



Original article

Comparison between Clinical Presentation of Foreign Body Aspiration Cases and Findings of their Rigid Bronchoscopy and Diagnostic Imaging

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Abstract:

Background: Foreign body aspiration (FBA) is a serious clinical problem among children, also occurring in adult patients with potentially high morbidity and mortality rates.

Aim and objectives: The objective of our study was to determine the accuracy and reliability of the clinical signs and correlating them to the rigid bronchoscopy and imaging findings in order to reach the optimum criteria that will enable us in the future to avoid unnecessary bronchoscopy and increase the rate of positive bronchoscopies. Reduce the drawbacks of rigid bronchoscopy, including its invasiveness and the potential for exacerbation of reactive airway disease.

Subjects and methods: This was a cross-Sectional Study conducted during a period of 6 months starting from October 2021. Totally 50 cases were included in this study. This study was conducted at Otorhinolaryngology Department, Beni-Suef University Hospital. **Results:** suspected FB shadow in CT-scans has high sensitivity and specificity 95.12% and 80% respectively. Pneumonia and lung collapse have high specificity but with low sensitivity. **Conclusion:** Especially when occurring in a young child. Early diagnosis and immediate control by a specialized

team are essential for ensuring correct treatment, which is generally endoscopic, without any risk of complication. Rigid bronchoscopy is the gold standard tool for the management of foreign body aspiration with 96% successful retrieval rate.

1. Introduction:

Foreign body in airway is a common emergency in Otorhinolaryngology practice. As we know, Rigid Bronchoscopy is the method of choice for removing it, although at times it leads to specialists performing unnecessary bronchoscopy, exposing patients to hazards of general anesthesia [1].

Foreign body aspiration (FBA) is a serious clinical problem among children, also occurring in adult patients with potentially high morbidity and mortality rates. Aspiration is more common in younger children (<3 years) and in boys (> 60%) with a peak incidence between 1 and 2 years of age [2].

An expiratory chest x-ray should be requested when the standard inspired film result is normal, as this strategy allows visualization of air trapped by a valvelike effect due to partial obstruction of the bronchial lumen [3].

However, these findings are nonspecific as they may occur even in patients without FB inhalation. Negative chest x-ray result in patients with a strong clinical suspicion of FB inhalation requires bronchoscopy [4].

Bronchoscopy is the most specific and sensitive diagnostic procedure and may also provide the ultimate treatment [5].

Multi-detector computed tomography (MDCT) with virtual bronchoscopy is a noninvasive

diagnostic technique with sensitivity and specificity of almost 100%, as it is able to show the lumen of the tracheobronchial tree and detect radiolucent FBs with accuracy similar to rigid bronchoscopy, identifying the exact location of the FB impaction. Furthermore, it can correctly detect parenchymal findings and allow an optimal visualization of the airways distal to the obstruction [5].

The objective of our study was to determine the accuracy and reliability of the clinical signs and correlating them to the rigid bronchoscopy and imaging findings in order to; Reach the optimum criteria that will enable us in the future to avoid unnecessary bronchoscopy and increase the rate of positive bronchoscopies. Reduce the drawbacks of rigid bronchoscopy, including its invasiveness and the potential for exacerbation of reactive airway disease.

2. Patients and Methods:

This was a cross-Sectional Study conducted during a period of 6 months starting from October 2021. Totally 50 cases were included in this study. This study was conducted at Otorhinolaryngology Department, Beni-Suef University Hospital.

Inclusion criteria:

All patients of suspected foreign body inhalation during the study period were included in this study and both sexes, age groups > 8 months.

Exclusion criteria:

Patients with a history of asthma or acute infection of the superior respiratory tract, age < 8 months (no available bronchoscopy set for that age), children with congenital anomalies in the upper airway, for example cleft lip and cleft palate, patients with respiratory failure requiring mechanical ventilation and patients with coagulopathy or bleeding diathesis that cannot be corrected.

Recruitment and procedures applied in the study

Place of recruitment (place of conduction of the study):

Subjects were recruited from Otorhinolaryngology Department at Beni-Suef University hospital.

Research Ethics Committee Approval and quality control:

The protocol and all corresponding documents were declared for Ethical and Research approval by the Council of Faculty of Medicine, Beni-Suef University.

Approval No: FMBSUREC/01112021/ Khalil

Subjects consent:

Written informed consents were obtained from the patient's caregivers before entering and start of the study.

