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Research Article

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The management of complicated airway foreign bodies in children: our institutional experience

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ABSTRACT

Background: Foreign body (FB) aspiration is typically seen in preschool children. The main objective was to study the utility of open surgical treatment for complicated airway foreign bodies in children.

Methods: This was a retrospective analysis of data pertaining to complicated airway foreign bodies managed at our institution between 1997 January to December 2015. The demographic data, clinical presentation, radiological studies, surgical management, complications, duration of hospital stay and follow up were recorded and analysed. The diagnosis of FB aspiration was made from documented clinical features and radiological investigations. The treatment included rigid bronchoscopy and surgical interventions as and when required.

Results: During the study period of 120 months, a total of 635 children with FB aspiration were treated at our institution. All of them underwent initially, rigid bronchoscopy and attempted FB retrieval. It was successful in 624 patients and 11 patients had complicated airway FB which could not be retrieved endoscopically. Among eleven patients analysed in the present study, 7 were males and 4 were females. The age of the patients ranged from 6 months to 16 years, the average age being 5.7 years. All of them did well postoperatively except one mortality.

Conclusions: Timely intervention with the experienced surgical team would minimize the complication rate and mortality rate. The concomitant performance of a tracheotomy is indicated for patients who have aspirated particularly wide FBs, which do not pass the subglottic region and in sharply pointed FBs whose points lodge in the subglottic region presenting with respiratory distress. Open surgical procedures including thoracotomy and bronchotomy for retrieval of impacted bronchial FB are invaluable adjunctive procedures for management of complicated FB aspirations.

Keywords: Airway foreign body, Tracheotomy, Bronchotomy, Complicated foreign body aspiration

INTRODUCTION

Foreign body (FB) aspiration is typically seen in preschool children. Exploring nature and inquisitiveness of these babies is commonly attributed for FB aspiration. The majority of acute foreign body aspirations presents dramatically and can be safely extracted with rigid or flexible bronchoscopy with optical

forceps.⁵ However, on rare occasions these patients may present with complications related to FB impaction and its effects distal to it. We present our study on complicated airway FBs and their surgical management in children.

METHODS

This was a retrospective analysis of data of all the patients who presented with complicated airway FBs managed at our institution between 1997 January to December 2015. The demographic data, clinical presentation, radiological studies, surgical management, complications, duration of hospital stay and follow up were recorded.

Chest radiograph was done in all the patients initially. Later a contrast enhanced computed tomography (CECT) of the thorax was done to accurately locate the position of FB and its effects distal to its lodgement on the airways. Rigid bronchoscopy with the intention of FB retrieval was attempted in all the patients and open surgical interventions were done in failed attempts. The surgical interventions were done by thoracotomy or thoracoscopic approach. The procedures included tracheotomy, bronchotomy and pulmonary lobectomy. The documented operative findings, nature of aspirated FBs, peri operative complications, need for post-operative ventilatory support, duration of hospital stay and follow up were analyzed

RESULTS

During the study period of 120 months, a total of 635 children with FB aspiration were treated at our institution. All of them underwent rigid bronchoscopy initially and attempted FB retrieval. It was successful in 624 patients and 11 patients had complicated airway FB which could not be retrieved endoscopically. Among eleven patients analysed in the present study, 7 were

males and 4 were females. The age of the patients ranged from 6 months to 16 years, the average age being 5.7 years. All 11 patients presented with clinical features suggestive of airway compromise. They underwent an initial chest radiograph, followed by rigid endoscopy via the mouth for attempted retrieval of FB. The procedure was unsuccessful in all the 11 patients who were included in the study.

Five patients required thoracotomy (right thoracotomy in 3 and left thoracotomy in 2) and selective bronchial isolation and bronchotomy for FB retrieval. Another four patients required tracheotomy and retrieval of FB. One baby required right lower lobectomy as the involved lobe was destroyed due to chronically retained FB with bronchiectatic changes. One patient with metallic FB migrated into posterior mediastinum was managed by thoracoscopic approach (Figure 6C and D) and another patient with sewing needle (Figure 1B), which migrated to posterior mediastinum is been managed conservatively and kept on close follow up.

Contrast enhanced computed tomography (CECT) thorax was done in seven patients. Out of 11 patients, 2 had organic FBs, 6 were radio opaque metallic FBs and 3 patients had non opaque inorganic FBs. The aspirated FBs included bone piece, mutton piece, nail, push board pin and metallic pen cap, plastic pen cap, glass pieces, metal screw, metal foil and sewing needle.

