because of the high risk associated with an overlooked FB aspiration, bronchoscopy was often performed for

definitive diagnosis and treatment. Repeated removal attempts are likely to result in increased complications. Therefore, the availability of a non-invasive, harmless technique to locate the FB pre operatively would greatly minimise morbidity and mortality.[7]

This was a retrospective and prospective study with the aim of analysing usefulness of virtual bronchoscopy in the diagnosis of long-standing airway foreign bodies.

## METHODS

This was a retrospective and prospective cross-sectional study over a period of five years from 2011 to 2016, in the department of otorhinolaryngology, Mahatma Gandhi memorial medical college and M. Y. hospital Indore, Madhya Pradesh. Study subjects included patients of the age group one month to fifteen years referred to the paediatric department with recurrent lung infection or chronic cough and cold. Patients with acute FB aspirations were excluded from the study. Study subjects were subjected to detailed history examinations, chest radiography, blood investigations, in case of non-resolving chest infections, patients were subjected to chest CT and virtual bronchoscopy. VB is a software based, three-dimensional visualization format created from non-invasive medical imaging methods such as CT and magnetic resonance imaging, with the goal of creating views similar to minimally invasive bronchoscopy procedure. After radiological confirmation of long-standing FB in the airway, with written high risk consent rigid bronchoscopy under general anaesthesia, rigid ventilation bronchoscope was introduced with the help of Macintosh laryngoscope, using optical forceps and visualizing the FB it was removed, check bronchoscopy performed to remove all the debris and mucus. Post operative management with regular oxygen saturation check, antibiotics, steroids were given. Ethical approval was obtained from the institutional ethics board. Data presented in the form of charts and graphs

Sampling method used was simple random sampling as patients with long standing foreign bodies for more than four weeks to 3 years in our study. Statistical analysis used was chi square test and data presented in the form of graphs and charts.

## RESULTS

In our study of 48 cases, we found that 72% of the cases belonged to the rural areas. Male predominance was seen with the ratio of 4:1. The mean age was 3.2 years ranging from 10 month to 15 years. The 63% of the patients came from lower socio-economic strata. Vegetative foreign bodies formed the major chunk i.e., 72% with the most common being the betel nut (27%) followed by groundnut (24%), non-vegetative foreign bodies consisted 28% of the total number of cases. Most of the cases were reported during the winter season that is 30% during October to November, 19% during January and February. The 53% had definitive history of FB aspiration and 47% didn't not have definitive history of aspiration. Duration of suspected FB aspiration ranges from 4 weeks to 3 years in our study. In 65% of cases patients were with history of recurrent episodes of lung infection where as in 15% of cases patients were asymptomatic with only minor episodes of cough and cold and 15% of cases were already on antitubercular therapy at the time of presentation. The 5% of cases were presented with respiratory distress, haemoptysis in 5% of cases.

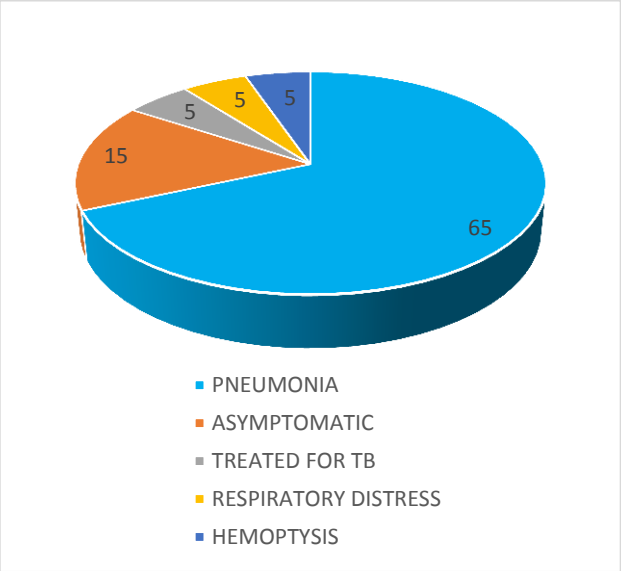


**Figure 1: Complains of patients.**

Cough was the main symptom (40%). fever in 15% cases, dyspnea (25%, cyanosis (10%). On auscultation reduced respiratory sounds present in 44 cases of which in 30 cases it was on left side, and rhonchi (in 32 cases) were the most common findings.