Procedures applied in the study: All patients were subjected to:

Full history including age, sex, witnessed or suspected foreign body aspiration, nature of the foreign body, time of aspiration, and presence of other medical conditions especially bronchial asthma or cardiac problems. Physical examination was done focusing on chest auscultation, for example air entry, wheezes, and other adventitious sounds. Routine laboratory investigations including: Complete blood count, liver functions, prothrombin time and concentration and international normalized ratio (INR), and kidney functions. Both the patients and their clinical and laboratory data were assessed by the anesthesia staff.





Figure (1): Examples of conducted CT-scans that show foreign body during our study

Preoperative preparation: The patients were kept nil orally for a minimum period of 4hrs (in elective cases). High-risk consent was taken from the parents. Oxygen was given through a face mask. Intravenous steroid (hydrocortisone 10 mg/kg body weight) was given to the patient, administration of nebulized albuterol and/or budesonide.

Type of anesthesia: General anesthesia.

Surgical technique: General anesthesia was used in all patients. The plan for induction and maintenance of anesthesia and the method of evaluation and removal of the foreign body were communicated preoperatively between the anesthesiologist and the surgeon. Pre-oxygenation with 100% oxygen for a period of 5 min was given. All patients were monitored using electrocardiogram, a blood pressure cuff and pulse oximetry throughout the procedure. Positive pressure ventilation was avoided, since this tends to drive the foreign body further distally. Boyce's position (flexed neck on the thorax and the extended head on the atlanto-occipital joint) was utilized.

Instruments

The following instruments were used during the procedure: Ventilating pediatric bronchoscope (Karl Storz), macintosh laryngoscope, rigid suction cannula, forceps: (a) Universal grasping forceps. (b) Peanut grasping forceps, cold light source with cable and tracheostomy set as standby.

Age-appropriate equipment for endoscopic foreign body removal was carefully selected before the patient was brought to the operating room.

The laryngoscope tip was placed in the vallecula to expose the larynx for passage of

the bronchoscope. The patient was breathed through the bronchoscope until the end of the procedure. The healthy bronchus was examined first. The bronchoscope was positioned above the foreign body, and secretions were gently suctioned to expose the object fully. The forceps were placed through the bronchoscope, and the foreign body was grasped. The bronchoscope, forceps, and foreign body were removed as a unit, and the bronchoscope was returned immediately to the airway for ventilation and assessment for other foreign bodies.

Postoperative management: The patients were monitored to ensure smooth and adequate recovery. The patients were given bronchodilators, mucolytics, antibiotics and steroids. Most children were discharged within 24 hours.

Statistical Analysis: Data were collected, coded, revised and entered to the Statistical Package for Social Science (IBM SPSS) version 20. The data were presented as number and percentages for the qualitative data, mean, standard deviations and ranges for the quantitative data with parametric distribution and median with inter quartile range (IQR) for the quantitative data with non-parametric distribution.

3. Results:

Table (1): Demographic data among all patients

Variable		No	%
Gender	Female	26	52%
	Male	24	48%
Address	Beni-suef	45	90%
	Cairo	2	4%
	Fayoum	2	4%
	Minya	1	2%
Age (years)	Mean± SD	3.896 ± 0.197	
	Range	1 – 15	
Laboratory Findings	Median (IQR)		
Hemoglobin (gm/dl)	11.75 (10.90-13.20)		
TLC	8.78 (5.73-13.50)		
Platelets	229 (178-308)		
INR	1.0 (0.9-1.1)		
Prothrombin time	11.3 (11.0-12.2)		
AST	33.5 (20.0-55.0)		
ALT	27 (14.50-38.25)		
Creatinine (mg/dl)	1.2 (0.9-1.4)		

Twenty six (52%) of patients were female, 24 (48%) of patients were males. Forty three of patient's (90%) were living in Beni-suef, only two patients were living in Cairo, two patients were from Fayoum and only one patient was living in Menya. Mean of age of all patients were 3.89 years with range from 1 to 15 years.