Results expressed in Table 1.

Age in Years	SEX	Mode	Nature of FB	Bronchoscopic attempts	Sex intervention	Result
14	F	Acute	Bone piece	1	Tracheotomy	Good
13	M	Chronic	Nail	2	Bronchotomy	Good
16	M	Chronic	Push board pin	5	Bronchotomy+ Lobectomy	Good
6	F	Chronic	Metal pen cap	3	Bronchotomy	Good
1.8	M	Acute	Mutton piece	1	Tracheotomy	Good
4	M	Chronic	Plastic pen cap	1	Tracheotomy	Good
6 months	M	Chronic	Sewing needle	1	Conserved	On follow up
1.5	M	Chronic	Screw	3	Bronchotomy	Good
3	M	Chronic	Metal pen cap	3	Bronchotomy	Good
2	F	Acute	Metal foil	2	Thoracoscopy	Expired
1.5	F	Acute	Glass pieces	1	Tracheotomy+ Laryngotomy	Good

Before decision for any surgical interventions, at least three attempts of bronchoscopic retrieval were attempted. One patient was attempted five times bronchoscopic retrieval before decision for lobectomy. He gave a history

of round pin aspiration and CECT also revealed similar picture. Surprisingly on table we noticed it was a push board pin having rectangular plastic hub (Figure 9A), which was hindering the bronchoscopic retrieval.

Five patients required thoracotomy (right thoracotomy in 3 and left thoracotomy in 2) where in selective bronchial isolation and bronchotomy for FB retrieval was done. Chest was entered at 5th intercostal space via posterolateral thoracotomy approach. The main bronchus was exposed and stay sutures were applied on the bronchus to take control of the airway. The impacted FB was localized by palpation or by intra operative imaging. A bronchotomy was done over the impacted FB and it was retrieved (Figure 7). Primary repair of bronchus was done using 3-0 or 4-0 non absorbable interrupted sutures. Thoracotomy wound was closed after keeping intercostal drain.

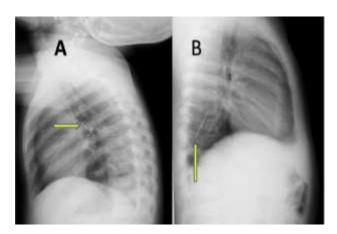


Figure 1 (A): Chest X ray- Yellow coloured arrow indicating LED bulb in the left main bronchus. (B): Chest X ray -Yellow coloured arrow showing sewing needle in the posterior mediastinum.

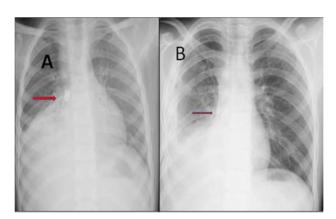


Figure 2 (A): Chest X ray- a red coloured arrow indicates metal pen cap lodged in the right main bronchus. (B) Chest X ray – a red colored arrow showing push board pin lodged in the right main bronchus.

Another four patients required tracheotomy via the neck and retrieval of FB. A transverse neck incision was made in the neck and tracheotomy was done at 3rd tracheal ring avoiding the isthmus of thyroid. Trachea was primarily closed with 3-0 non absorbable interrupted sutures in all the patients after FB retrieval. One patient who presented with glass pieces in the trachea, required laryngotomy in addition to tracheotomy for retrieval of glass pieces.

One patient who presented with features of bronchiectasis required right lower lobectomy as the involved lobe was destroyed due to chronically retained FB with bronchiectatic changes (Figure 2B and 4B). One patient presented with respiratory distress suspected to be having airway FB, but routine serial chest X rays (Figure 5A and B) and bronchoscopy did not reveal any FB. Eventually turned out to be cricopharyngeal FB, which got migrated into posterior mediastinum requiring thoracoscopic retrieval by CECT (Figure 6C, D and Figure 8B). However this patient developed acute respiratory distress syndrome (ARDS) and later succumbed. One patient who had migrated metallic sewing needle into the right posterior mediastinum was managed conservatively with close observation and repeated imaging.

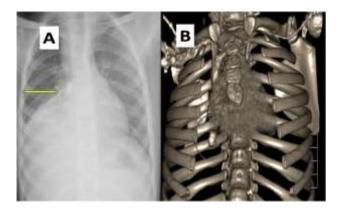


Figure 3 (A): Chest X ray- Yellow colored arrow indicates metal pen cap lodged in the right main bronchus. (B): Reconstituted CECT image of metal pen cap.