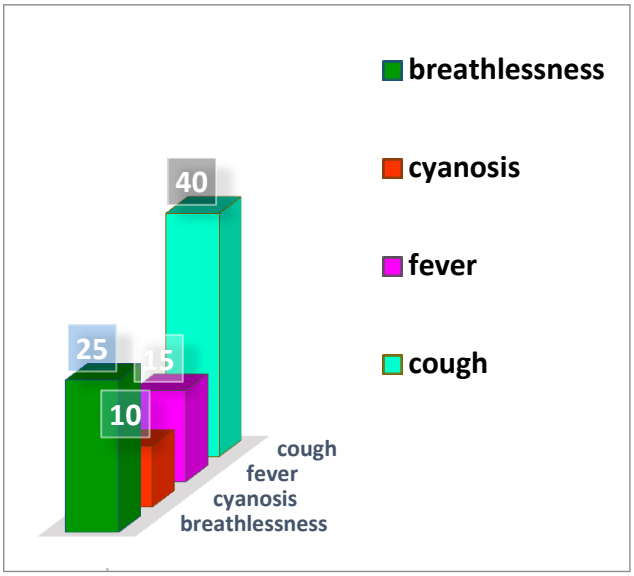


**Figure 2: Symptoms.**

Chest x-rays findings showed that 44% of the cases had consolidations in lung parenchyma, 15% of cases have atelectasis, bronchiectasis changes in 10% of cases. In 2 cases plain chest x-ray suggestive of pneumomediastinum whereas 10% of the cases had a normal chest x-ray, hence a negative chest radiograph doesn't rule out a FB. VB had a positive predictive value of 98.3%. This was similar in comparison with rigid bronchoscopy which is the gold standard for the diagnosis. Only in 2 cases where intraluminal filling defect were seen in the left main bronchus, but on rigid bronchoscopy mucus plug along with granulations was found. Majority of FB in air passage were in left main bronchus 52% followed by right main bronchus (33%), in 4 cases intermediary bronchus and 2 cases middle lobe bronchus and 1 case in left upper lobe bronchus. In all suspected cases on basis of clinical profile and radiological evidence rigid bronchoscopy done and foreign bodies removed. We found that in long standing cases of airway foreign bodies muco-pus along with granulations present proximal to the site of lodgement of foreign bodies in 40% of cases and stricture in 28% of cases. Organic foreign bodies in most of the cases i.e., in 70% were responsible for complications.

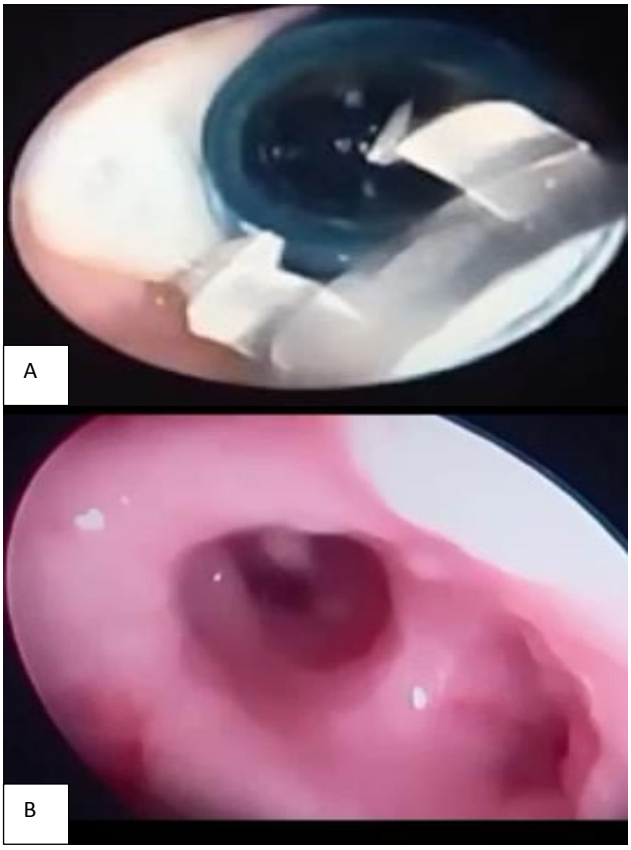


**Figure 3 (A and B): A 7-year-old male presented with history of recurrent pneumonia, history of aspiration of pen part 10 months back while playing. VB of intraluminal FB in the right main bronchus. Optical bronchoscopy showed, FB pen part in the right bronchus along with pus and stricture formation a complication of a long-standing FB.**

## DISCUSSION

Long standing bronchial foreign bodies are great masqueraders presenting with non‑specific symptoms and with a high propensity of being missed thus a high index of suspicion should be there. A history of FB aspiration given by parents is the always the first clue in making a diagnosis but it's unfortunate that only in few of the cases one can get a proper history.[2] Profile of symptoms are generally non-specific ranging from none to chronic cough, wheezing, hemoptysis and recurrent episodes of chest infections. Evaluation should be undertaken even if FB was removed previously and patient has symptoms as part of it.

In our study we found that 72% of the cases belonged to the rural areas and 63% of the patients came from lower socio-economic status. This data explains the reason behind the delay in diagnosis of bronchial FBs. The 32% had definitive history of FB aspiration and 68% didn't not have definitive history of aspiration. In most of the cases patient were being treated for pneumonia or as case of pulmonary tuberculosis. Time passed since suspected FB aspiration ranges from 4 weeks to 3 years in our study suggest that how unnoticed aspirations can remain asymptomatic for prolonged duration or may cause some non-specific symptoms which often gets relieved with medications.

