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Diagnostic Value of Flexible fiber Optic Bronchoscopy in the Evaluation of Children with Suspected Airway Foreign Body: A Review

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ABSTRACT
The diagnosis of airway obstruction in pediatric patients by flexible fibreoptic bronchoscopy is an important tool as it decreases the number of negative rigid bronchoscopies. Its role in the exclusion of airway foreign bodies is nearly 100%. A chest CT scan may parallel its role but has its limitations as being a virtual bronchogram and its non availability at select centers. A retrospective study of 124 cases of suspected airway foreign bodies was done. The negative predictive value of a diagnostic bronchoscopy in viewing a foreign body is high and also can guide in finding other causes for the obstruction. It also provides an opportunity for other procedures like tracheobronchial lavage and suctioning of secretions if required.

INTRODUCTION

Pediatric foreign body aspiration is one of potentially serious and common household problems of significance presenting to the emergency room. The age of occurrence is from 3m to 14 y but the high risk age group is between 1-2 y. This is attributed to the children's curiosity and tendency to explore the environment in this particular age group. Also children with developmental and psychological disorders are more prone to have foreign body aspirations. A higher incidence is seen in children with congenital malformations as mentioned in some previous studies. The incidence of FB aspiration is higher in boys than girls and this sex predilection may be related to different physical and psychomotor development seen in both sexes and also to the methods of parenting and sex ratio of the population[1]. The condition when associated with a confirmed history of coughing or choking, a diagnosis to rule out or confirm the presence of a trachea-bronchial foreign body is needed. The various settings related to a foreign body aspiration in a child need to be considered: The retention time of a foreign body depends upon the age of the child. In children less than 1 y and older than 6 y, the caretakers are seen paying attention. Children more than 6 y age can clearly express concern and show discomfort in aspirated FB[1]. The location of a FB, when it is trapped beyond the trachea is seen mainly in the right bronchus owing to a larger angle between right main bronchus and airway. The FB type, whether organic or non organic depends many a times on the dietary habits of the region involved. Sometimes FBs are missed clinically or radiologically initially, but come with complications that arise due to an old retained FB. They cause complications like obstructive emphysema, atelectasis and co-morbid long term pulmonary infection or sometimes even a bronchopneumonia. Other lesser known complications are pulmonary bulla, pleural effusion, pneumothorax with mediastinal emphysema[2]. The delay in the diagnosis of airway FBs in children has many reasons. Only 57% of cases show a classic triad of sudden onset choking, coughing and wheezing or unilaterally decreased breath sounds. Various pediatric common illnesses like bronchiolitis, pneumonia or asthma can be confused with a similar presentation. Lower airway foreign bodies can present with subtle or non specific symptoms of lower respiratory tract findings. Complications arising from un indicated treatment with steroids, antibiotics and bronchodilators further adds to the confusion. The differentiation from many chronic childhood illnesses like pulmonary infections, bronchiectasis, asthma, lung collapse or abcess can become difficult. The role of chest X-ray in the diagnosis of FB airways is with a poor diagnostic yield. It can only detect 10-20% of radiopaque FB. It is difficult to pick up complications like emphysema or atelectasis and sometimes may be very challenging. The chest CT has a high sensitivity (99%) and specificity (92%) for the detection of airway FB, but negative CT scan, at the same time does not necessarily rule out a FB[3]. A correct diagnosis is achieved with flexible bronchoscopy only when a high clinical suspicion is maintained with or without a history of aspiration. Both rigid and flexible bronchoscopy is implicated in FB removal in children. The role of rigid bronchoscopy remains unequivocal in diagnosing and removing only established airway FB confirmed either on history, or by clinical examination or radiologically proven. In cases with high clinical suspicion or a history indicative of aspiration, in radiolucent objects, role of flexible bronchoscopy is noteworthy. It can be considered in the removal in certain pediatric cases in expert hands.

MATERIALS AND METHODS

Records of patients who had undergone flexible fiberoptic bronchoscopy for foreign body evaluation in Varad Children's Hospital, Aurangabad, India during 2017-2022 were retrospectively evaluated. 124 patients were enrolled in this study when there was suspicion of airway foreign body and fiberoptic bronchoscopy was performed. The study involved cases with a wide age range between 90 days and 16 years, frequency of children involved was more in toddlers between 1-2 years. Males outnumbered females.

Initial Clinical Presentation: All cases were subjected to flexible fiberoptic bronchoscopy for the diagnosis of FB. The cases were either referred with a strong suspicion or when there was a history of choking. In other cases, a FB was suspected with a non resolving lower respiratory infection or recurrent symptoms. Other cases were referred with a suspicion on the basis of chest x ray or CT scan findings.

