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The multivariate analysis of indications of rigid bronchoscopy in suspected foreign body aspiration



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ABSTRACT

Objective: Foreign body aspiration (FBA) could be a serious life-threatening condition in children. Patients usually underwent bronchoscopy with suspicious of FBA alone. In this study, we aimed to determine which patients need to go to bronchoscopy based on pre-operative findings.

Methods: Retrospective analysis of patients underwent bronchoscopy between 1999 and 2015 was performed. Clinical symptoms, witnessed aspiration event (WAE), physical examination findings (PEFs) and radiological findings (RFs) were analyzed by multivariate analysis to evaluate the indications of bronchoscopy.

Results: 431 patients (266M, 165F) underwent bronchoscopy with a median age of 2 years (7 months–16 years). A foreign body was detected in 68% of the patients. Univariate analysis demonstrated that wheeze was the sole distinctive clinical symptom for detection of FBA ($p < 0.001$). The rates of positive WAE, PEFs and RFs were 83%, 71.7% and 36.9%, respectively. All of them were identified as independent predictive parameters in the detection of FBA by univariate analysis ($p = 0.003$ & $p < 0.001$ & $p = 0.015$). Multivariate analysis was performed with considering the association between them. The rate of positive bronchoscopy was 91.3% in patients with positive WAE, PEFs and RFs together (84/92). In patients with a positive WAE alone who had not got PEFs and RFs, the rate of positive bronchoscopy was 34.2% (25/73). A foreign body was detected in 84% of the patients who had not got a WAE but positive PEFs and RFs together (21/25). Bronchial laceration was occurred in one patient during bronchoscopy. Pneumothorax was not seen in any of the other patients. The rate of mortality was 0.4% in the overall group (2 patients). **Conclusion:** The indications of bronchoscopy in suspected FBA are usually based on clinical suspicious. The definition of “suspicious” could be a WAE or positive PEFs and RFs. The association of these factors increase the rate of positive bronchoscopies. In the light of our study, the classical indication for suspected FBA is still valid as “suspicious requires bronchoscopy”.

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1. Introduction

Foreign body aspiration (FBA) is a serious and common health problem in childhood which could cause significant morbidities and even mortality [1–5]. The types of aspirated foreign bodies could be varied according to the social and cultural characteristics and feeding habits of the parents and children [6]. Recurrent respiratory disorders such as atelectasis, pneumonia or bronchiectasis

could be seen as a result of late diagnosis of FBA, and occasionally requires surgical procedures like segmentectomy or lobectomy [7]. Therefore, an aggressive diagnostic approach which comprised rigid bronchoscopy under general anesthesia is usually advised to avoid overlooking the definite diagnosis of FBA [8,9].

The extended indications for rigid bronchoscopy result with a high percentage of negative bronchoscopies in children [10]. Patients underwent bronchoscopy usually with a witnessed aspiration event for FBA alone. Is it really sufficient to perform a surgical procedure in a suspected child who has not got any clinical and/or radiological problems? Also, another substantial dilemma is in suspected patients without a witnessed aspiration event but have positive physical or radiological findings for FBA. Is it necessary to perform bronchoscopy in such cases without any aspiration history? In this study, we aimed to present our surgical experience in

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suspected foreign body aspiration in more than four hundred cases to answer these substantial questions by univariate and multivariate analysis to review and if necessary to revise the indications for rigid bronchoscopy in children.

2. Material and methods

Retrospective analysis of patients who underwent rigid bronchoscopy due to a suspected foreign body aspiration (FBA) between 1999 and 2015 was performed. Data regarding age, sex, aspiration period before admission, witnessed aspiration event (WAE), clinical symptoms including cough, wheezing, dyspnea and cyanosis, physical examination findings (PEFs) including unilateral decreased breath sounds, dyspnea, wheezing and stridor, radiological findings (RFs) including hyperaeration, pulmonary infiltration and atelectasis, operative findings and complications were reviewed. Postero-anterior chest radiograph was achieved in all of the patients before and after bronchoscopy.

Patients underwent rigid bronchoscopy under general anesthesia by using ventilation type rigid bronchoscopes (Karl Storz Co., Tuttlingen, Germany). A 0° lens (103424AA Karl Storz) and a video system was used to demonstrate the tracheobronchial tree. An optical forceps (10378KF Karl Storz) was used to grasp and extract the foreign bodies. A thin catheter with a balloon at its tip was occasionally necessary to extract small particles which localized at distal segmenter bronchia. Second bronchoscopy procedure could be necessary if bleeding or granulation tissue did not permit to extract distally localized small foreign bodies. Control bronchoscopy was carried out in patients who had an excessive granulation tissue at main bronchi in the first bronchoscopy to control the final status of granulation tissue at airways.

