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Tracheobronchial foreign bodies: a review of 787 cases

Trakeobronşiyal yabancı cisimler: 787 olgunun değerlendirilmesi

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ABSTRACT

Background: This study aims to evaluate the diagnoses and treatment methods of patients who applied to our clinic with suspected foreign body and discuss the results.

Methods: Data of 787 patients (353 males, 434 females; mean age 11.7 years; range 5 months to 85 years) who were performed endoscopic procedure due to suspected foreign body in our thoracic surgery clinic between January 1982 and December 2012 were retrospectively reviewed. Age, sex, clinical symptoms, localization of foreign body in the respiratory tree, radiological findings, nature of the foreign body, time lapse between foreign body aspiration and removal, complications, and mortality rates were evaluated.

Results: Male to female ratio was 1:1.2. In 13.7% of the cases (n=108), foreign body was not found by bronchoscopy (true absence of foreign body+peripheral localization of foreign body). Of the cases, 83.2% (n=655) was removed by bronchoscopy. Thirty-five cases (4.4%) with bodies located too peripherally or which could not be grasped by forceps were removed via thoracotomy+bronchotomy. Total number of cases with removed foreign body/bodies was 690. Of the removed foreign bodies, 43.9% was pins, 27.2% was nuts, and 28.9% was other foreign bodies. Of the aspirated foreign bodies, 52.2% was localized in the right and 32.2% in the left bronchial systems, 13.9% in trachea, and 1.7% in both bronchial systems. Complication rate was 3.3% and there were four mortalities.

Conclusion: Tracheobronchial foreign bodies may be life-threatening particularly in the 0-3 age group by causing more frequent early or late complications compared to other age groups. We hope that the frequency of tracheobronchial foreign body aspirations decrease through means of education.

Keywords: Bronchus; foreign body; trachea.

ÖZ

Amaç: Bu çalışmada kliniğimize yabancı cisim şüphesi ile başvuran hastaların tanı ve tedavi yöntemleri değerlendirildi ve sonuçlar tartışıldı.

Çalışma planı: Ocak 1982 - Aralık 2012 tarihleri arasında göğüs cerrahisi kliniğimizde yabancı cisim şüphesi ile endoskopik işlem uygulanmış 787 hastanın (353 erkek, 434 kadın; ort. yaş 11.7 yıl; dağılım 5 ay-85 yıl) verileri retrospektif olarak incelendi. Yaş, cinsiyet, klinik semptomlar, yabancı cismin bronşiyal ağaçtaki yerleşim yeri, radyolojik bulgular, yabancı cismin türü, yabancı cisim aspirasyonu ile çıkarılış zamanı arasındaki süre, komplikasyonlar ve mortalite oranları değerlendirildi.

Bulgular: Erkek-kadın oranı 1:1.2 idi. Olguların %13.7'sinde (n=108) bronkoskopi ile yabancı cisim bulunmadı (yabancı cisim gerçekte yok+periferal yerleşimli yabancı cisim). Olguların %83.2'si (n=655) bronkoskopi ile çıkartıldı. Yabancı cismin çok periferde olduğu veya cismi forsepsin tutamadığı 35 olgu (%4.4) torakotomi+bronkotomi ile çıkartıldı. Yabancı cisim/cisimlerin çıkarıldığı toplam olgu sayısı 690 idi. Çıkarılan yabancı cisimlerin %43.9'u iğne, %27.2'si kuruyemiş ve %28.9'u diğer yabancı cisimler idi. Aspire edilen yabancı cisimlerin %52.2'si sağ, %32.2'si sol bronşiyal sistemde, %13.9'u trakeada ve %1.7'si her iki bronşiyal sistemde yerleşimli idi. Komplikasyon oranı %3.3 idi ve dört hasta kaybedildi.

Sonuç: Trakeobronşiyal yabancı cisimler özellikle 0-3 yaş grubunda diğer yaş gruplarına kıyasla daha sık erken ve geç komplikasyonlara neden olarak hayatı tehdit edebilir. Trakeobronşiyal yabancı cisim aspirasyonu sıklığının eğitim ile azalmasını umut etmekteyiz.

Anahtar sözcükler: Bronş; yabancı cisim; trakea.