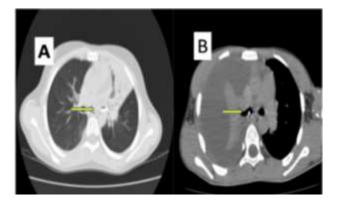


Figure 4: CECT chest cross sectional images (A): Nail across the left bronchus. (B): Push board pin lodged in the right main bronchus.

Only 6 operated patients were placed on post-operative ventilator support for 2 to 4 days. The average duration of hospital stay was 11.6 days and ranged from 4 days to 16 days. Ten patients had good results with uneventful recovery. One patient with mediastinitis secondary to migrated cricopharyngeal FB succumbed to death due to ARDS. All the patients were followed up at 10 days, 1 month and 3 months after discharge. Subsequently annual follow up was done. The average duration of follow up was 78 months and ranged from 2 months to 119 months.



Figure 5 (A) and (B): Plain chest X ray –serial chest X rays not showing metallic foil.

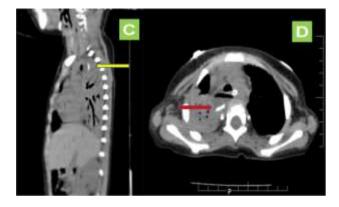


Figure 6 (C) and (D): CECT chest showing migrated metallic foil from cricopharynx.



Figure 7: Intra operative picture showing retrieval of metal pen cap through bronchotomy.

We had few complicated FBs which were managed efficiently by rigid endoscopy alone, which included LED bulb (Figure 1A), metallic ear stud in left bronchus. One patient had metallic screw in the right main bronchus, but on bronchoscopic procedure, there was no FB in the bronchial tree. On table intra operative imaging revealed its spontaneous migration into stomach. Eventually FB was passed in the stools.¹³

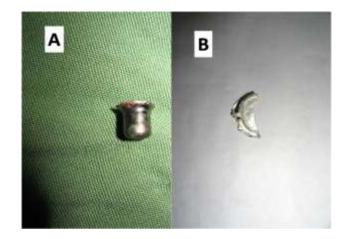


Figure 8 (A): Retrieved FB-metallic pen cap. (B): Retrieved metallic foil.

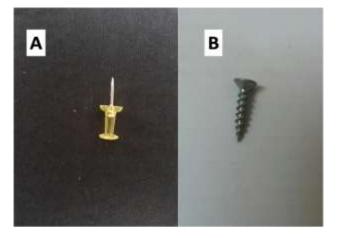


Figure 9 (A): Replica of FBs a push board pin. (B): Metallic screw.

DISCUSSION

The presence of foreign material within the airways of children continues to be a significant cause of morbidity and mortality. In some countries FBs are even the most common cause of accidental death among children less than one year old. Physicians always should consider the presence of foreign body aspiration as a diagnostic possibility in children with the typical symptoms such as intense coughing, wheezing, vomiting, paleness, cyanosis, or short apnea episodes. ²

Rigid endoscopy is the gold standard for retrieval of airway FBs.^{1,2} As the subglottic region is the narrowest part of the airway of the child, any edema caused by the

passage of a large caliber FB can reduce even further the caliber of this area and making it impossible for the FB to pass across it. This is a dramatic moment during the performance of an endoscopic procedure, since a FB which does not pass the subglottic region completely obstructs the trachea with hypoxemia, bradycardia and sudden cardiac arrest. Before this catastrophic event can occur it is important that the surgeon pushes the FB with the bronchoscope into one of the main bronchi, in order to allow respiration with at least one of the lungs. This is a life saving maneuver and is indispensable. However, in rare situations, certain materials cannot be removed by endoscopy, and must be removed after making an opening in the airway. A revision undertaken by Marks et al., studying 6,393 patients with FBs in the airway showed that when open surgery is indicated for the removal of the FB, thoracotomy (2.5%) is more commonly required than tracheostomy (2%). Of the 104 patients who needed tracheostomy, 52 were because of laryngeal edema after bronchoscopy, 12 as a route for the introduction of a bronchoscope, 11 in order to permit assisted ventilation, and only 10 to enable the removal of large objects which would not pass the subglottic region.³

During retrieval of a tracheobronchial FB, the removal of such an object through a tracheal opening is indicated when the FB is overly wide and will not pass the subglottic region.⁴ Other indications for tracheotomy are the removal of sharply pointed FBs whose points lodge in the subglottis or in the vocal cords and when the FB impacts the subglottic region and provokes an acute obstruction.^{3,5,6} In the present study 3 patients required tracheotomy for removal of large impacted FB. Two of them had impacted organic food matter in the trachea, i.e. an impacted bone piece and an impacted mutton piece. The third patient had a plastic pen cap impacted in the trachea. All the patients tolerated procedure well; tracheotomy was closed primarily and post-operative elective ventilation was done.