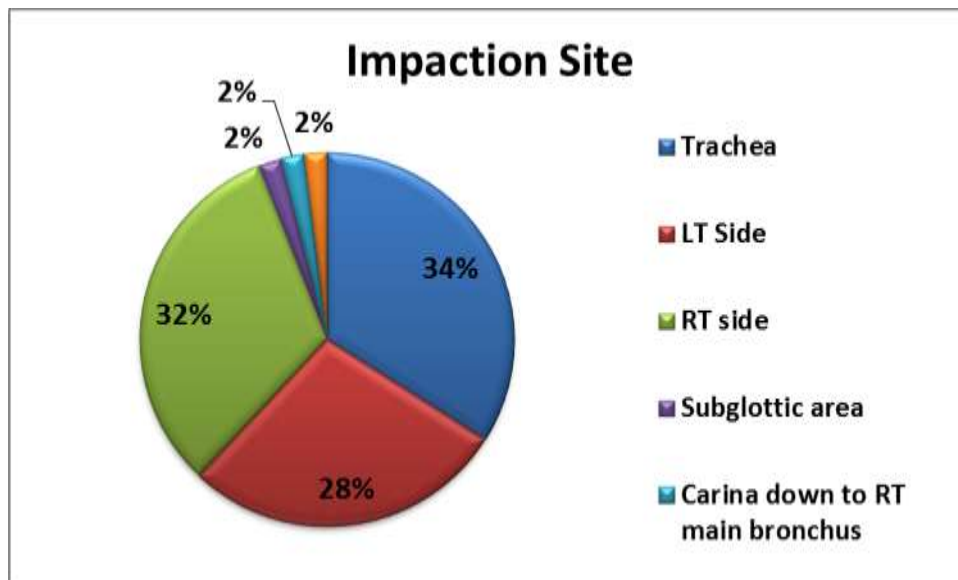


Figure (2): Site of Impaction among studied patients

17 of patients were in Trachea (34%), 14 (28) of patients were in left side and 16 (32%) of patients were in right side, only one patients (2%) were in Subglottic area, only one patients (2%) were in Carina down to Rt main bronchus and only one patients (2%) were in Distal part of Trachea (carina)

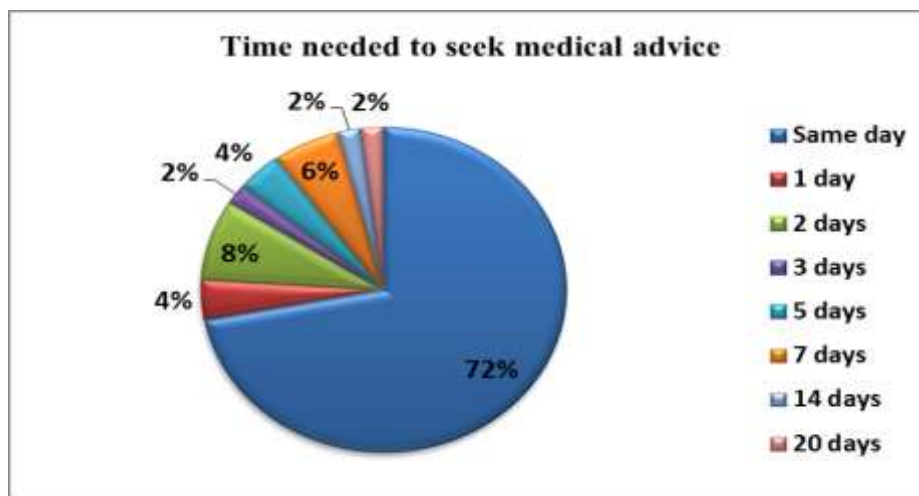


Figure (3): Time needed to seek medical advice among studied patients

36 of patients (72%) were needed to seek medical advice in same day, only two (4%) were needed that after one day, four patients (8%) were after 2 days and one patient (2%) were needed after 20 days.

Table (2): Sensitivity, specificity and PPV of imaging

Imaging Comment	Sensitivity	Positive predictive value	Specificity
Suspected FB shadow	95.12%	97.50%	80%
Emphysema	19.15%	81.82%	33.33%
Collapse	14.89%	100%	100%
Pneumonia	10.87%	83.33%	75%

The above table shows that suspected FB shadow in CT-scans has high sensitivity and specificity 95.12% and 80% respectively. Pneumonia and lung collapse have high specificity but with low sensitivity.

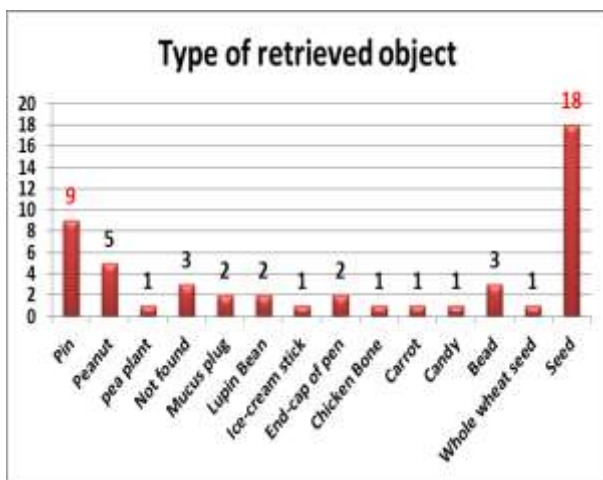


Figure (4): Type of retrieved object

The above figure shows that, the most common retrieved objects were seeds (36%) followed by pins (18%). Seeds included white pumpkin seeds by 6%, Nubian roasted melon seeds by 14% and sunflower seeds by 16%.