Investigations Before Scopy: Of all the cases, x ray chest was reported as normal in 31 cases in which foreign body was recovered later (31/65), 21 had hyperinflation (21/65) of which 4 had bilateral and 11 had hyperinflation on right side and 6 on the left side. Lung collapse was seen in 10 cases, 6 in the right lobe and 4 in the left. In 3 cases, pneumothorax was reported.

Procedure: In all cases, diagnostic bronchoscopy was done with a 3.5 mm fiber optic Pentax flexible bronchoscope with a working channel of 1.2mm. It has a side port for flushing or for instilling local anesthetic agent and another port for connecting to the suction apparatus for suctioning the secretions during the procedure. The average length of time needed for the procedure was between 1-4 min. A mild sedation during the procedure was achieved with a short acting

benzodiazepine like midazolam and 2% xylocaine after dilution was instilled during the scopy at vocal cords or tracheal level. All patients tolerated the procedure well and not a single complication was recorded during the procedure.

RESULTS AND DISCUSSIONS

FB was recovered in 65 of the total 124 cases. In the remaining, findings were:

- either a total negative outcome in 42 cases.
- 12 cases involved secretions and mucus plug which needed suctioning during scopy.
- 5 cases suspected of an extrinsic pressure.

The fiber optic bronchoscopy was very useful in detecting the site, location and the type of FB. It helped to check for partial or complete airway obstruction. A search was made to look for any granulation tissue surrounding it or take out the secretions during the procedure. The information gained from diagnostic scopy was useful for the person doing rigid bronchoscopy for foreign body removal in a different setting with sedation and anaesthesia. The foreign bodies in most cases were subjected to removal by rigid bronchoscope. Those were identified as either organic or non-organic. The organic FBs mostly consisted of peanuts, cashew nut pieces, almond pieces, coconut fragments, turmeric seeds and chikoo seeds and small food particles in some. The non organic bodies found were in the form of small pebbles and plastic beads.

Complications: No complications occurred during the diagnostic procedure in all cases.

Though rigid bronchoscopy remains the procedure of choice of removal of airway FB, FFB can be implied for the diagnosis with a back up in the form of RB and operating room. It not only helps in the proper visualization of the airway and its smooth passage to visualize the distal airways with precision, it also suggests the site of FB, type of FB, shows if it is causing a partial or complete obstruction. It also indicates the presence of inflammation and granulation tissue. It helps in suctioning the secretions which can be analysed for cytology and bacteriological studies. With the help of FFB, it can be determined whether the FB is movable or fixed. As mentioned in the literature, this can even be the method of removal of some of the foreign bodies in expert hands. In our experience, the information gained on FFB could be passed on to the expert in doing RB to plan his procedure according to the site, type, nature and its associated complications detected on FFB. Various advantages of flexible bronchoscope and disadvantages of a rigid scope can be discussed.

- Bronchi, upper or subsegmental are not readily visible with a rigid scope.
- There are limitations of using a rigid scope for patients with cervical spine, mandible or head abnormalities.
- Not suitable for FB in peripheral airways especially those in upper lungs. It is highly operator based and qualified personnel are limited.
- Complications associated with rigid scopy are hypoxemia, tracheal bronchial lacerations or bleeding, laryngeal edema, broncho laryngospasm, pneumothorax, pneumomediastinum, reintubation, mechanical ventilation, cardiac arrest, anoxic brain injury etc[4].

Flexible bronchoscopy is a safe diagnostic and treatment option with minimum risk and complications. With skills from a performing physician, this can be conducted under local anaesthesia and sedation.

- This can remove abnormally proliferated granulation tissue along with flushing of the inflammatory site during FB removal.
- The complications like bronchiectasis, atelectasis, pneumonia which are localized and non full lung diffuse are reduced.
- In airway FB particularly of the children, this can be also a means of removal.
- FB removal in assistance with biopsy forceps, snares, basket and balloon method can be done in select cases.
- There is only danger of dislodging and further compromising the airway.
- This has a very high sensitivity and specificity (close to 100%).
- This can be performed in children under simple sedation associated with local anaesthsia of upper airway in a room equipped for resuscitation but better be performed in operation room under general anaesthesia.
- Sometimes it fails to visualize the foreign body in the presence of intense granulomatous reaction around the FB or abundant bronchial secretions.