Complications of tracheobronchial FB aspiration is usually related to age, nature and localization of the FB, and the time passed after the aspiration. While fatal complications are seen in the acute period, in long standing cases mostly suppurative complications occurs while acute presentations mostly result in fatal complications. The most dangerous age group is between 1 and 3 years.[4] Organic materials are the most common aspirated foreign bodies associated with complications as we found in our study organic foreign material seen in 72% of cases.[6-8]

The 2.4% of all cases of recurrent pneumonia has been reported in the literature as pneumonia related to FB aspiration and usually seen in young age group mostly because of parents' poor attention to children. The incidence of pneumonia in FB aspiration is between 2.9% and 19% in children and pneumonia incidence in FB aspirations was reported as 42.9% in patients younger than 3 years.[2] In our series, there were twenty-four patients with recurrent/persistent pneumonia. After rigid bronchoscopy and removal of FB patients were transferred to the pediatric department for the management of pneumonia.

In our series, the incidence of atelectasis was 5.1%, and after bronchoscopy, atelectatic lungs expanded in all patients. The incidence of atelectasis in tracheobronchial FB aspirations is between 4.4% and 41.6% in the literature.[1-5,10]

Bronchiectasis is the most frequent complication in tracheobronchial FB aspirations in the late period.[3] The incidence of bronchiectasis due to foreign bodies settled in airways was reported in a range between 1% and 5.6% in the literature. In our study we found associated bronchiectasis in 10% of cases. Bronchial lavage was taken for bacteriological examination and tests were done for tuberculosis.

The incidence of pneumomediastinum in FB aspirations is between 0.8% and 5.8% in the literature. General etiological factors in pneumomediastinum occurs because of mucosal injury of the tracheobronchial system or the esophagus, mediastinitis, and damage of alveolar structures. In our study we found pneumomediastinum in 2 cases only of which in one case associated pneumothorax was present.

In our study majority of foreign bodies in air passage were in left main bronchus 52% followed by right main bronchus (33%). In one case FB found in upper lobe bronchus proximally which during rigid bronchoscopy was removed after gentle chest percussion in right lateral position.

We observed that chest radiograph is normal in 10% cases. Hence negative chest radiographs do not rule out FB Rather each suspected case of FB aspiration should be considered for virtual bronchoscopy whenever possible and should be subjected to diagnostic and therapeutic bronchoscopy accordingly.

In our study VB had a positive predictive value of 98.3% in detecting FB which was similar to the gold standard rigid bronchoscopy which itself had a positive predictive value of 99.1%. It is useful as it simulates the endoscopists view of the airway using 3D reconstruction as it takes advantage of the natural contrast between the airway and the surrounding tissues to detect the exact location, size and shape of the FB. Unlike the flexible bronchoscope virtual bronchoscope can provide images beyond the level of obstruction such as a stenosed part. This also helps the surgeon plan the procedure of rigid bronchoscopy as he is sure of the position, size nature of the FB, type of forceps also can be decided with the help of virtual bronchoscopy.[10]

A negative virtual bronchoscopy can prevent a patient from unnecessary hazards due to rigid bronchoscopy and general anesthesia as it is the only imaging modality which gives 99.9% tree as far as the segmental bronchi and sometimes also the subsegmental bronchi and the bronchi below a closed obstruction.[10] One group of authors investigated the use of VB in paediatric patients with suspected FBA and concluded that it can correctly identify the position of the FB in the respiratory tree.[8] The authors demonstrated that, when the VB result is normal, without evidence of endobronchial obstruction, the use of conventional bronchoscopy was not superior in providing relevant additional information. In another study, when images obtained by means of VB and conventional bronchoscopy in patients with suspected FBA were compared, similar results were found.[2] In a recent study comparing VB and conventional bronchoscopy, the estimated sensitivity and specificity of VB were 96% and 58%, respectively.[9]

Another group of authors recently published a study comparing VB and rigid bronchoscopy in patients with suspected FBA, suggesting that the use of this new technique can shorten the time to the performance of bronchoscopy and accurately locate the FB.

***Limitations***

Virtual Bronchoscopy is an expensive software and not all centres have this software with them, also many patients belonging to low socio-economic status are lost to follow up.

## CONCLUSION

FB aspiration is a common cause of morbidity and mortality among children. Because of the high risk associated with an overlooked aspirated FB, bronchoscopy is often performed for definitive diagnosis and treatment, even when there is little suspicion or a doubtful history. Rigid bronchoscopy remains the gold standard in managing these cases. But repeated removal attempts are likely to result in increased complications. Therefore, the availability of a non-invasive, harmless technique to locate the FB pre operatively would greatly minimise morbidity and mortality. In this study we here-by see the changing trend in the diagnosis over a decade from chest x-rays to virtual bronchoscopy which is the only imaging modality which gives 99.9% reassurance about the presence or absence of a FB, because of its high sensitivity and specificity, hence proves to be a life-saving tool.

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