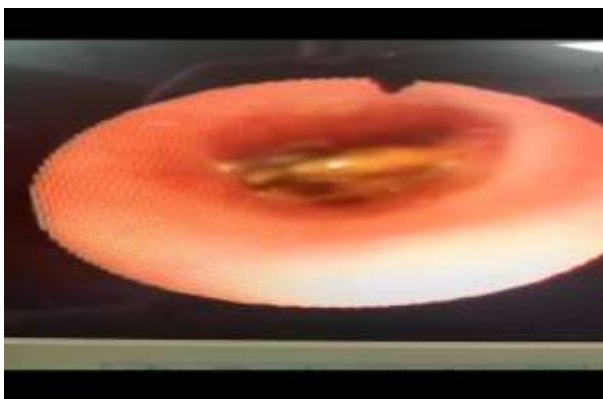


Figure (5): A seed was found at the trachea just above the carina



Figure (6): Clear air-way after extraction of the seed. The picture shows the carina along with the openings of the two main bronchi



Figure (39): Successful retrieval among studied patients

This table shows that 48 patients (96%) had successful retrieval; however, in 2 cases retrieval could not be achieved, one of them the foreign body was adherent to the bronchial wall and presented upside down, the other one

had bronchial wall injury and hemoptysis. Both patients were referred to another hospital.

Table (3): Complications among all patients

Variable		No	%
Complications	NO	45	90%
	Yes	5	10%

This table shows that 5 patients (10%) were having complication, 8% had bronchospasm or hypoxia and only 2% had cardiac arrest. It is worth mentioning that, additional observation (longer hospital stay) required for younger children to ensure full recovery with no evidence of complication. Extra caution is also required, especially in aspiration of organic material for late onset complications, such as pneumonia. Please note that manual jet ventilation anesthetic technique decrease the risk of intraoperative hypoxemia.

Table (4): Hospital Stay in Days among all patients

Variable		No	%
Hospital Stay in Days	One day	32	64%
	Two days	14	28%
	Three days	2	4%
	Ten days	1	2%
	Fourteen days	1	2%

This table shows that 32 patients (64%) were staying in hospital one day, 14 patients (28%) were staying 2 days and one only patient (2%) was staying fourteen days.

4. Discussion:

For saving the life of the patient, flexible or rigid bronchoscopy is the standard procedure

used to extract the foreign body. This procedure has the drawbacks of being invasive, needs general anesthesia, and carries the risk of complications. Hence, its use should be limited to patients with a suspected diagnosis of foreign body aspiration. However, there are no clinical clues that help physicians to confirm or exclude the diagnosis; thereby they could take the decision of opening the operation room for bronchoscopy [6].

Therefore, the aims of the present study were to determine the accuracy and reliability of the clinical signs and correlating them to the rigid bronchoscopy findings in order to reach the optimum criteria that will enable us in the future to avoid unnecessary bronchoscopy and increase the rate of positive bronchoscopies and to reduce the drawbacks of rigid bronchoscopy, including its invasiveness and the potential for exacerbation of reactive airway disease.

This cross-sectional study included 50 patients diagnosed with suspected foreign body inhalation. They were recruited and assessed for eligibility from Otorhinolaryngology Department, Beni-Suef University Hospital.

Regarding the demographic characteristics of the studied cases, our results revealed that the mean age of patients was 3.896 ± 0.197 years old, ranging between 1-15 years old. 52% were females and 48% were males.

Likewise, it has been reported by **Zang et al.** [7] that foreign body aspiration is highly frequent in age groups less than 4 years, and it

occurs in only 5% of children aged 4–14 years. Children younger than 3 years have great curiosity, and they usually explore things by placing them into their mouth. So, they have an increased risk of foreign body aspiration especially in the absence of parental supervision.

Moreover, a previous study by **Reyad et al. [6]** indicated that the median age of children who aspirated foreign bodies was 2.0 (IQR = 1.2–3.0) years, however, with male predominance (63.1%).

Regarding the site of impaction of the aspirated foreign bodies among all patients, our results revealed that trachea was the site of foreign body impaction in 34% of cases followed by the right main bronchus (32%) and left main bronchus (28%), followed by subglottic area, carina down to right main bronchus, and distal part of Trachea (2% each).