We used four parameters to perform statistical analysis as witnessed aspiration event (WAE), clinical symptoms, radiological findings (RFs) and physical examination findings (PEFs). Univariate and multivariate analysis was performed in these parameters as alone or together to determine the sensitivity, specificity, positive and negative predictive values.

All of the parents and adolescents gave their informed consent prior to their inclusion in the study. An approval was obtained from our institutional review board. The statistical analysis was performed by SPSS for Windows 20.0. The data underwent Pearson Chi-square test analysis, and *p* value as lower than 0.05 was considered to be statistically significant.

3. Results

3.1. Patient demographics

A total of 431 children (266 M, 165 F) underwent rigid bronchoscopy for suspected foreign body aspiration in the study period. Mean age of the patients was 3 ± 3.3 years, and the median age was 2 years (range, 7 months to 16 years). Most of the patients were lower than 3 years old (≤ 3 years old: 352 patients, 81%). The age of patients was lower than ≤ 1 year old in 127 patients (29%), and higher than ≥ 12 years in 24 patients (5%).

A foreign body was detected in 68% of the patients and named as positive bronchoscopies (295 patients). Foreign body was not detected in 32% of the patients and named as negative bronchoscopies (136 patients). The mean age of the patients was 3.2 ± 3.6 years in positive bronchoscopies (7 months–16 years), and 2.6 ± 2.5 years in negative bronchoscopies (1 years–16 years). The age of the patients in positive bronchoscopies was slightly higher than negative bronchoscopies ($p = 0.046$) (Table 1).

Most of the patients were male with a 1.6 male to female ratio (266 M, 165F). The rate of foreign body detection on bronchoscopy

was 67.7% and 69.7% in male and female patients, respectively. There was not seen any statistically significant difference between the genders in the detection rate of foreign body on bronchoscopy ($p = 0.660$).

The elapsed time from the beginning of the clinical history to admission was divided into three groups. They were grouped as early admission before than ≤ 7 days in 306 patients, moderate admission between 8 and 29 days in 45 patients and late admission after than ≥ 30 days in 80 patients. The rate of foreign body detection on bronchoscopy was 68% in early admissions, 78% in moderate admissions and 65% in late admissions. There was not seen any statistically significant difference between early, moderate or late admissions in the rate of foreign body detection on bronchoscopy ($p = 0.319$).

3.2. Clinical symptoms

Most of the patients had clinical symptoms before or during clinical admission (427 patients, 99%). Only four patients did not have any clinical symptoms. The admission symptoms were cough (96.8%), cyanosis (46.4%), wheeze (37.6%) and dyspnea (13.2%). The sensitivity, specificity, positive and negative predictive values of clinical symptoms were evaluated by univariate analysis and presented in Table 2. Only wheeze had a statistically significant correlation with the detection of foreign body on bronchoscopy ($p < 0.001$). The other clinical symptoms such as cough, cyanosis or dyspnea did not have a significant predictive value in the detection of foreign body on bronchoscopy ($p > 0.05$).

3.3. Types of foreign bodies

Extracted foreign bodies were grouped as organic or inorganic types. Foreign bodies were organic in 249 patients (84%). Most common organic bodies were peanuts, hazelnuts and sunflower seeds. Inorganic foreign bodies were detected in 46 patients (16%). Most common types were pins and pen caps. The list of extracted foreign bodies was presented in Table 3.

3.4. Operative findings

A foreign body was detected in 68% of the patients (295 patients). The localization of foreign bodies were left bronchus in 130 patients (44%), right bronchus in 124 patients (42%), trachea in 29 patients (10%) and bilateral in 12 patients (4%). Granulation tissue was detected in 28 patients during bronchoscopy. 16 of them who had excessive tissue underwent control bronchoscopy 3 weeks later to evaluate the final status of granulation tissue and airways. There was not seen any major stenosis or irregularity at the airways on control bronchoscopy. Foreign bodies were extracted at the first bronchoscopy in the majority of patients (98%). Only six patients required second bronchoscopy to extract the residual foreign body. The major causes for unsuccessful extraction were bleeding and distant localization at peripheral segmental bronchioles. Bleeding precluded apparent visualization of the foreign body during bronchoscopy. Bronchoscopy was terminated in these patients. Second bronchoscopy was performed 2 or 3 days later. All of the foreign bodies were extracted finally. Lung infection was deteriorated or started firstly after bronchoscopy in 31 patients (7%). Two patients with late clinical admission for foreign body aspiration required subsequent lobectomy due to chronic problems as bronchiectasis and atelectasis. Bronchial laceration was occurred in one patient with a hooked needle at left main bronchus. Patient underwent urgent thoracotomy due to tension pneumothorax and hemodynamic instability. Bronchus was repaired primarily, and post-operative period was uneventful in this patient. Pneumothorax was

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