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Tracheobronchial foreign body (FB) aspiration is a lethal clinical state requiring emergent intervention. Prevention, first aid, and improved endoscopic technologies decreased the mortality rate due to FB aspiration. Nevertheless, National Safety Council report in 1996 states that FB aspiration causes more than eight deaths per day.[1] Removal of FB from the tracheobronchial system was first reported in 19th century by Gustav Killian, and the principles of removal procedure were explained with detail in the first half of the 20th century by Chevelier Jackson. Yearly, almost 600 child deaths under 15 years of age following aspiration of FBs are estimated in the USA.[2] In fact, choking on food has been the cause of 2,500 to 3,900 deaths per year in the USA including the adult and child populations.[3,4] The most frequent method used for removal of tracheobronchial FBs is bronchoscopy. In this study, we aimed to evaluate the diagnoses and treatment methods of patients who applied to our clinic with suspected FB and discuss the results.

PATIENTS AND METHODS

Data of a total of 787 patients (353 males, 434 females; mean age 11.7 years; range 5 months to 85 years) with suspected tracheobronchial FB aspiration who administered to Department of Thoracic Surgery of Dr. Siyami Ersek Thoracic and Cardiovascular Surgery Training and Research Hospital between January 1982 and December 2012 were retrospectively reviewed. All patients underwent bronchoscopy. We excluded the patients who removed the FB by coughing without undergoing bronchoscopy. We applied rigid bronchoscopy to all the patients under general anesthesia with muscle relaxing agents, except in four patients. If the FBs were found to be localized distally in the tracheobronchial tree and/or if the FB could not be retrieved by rigid bronchoscopy, we applied a fiberoptic bronchoscopy for the removal of the FB. We reviewed the patients according to age, sex, clinical symptoms, site of the FB, radiologic signs, FB material, the time interval between aspiration and removal of the FB, type of intervention, complications, and mortality. We used patient history, physical examination, clinical symptoms, and radiologic diagnostic techniques to establish diagnoses. We followed-up the patients for one week to two years as outpatients depending on the patients' clinical state and types of foreign material and complications. The study protocol was approved by the "Siyami Ersek Thoracic and Cardiovascular Surgery Center", Hospital Ethics Committee. A written informed consent was obtained from each patient. The study was conducted in accordance with the principles of the Declaration of Helsinki.

RESULTS

An analysis of patients according to age groups revealed that >10 year-old group was the most populated having 339 patients (43.1%), while one to three-year-old group had 236 patients (30.0%) and was the second highest populated group (Figure 1). Male/female ratio was 1:1.2. The most frequently recorded symptoms were coughing, stridor, dyspnea, and fever.

We performed bronchoscopy in all patients. In four patients, flexible bronchoscopy with local anesthesia was performed. Other than these four, we performed rigid bronchoscopy to the patients under general anesthesia. We removed the FB with rigid bronchoscopy or thoracotomy+bronchotomy in 690 (87.7%) of 787 patients. In 13.7% (n=108) of the patients, we were unable to find a FB with rigid bronchoscopy. Those 108 patients included both "real absence of the FB" and the cases in which the "FBs were not seen because of their localization in the peripheral airways" which were not reachable with rigid bronchoscopy. There were 97 real absence cases (12.3%) in which a FB was neither seen with rigid bronchoscopy nor with other diagnostic techniques and were proved to be absent. Of the extracted FBs, we removed 655 (94.9%) with bronchoscopy. We performed a thoracotomy + bronchotomy in 35 patients (5.1%) in which we were unable to find the FB because of its peripheral site (n=23), or we spotted the FB but was unable to extract it with forceps (n=12). Majority of these patients requiring thoracotomy had aspirated needles where we could not locate the FB by bronchoscopy or we could locate it but could not grasp it with the forceps. Sixteen of the distal FBs (needles) which were not reachable by rigid bronchoscopy were reached with flexible bronchoscopy; whereas 13 of these (needles) were

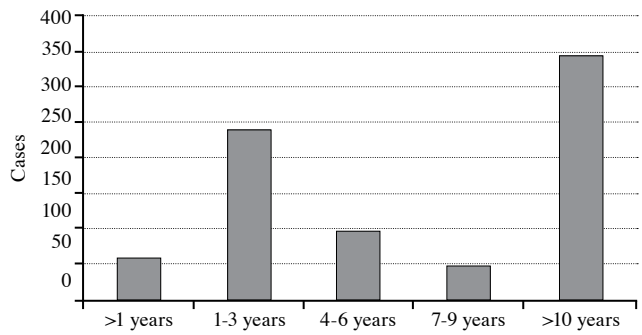

Figure 1. Age distribution of patients with suspected foreign body aspiration.

removed in another session of flexible bronchoscopy under local anesthesia after the rigid bronchoscopy.