A previous study by **Reyad et al. [6]** revealed that concerning the site of the foreign body, the right and left main bronchi were the most frequent (43.8% and 21.0%, respectively). Other sites, including lower trachea (14.3%) and the subglottic area (12.4%), were less frequent. Moreover, **Rodríguez et al. [8]** indicated that the majority of foreign body (66.1%) was located in the bronchial tree, followed by location in larynx and trachea.

Na'ara et al. [9] indicated that the site of the aspirated foreign body was in left main bronchus in 42% of pediatric cases, right main

bronchus in 33%, and trachea in 6% and larynx in 5% of cases.

Regarding time needed to seek medical advice among all patients, our results revealed that 72% of patients seek medical advice in the same day following foreign body aspiration.

A retrospective single-center cross-sectional study by **Ding et al. [10]** indicated that 23% of the patients were admitted within 24 hours of the foreign body aspiration, 40% within 1 week, 30% within 1 month, and 7% more than 1 month after aspiration.

Our results revealed that foreign body shadow occur in 88% of cases and 4% were highly suspected. Pleural Effusion presented in 6.4% of patients.

Similarly, a previous study by **Reyad et al. [6]** indicated that the most common radiologic abnormalities of patients with suspected foreign body aspiration were radiopaque shadow (7.7%) and hyperinflation (3.1%). However, the presence of chest X-ray abnormalities did not reveal significant association with the detection of a foreign body. **Sink et al. [11]** revealed that the most common abnormal radiographic finding in children with foreign body aspiration was air trapping (33%).

Regarding clinical presentation of patients, our results revealed that 82% of patients have wheezes, 72.00% have cough, 62% witnessed aspiration and choking and 64% have unequal air entry (diminished air entry). 62% of patients have dyspnea, 24% have crepitation,

14% have stridor, 10% have aphonia and 4% have respiratory arrest.

Such findings are in agreement with **Sink et al. [11]** that indicated that the most common presenting symptoms of foreign body aspiration in children were cough (88%), choking/gagging (67%), and wheezing (57%).

A previous study by **Reyad et al. [6]** indicated that the objective finding of clinical signs such as unilateral wheezes on chest examination in the presence of symptoms such as a sudden cough, dyspnea, and hoarseness could predict foreign body aspiration and help physicians in deciding bronchoscopy.

Regarding type of retrieved object among all patients, our results revealed that 56% were exogenous foreign body (Vegetable), 34% were exogenous foreign body (non-vegetable). 4% of patients had endogenous foreign body such as blood, mucus, and secretions. No retrieved objects occurred in 6% of cases.

A previous study by **Xu et al. [12]** studied residual airway foreign bodies in children who underwent rigid bronchoscope revealed that most residual foreign bodies were food-related: nuts (87.1%) and beans (9.7%).

Our results revealed that successful retrieval among all patients occur in 96% of cases, however, no successful retrieval in 4% of cases.

Similarly, a recent study by **Moslehi et al. [13]** demonstrated that among 63 pediatric patients who had undergone rigid bronchoscopy, airway foreign bodies were successfully

removed in 90.48% of cases. Rigid bronchoscopy failed in 9.52% patients. Additionally, **Golan-Tripto et al. [14]** revealed that the failure to remove the aspirated foreign body occur in 9.9% of the pediatric cases.

Moreover, a previous study by **Antón-Pacheco et al. [15]** on foreign body aspiration in children revealed that the global rate of complications was 16.1%. Patients with a delay in treatment beyond 72 hours from the aspiration episode showed a statistically significant risk of developing both intraoperative and postoperative complications.

A previous study by **Kwok et al. [16]** revealed that one child was brought to hospital in cardiac arrest and, despite successful removal of the aspirated foreign body, died as a result of hypoxic brain injury. **Sjogren et al. [17]** indicated that unwitnessed aspiration events and abnormalities on chest radiograph may be associated with a more complicated course in children with foreign body aspiration.

Regarding the hospital stay in days among all patients, our results revealed that 64% of cases stayed one day, 28% stayed two days, 4% of cases stayed three days. 2 of cases stayed ten days and 2% of cases stayed fourteen days.

A previous study by **Rodríguez et al. [8]** indicated that 73.2% of pediatric patients were hospitalized between one to 30 days (75.6% of them were under 72 hours). **Na'ara et al. [9]** revealed that 33% of pediatric patients were

discharged 1 day following hospitalization, and the mean hospital stay was 2.9 days (range: 1-27 days).

5. Conclusion:

Especially when occurring in a young child. Early diagnosis and immediate control by a specialized team are essential for ensuring correct treatment, which is generally endoscopic, without any risk of complication. Rigid bronchoscopy is the gold standard tool for the management of foreign body aspiration with 96% successful retrieval rate.

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