The location of the aspirated FB depends upon the age of the child and the position/ posture at the time of aspiration. In the majority of cases in our study the FB was removed from the right main bronchus than the left which explains the wider and steeper anatomy of the right main bronchus but in infants and smaller children, due to the predominance of left main bronchus, the aspiration was also seen on the left in younger age group. Complications like obstructive emphysema., atelectasis or co morbid associated complications like bronchopneumonia were seen rarely in our study and can be attributed only for an old retained FB, so more inflammation and infection are expected. The relative study of aspiration of organic vs. inorganic FB was done to show more of organic FB

Fig. 1: Normal Bronchogram

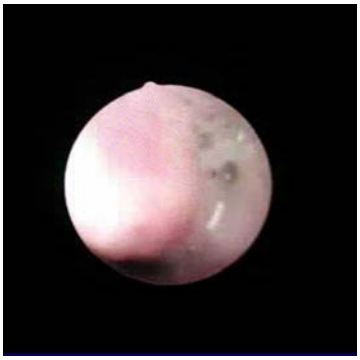

Fig. 2: Foreign Body Obstructing Right Main Bronchus

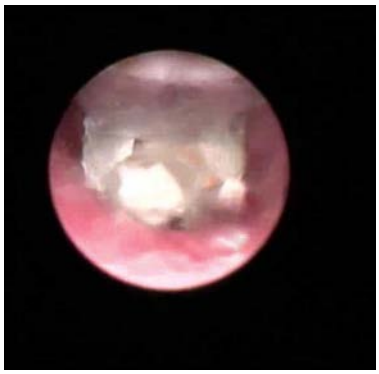

Fig 3: Foreign Body in Trachea

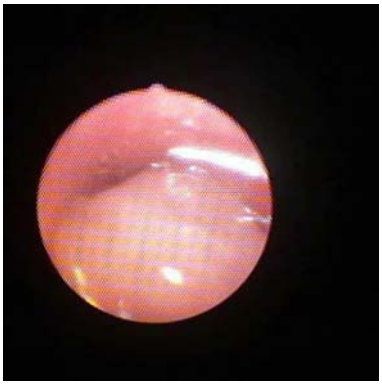

Fig. 4: External Compression of Trachea

aspiration in our study. Peanut pieces were relatively the most common object found in this study. This could be attributed to the society and family's social, cultural and dietary habits. This probably is attributed to the low cost and availability of peanuts in our region[5]. Choking and coughing are the likely events to be associated with FB aspiration, which were observed with only a small percentage of children. This could be due to a lower age at presentation and inability on the part of parents to notice such symptoms. Most of the cases have been referred by primary physicians with the suspicion of airway FB. The most relevant investigation done in suspected cases was chest radiograph in almost all cases. The most noted radiological findings were obstructive emphysema either localized or generalized, atelectasis or a partial lobe collapse. Longer retention time of FB, particularly an organic type can give rise to complications of pneumonia and collapse- consolidation. Many of the cases showed a normal chest X-ray[6]. The bronchoscopy procedure lasted for an average duration of 2 and 1/2 min and was a relatively shorter time compared to some other studies. The other studies also conducted FB removal in the same setting, while this study was done only for the diagnostic purpose. The rarity of complications associated with our study may be probably due to a very short time required and conducted under some mild sedation and local anesthetic agent. Our study was limited in many ways. This was conducted only at a single center and is a retrospective analysis of cases. Studies like CT chest for the confirmation or complications were not done, either due to non availability or due to financial constraints in many cases. This procedure which is a less invasive and safe motivated us to do it with a relative ease and gave results more than any other diagnostic modality.

CONCLUSION

The yield of a clinical examination in the confirmation of a suspected airway foreign body is low. This is attributed to a low sensitivity and specificity of a good clinical examination in identification of a penetration syndrome merely on the auscultatory findings. A good radiological examination in the form of X ray also may have a poor interpretation, and is based on variables like inspiratory or expiratory films and their reporting. Doing a CT chest after no confirmatory findings on an x ray which is done in almost all cases, either is not feasible or not available easily. The best diagnostic modality in any setting with an expertise in the field and a back up for resuscitation is a relatively simple and safe procedure in the form of fiber optic bronchoscopy to have a better diagnostic yield. It also helps to get specimen for bacteriological or other tests. The advantage of doing it under mild sedation and local anesthesia further justifies its use. In centers

equipped for removal of small foreign bodies in distal airways particularly in children, this can add to its utility in the FB removal. The use of more invasive and risky procedure of rigid bronchoscopy can be spared only for the confirmed cases of radio-opaque and obstructive foreign bodies and that too in an operating room with anesthesia.

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