Locations of 690 FB at the time of removal were as follows: right bronchial system in 360 patients (52.2%), left bronchial system in 222 patients (32.2%), trachea in 96 patients (13.9%), and both right and the left bronchial systems in 12 patients (1.7%) (Table 1). In the radiological evaluation of all patients, a radiopaque FB was the most frequently seen finding in 330 patients (41.9%), followed by normal radiography in 256 patients (32.5%), and unilateral hyperaeration in 92 patients (11.6%) (Table 2).

Of the FBs which were removed either by bronchoscopy or thoracotomy, 394 (57.1%) were inorganic while 296 (42.9%) were organic materials. Among the inorganic FBs, the most frequent one was needle in 303 patients (43.9%). The most frequent organic FB was edible nuts in 188 patients (27.2%). We detected plastic bodies in 48 patients (7.0%) and removed other inorganic materials, such as metal bodies or teeth etc., in 43 patients (6.2%). The aspirated organic material consisted of food, corn, olive, and seed in 108 patients (15.7%).

The time intervals between the aspiration of the FB and its removal were as follows: of the FBs, 49.3% were removed within 24 hours, 47.0% were removed between 24 hours and one week period, and 3.8% were removed after one week. All children below 10 years of age received intravenous corticosteroid during bronchoscopy to prevent subglottic edema.

We observed complications in 2.8% of the patients including six laryngospasms, eight cardiac arrests, four adult respiratory distress syndromes (ARDS) followed-up with tracheostomy, three pneumothoraces, and one pneumonia. We noted mortality in 0.5% of the patients (n=4). Patients experiencing ARDS were the ones with late submission to hospital after aspirating edible nuts. During bronchoscopy, we observed that the organic materials had softened and degraded so that we were unable to remove the material totally. During bronchoscopy, when we observed that part of the material slipped into the distal airways, the patients were forced to expectorate after extubation. Four patients developed ARDS and two of them died. In five patients, anoxic arrest after the aspiration of nuts or olive seeds into both right and left bronchial systems causing obstruction occurred. Two of these patients died, while we removed the FBs completely in three patients who recovered after cardiopulmonary resuscitation.

Table 1. Localization of tracheobronchial foreign bodies

Localization	Number	%
Right bronchus	360	52.2
Left bronchus	222	32.2
Trachea	96	13.9
Bilateral bronchi	12	1.7
Total	690	100

DISCUSSION

Foreign body aspiration is a life-threatening situation. Particularly in children, it may lead to more severe results. Even though FB aspirations can be seen at any age, one to three years of age interval is stated as the most frequent in the literature.[5-9] Our study confirms the results of other studies.[10,11] indicating that children are at higher risk for tracheobronchial FB aspiration in the first three years of life.

In Darrow and Holinger's study,[5] 84% of the patients consisted of children under the age of five, and 73% of the children was under the age of three. Mu et al.'s[6] study among children states that 90% of the patients were children younger than three years of age. Carluccio et al.[7] reported that 61.9% of children were younger than three years of age. Puhakka et al.[8] along with Mantel and Butenandt[9] demonstrated similar high rates. The reason of this high incidence among children is their tendency to put almost all small materials into their mouth out of interest.[5] In recent years, there has been an increase in needle aspirations among children above the age of 10 due to increased rate of scarf usage. Males have higher FB aspiration rates than females. Male/female ratio is 2 to 1.[1,7,8] Mu et al's.[6] study stated the male/female ratio as 1.2:1. In our study, male/female ratio was 1:1.2. Because of the anatomic structure of the bronchial tree, there is a consensus

Table 2. Radiological findings in patients with suspected foreign body aspiration

Radiological findings	Number	%
Radiopaque foreign body	330	41.9
Normal	256	32.5
Unilateral or lobar hyperlucency	92	11.7
Atelectasis	69	8.8
Pulmonary infiltrate	14	1.8
Bronchiectasis	9	1.1
Tracheal lumen abnormalities	9	1.1
Mediastinal shift	8	1.0
Total	787	100

Figure 2. Radiopaque and hyperlucency in chest X-ray of patient with screw aspiration.