Although the aspiration of pen caps occurs at all ages, its incidence is more frequent in children. 7,9 Pen caps aspiration is a challenging problem because of the difficulties during extraction and higher morbidity compared with other foreign body aspirations.⁴ Only metallic pen cap foreign bodies are visible in chest X ray (Figure 3A,3B and Figure 8A); thus, secondary radiographic changes must be sought in plastic ones. These include segmental or lobar collapse, air trapping, and post obstructive lobar or segmental infiltrates.^{2,4} The prevalence of atelectasis might be a result of the longer delay in diagnosis, a delay that allows time enough for the complete closure of the airway and atelectatic changes (Figure 4A and 4B).2 In such cases in which classic bronchoscopy failed and/or pen caps could not be removed via vocal cords, open surgical approaches, either bronchoscopy and tracheostomy or thoracotomy and bronchotomy, may be an alternative procedure of choice.⁴ Pen cap is removed together with the bronchoscope because of their diameter. Pen caps have slippery surface,

they tend to be ungrasped during bronchoscopic removal (Figure 8A). Tracheal or bronchial foreign bodies larger than the subglottic region cannot be securely grasped with forceps for safe removal through the usual route. In these circumstances, open surgical removal of an airway foreign body is preferred to bronchoscopic removal. ¹⁰⁻¹²

Open surgical procedures include tracheotomy, thoracotomy, and bronchotomy. Ulku R et al., performed thoracotomy and bronchotomy in cases in which removal of pen cap failed because of immobility, very distal bronchial placement, and/or impossible grasping owing to severe circular bronchial edema immediately proximal to foreign body, slippery surface, and the pen cap having settled completely in the bronchus.⁴ In the same series, thoracotomy was required for 5 cases in which other interventions failed.4 In the present study, 2 patients had impacted pen caps in the airways. One was metal pen cap impacted in the right main bronchus and another was plastic pen cap impacted in the trachea. The patient with plastic pen cap underwent tracheotomy and its removal as described earlier. The other patient with impacted metal pen cap underwent right thoracotomy, bronchotomy and its retrieval. The bronchus was closed primarily and patient ventilated electively.

In the present study, 6 were radio-opaque FB and 5 were radiolucent FB. In view of this the need for CECT cannot be overemphasized. The accurate localization of FB is achieved by CECT (Figure 4 A and B, Figure 6 C and D). Other features that can be observed in CECT imaging are atelectasis, bronchiectasis, recurrent pneumonia, or fibrosis.

Ulku R et al have performed thoracotomy and bronchotomy in cases in which removal of pen cap failed because of immobility, very distal bronchial placement, and/or impossible grasping owing to severe circular bronchial edema immediately proximal to foreign body, slippery surface, and the pen cap having settled completely in the bronchus.⁴ In their series, thoracotomy was required for 5 cases in which other interventions failed.4 In the present study thoracotomy was required in 6 patients and thoracoscopy in 1 patient. Among 6 patients, bronchotomy and FB retrieval was done in 5 patients. All the patients tolerated procedure well and had uneventful recovery. One patient underwent right thoracotomy and lower lobectomy in view of irreversible bronchiectatic changes. This patient also had uneventful recovery and doing well on follow up of two years.

CONCLUSION

Timely intervention with the experienced surgical team would minimize the complication rate and mortality rate associated with tracheobronchial FBs. We conclude that a minority of children with FB aspirations cannot be removed by endoscopy alone, even when performed by an experienced surgeon. The concomitant performance of a tracheotomy is indicated for patients who have

aspirated particularly wide FBs, which do not pass the subglottic region and the sharply pointed FBs whose points lodge in the subglottis. Open surgical procedures including thoracotomy and bronchotomy for retrieval of impacted bronchial FB are invaluable adjunctive procedures for management of complicated FB aspirations. Prevention of FB aspiration by public education and awareness is the need of the hour. All physicians need to keep a high index of suspicion for airway FB in children who present with recurrent cough.

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Ethical approval: The study was approved by the

Institutional Ethics Committee

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