among the authors that right bronchial aspiration is the most frequent localization.[6,7,8,10,12] Our study's results contribute to the same conclusion indicating that right sided aspiration is most frequent with a rate of 52.2% (Figure 2). Darrow and Hollinger[5] stated that 34% of aspirations consists of edible nut aspirations. This ratio was found to be 67% in Mantel and Butenandt's[9] study. Moreover, in their study consisting of 400 patients from China, Mu et al.[6] showed that the aspiration material was organic in 95% of patients.[13] Carluccio et al.[7] stated the organic material aspiration ratio as 31.5%. Our research demonstrated the aspiration ratio of organic material as 42.9%, while the edible nut ratio was 27.2% (Figure 3). The varieties in the types of FBs aspirated in different series depend on social, economic, and cultural conditions.[4] While FB aspirations in non-industrialized countries mostly consist of organic body aspirations, most aspiration materials in industrialized ones were plastic bodies. In the Middle East, aspiration of scarf needles (especially among females) were removed mostly. In our study, 303 aspiration cases out of 536 had needles (Figure 4). While putting on their scarves, most females hold the needle between their lips. Radiopaque FBs could be easily seen on posterior-anterior chest X-rays, while radiolucent bodies could be suspected according to the secondary signs on chest X-ray. The most common secondary signs were mediastinal shift, obstructive emphysema, and atelectasis.[1,6,7,13] Radiopaque FB images were the most common radiologic results in our clinic with a high ratio of 41.9% which was caused by the substantial number of needle aspiration cases. Normal radiographs and unilateral hyperaeration, respectively, are the consequent secondary radiological signs. Girardi et al.[14] found normal X-rays in as high as 47% of patients with FB aspiration. Due to the risk of underdiagnosis of FB aspiration, a diagnostic or therapeutic bronchoscopy should be performed as appropriate even when there is a slightest suspicion about the possibility of a FB lodged in the airways.[15] Several authors believe that it is preferable to have a negative bronchoscopy than to leave a FB lodged in the patient's airway.[4,10,11,16-20]

In our study, the negative bronchoscopy ratio was determined as 13.7%. Puhakka et al.[8] reported normal results for 17% of children included in their study. Another research by Puhakka et al.[21] analyzing 748 children stated 10.6% of patients having completely normal bronchoscopies. There are publications recommending bronchoscopy on patients with

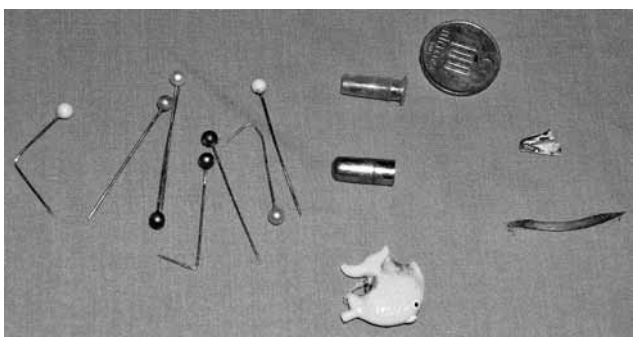

Figure 3. Some tracheobronchial foreign bodies removed by bronchoscopy in our clinic.

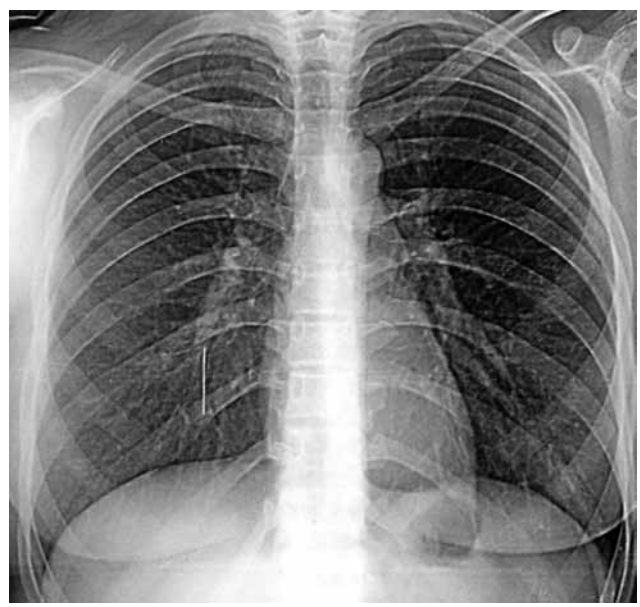

Figure 4. Pin aspiration in right bronchus.

suspicion of FB aspiration. Mantor et al.[22] emphasized that some negative broncoscopies are crucial for preventing deaths that might occur from unnoticed FB aspirations. Carluccio et al.[7] agree with other authors on the necessity of bronchoscopy on patients especially under three years of age with highly suspicious clinical history, even when there are no clinical symptoms or the radiographic results are negative. The time between FB aspiration and intervention varies among different studies. Carluccio et al.[7] reported the removal of FB ratio within the first 24 hours as 20.5% and the removal ratio within a week as 66.4%, whereas Mu et al.[6] reported the removal of FB ratio within the first 24 hours as 28% and the removal ratio within a week as 71%. Kiyan et al.[4] reported that among 125 FB aspiration confirmed patients with a positive clinical history, 46 (36.8%) had rigid bronchoscopy within the first 24 hours. In 37 patients (29.6%), bronchoscopy was performed two to seven days after aspiration, while in 42 patients (33.6%), after eight days.[4] In our study, removal ratio within the first 24 hours was 49.3%, two to seven days was 47.0%, and more than a week was 3.8%. Delayed diagnosis of FB aspiration, which is usually accompanied by misdiagnosis such as asthma, bronchitis, pneumonia, croup, etc., increases the symptomatic period, the rate of complications, and complicates diagnosis and subsequent treatment. In some pediatric series, the diagnosis has been established up to seven days after the event in 16 to 69% of patients.[23] Our ratio of intervention within the first 24 hours was high. We believe this was due to the high rate of needle aspirations (235 of our cases) and the fact that patients both were old enough to provide sufficient medical history as well as to administer to our clinic immediately. Thus patients who administer early and undergo urgent bronchoscopy usually develop no complications.

In the early phase of FB aspirations, complications such as pneumomediastinum, failure in the removal of FB (which requires thoracotomy), laryngeal edema, bronchospasm, endobronchial hemorrhage, pneumothorax, tracheostomy, or cardiac arrest might occur.[1,7,12] Later phases might show complications such as bronchial stricture, atelectasia, pneumonia, or granuloma.[1] Nowadays and particularly if performed by experts, rigid bronchoscopy is a safe method with a reported morbidity of 2%-17%[17,24-26] and mortality of 0%-0.8%.[11,17,25,26] Lima et al.[27] observed a 3.8-fold higher risk for bronchial sequelae in children with delayed diagnosis and extraction of a tracheobronchial FB more than seven days after the aspiration event compared to those with earlier diagnosis. Inglis and Wagner[24] observed similar findings with a time-depending trend for increased complication rates of 15%-36% after a delay of more than seven days. Particularly, secondary injuries initiated by organic aspirates are related to diagnostic delay.

Foreign bodies cause mucosal irritation and inflammation resulting in mucosal edema[10,24,25] In our study, we noticed laryngospasm in six, cardiac arrest in eight, ARDS in four, pneumothorax in three patients, pneumonia in one patient, and mortality occurred in four patients. After bronchoscopy, Kiyan et al.[4] observed severe bronchospasm in five patients and prolonged oxygen therapy was necessary in one patient. One of our patients who was hypoxic at admittance and required immediate bronchoscopy had cardiac arrest immediately after induction of anesthesia before any surgical attempt. After resuscitation and stabilization, the FB which filled most of the tracheal lumen was extracted.

After the removal of the FB, some patients were put on a regimen of antibiotics, bronchodilators, or corticosteroids and chest physiotherapy for short periods, usually for 48 hours, depending on the presence of purulent endobronchial secretions or an inflammatory aspect of the airway mucosa. Authors recommend corticosteroid use, both before and after bronchoscopy, to lower down postoperative subglottic edema rate that can require emergent thoracostomy.[1,7] Our study also showed that organic FBs have to be removed as soon as possible. It is also extremely important to remember that "suspicion" is the most significant means for diagnosing tracheobronchial FBs. Another important point is that during the time interval between the latest chest X-ray and intervention, the FB might change location and consequently be found in a different location during bronchoscopy, or may not even be located at all. It is agreed by authors that teams to operate bronchoscopic FB removals should consist of well-educated and experienced professionals such as anesthesiologists, nurses, and endoscopy experts, while the entire team should be able to work with appropriate tools.[1,28]

In conclusion, tracheobronchial foreign bodies are life-threatening issues, especially for the 0-3 age group, during which they may cause early or late complications more frequently than other age groups. Furthermore, in various series, the presence of a foreign body has been associated with airway hyperreactivity or the development of bronchiectasis, which may progress in number and severity and cause the patient to require a resection as a last therapeutic resort.[5,7,8] We hope that the frequency of tracheobronchial foreign body aspirations decrease through means of education.

Declaration of conflicting interests

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