Foreign bodies in the tracheobronchial tree in adults

Ciała obce w drzewie oskrzelowym u dorosłych

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Abstract

Background: The inhalation of foreign bodies in adults is less common than in children, however, in some cases it may constitute a serious clinical problem. The aim of the study was to evaluate the circumstances of aspiration, methods of treatment and respiratory complications.

Material and methods: The retrospective review encompassed 29 709 bronchoscopies performed between 1999 and 2009 in the Lower Silesian Centre of Lung Diseases in Wrocław.

Results: Forty-three cases of foreign body inhalation were identified. In the majority of patients (69.8%), aspiration was suspected prior to admission, with risk factors being present in 11 (25.6%). There were four out-patients (9.3%). The time of hospitalization was longer in the group of patients with an unsuspected foreign body (mean 9.6 days) than in the group of patients with a known history of aspiration (mean 4 days). The foreign bodies were removed by flexible bronchoscopy (37.2%), rigid bronchoscopy (55.8%) or thoracotomy (7%). Granulation tissue was observed in most of the patients in whom diagnosis was made more than one week from aspiration (17/21 – 81%) and in only two patients with the aspiration to admission time of less than one week (2/22 – 9%). Four patients needed further hospitalization due to complications. They were successfully treated endoscopically with argon plasma coagulation or with antibiotics and made a full recovery.

Conclusions: In cases of persistent symptoms from the respiratory tract, in patients with risk factors, foreign body aspiration should be considered. Interventional bronchoscopy should be performed as soon as possible to prevent complications. Thoracotomy is rarely necessary. Even in cases of complications, further course of the disease is uneventful.

Key words: foreign body, flexible bronchoscopy, rigid bronchoscopy.

Streszczenie

Wstęp: Ciała obce w drzewie oskrzelowym u dorosłych są spotykane rzadziej niż u dzieci, mogą jednak stanowić poważny problem diagnostyczny i terapeutyczny. Celem pracy jest ocena okoliczności aspiracji, metod leczenia i powikłań oddechowych spotykanych po usunięciu ciała obcego.

Materiał i metody: Retrospektywnie oceniono 29 709 bronchoskopii przeprowadzonych w latach 1999–2009 w Dolnośląskim Centrum Chorób Płuc we Wrocławiu.

Wyniki: Ciała obce w drzewie oskrzelowym stwierdzono u 43 chorych (0,14%). W większości przypadków (69,8%) aspiracja spodziewana była przed przyjęciem do szpitala, czynniki ryzyka stwierdzono u 11 osób (25,6%). Czworo chorych (9,3%) leczono w trybie ambulatoryjnym. Czas hospitalizacji był dłuższy, gdy nie spodziewano się aspiracji ciała obcego (średnio 9,6 dnia) w porównaniu z chorymi ze znanym wywiadem (średnio 4 dni). Ciała obce usuwano za pomocą bronchofiberoskopu (37,2%), sztywnego bronchoskopu (55,8%) bądź poprzez torakotomię (7%). Ziarninę obserwowano u większości chorych z diagnozą postawioną powyżej tygodnia od aspiracji (17/21 – 81%) i tylko u 2 przyjętych do 7 dni od początku choroby (2/22 – 9%). Czworo chorych wymagało dalszej hospitalizacji z powodu powikłań oddechowych (ziarnina, zapalenie płuc). Pacjenci ci byli leczeni z sukcesem przy użyciu argonowej koagulacji plazmowej oraz antybiotykoterapii.

Wnioski: U chorych z czynnikami ryzyka, z przetrwałymi objawami ze strony układu oddechowego, należy rozważyć możliwość aspiracji ciała obcego. Wcześnie wykonana bronchoskopia pozwala na uniknięcie późniejszych powikłań. Większość ciał obcych (> 90%) można usunąć przy użyciu bronchofiberoskopu lub bronchoskopu sztywnego, jedynie nieliczni chorzy wymagają torakotomii. W przypadku wczesnej diagnozy, braku uszkodzenia śluzówki drzewa oskrzelowego i braku towarzyszących powikłań oddechowych zaleca się leczenie w trybie ambulatoryjnym. Powikłania oddechowe po usunięciu ciała obcego są rzadkie i całkowicie wyleczalne.

Słowa kluczowe: ciało obce, bronchofiberoskopia, sztywna bronchoskopia.

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Introduction

At the end of the 19th century, Gustav Killian (1860-1921), a German otolaryngologist, removed a piece of pork bone from the bronchus. It was the first report of interventional bronchoscopy performed to remove a foreign body. Killian used a metal tube with an external source of light [1]. Nowadays, flexible and rigid bronchoscopies are used in the treatment of patients with foreign bodies in the respiratory tract. Accidental inhalation of foreign bodies is observed at any age, but in children it may lead to sudden death [2]. Although the inhalation of foreign bodies in adults is less common than in children, in some cases it may constitute a serious clinical problem.

In this study, we present 11 years of experience in the management of inhaled foreign bodies, evaluate the circumstances and the diagnosis of aspiration. The aim of the study was also to determine further extraction-related respiratory complications.

Material and methods

Between January 1999 and November 2009, 29,709 bronchoscopies were performed at the Lower Silesian Centre of Lung Diseases (consisting of the Department of Thoracic Surgery and the Department of Pulmonology of the Medical University of Wrocław) of which 28 824 were flexible and 885 were rigid bronchoscopies. Forty-three (0.14%) bronchoscopies were performed to remove a foreign body from the respiratory tract. The hospitalization data of the 43 patients (19 females and 24 males, aged 15 to 81, mean 55.2 years old) were retrospectively reviewed to obtain a complete medical history, physical examination results, chest x-ray, risk factors, localization and the type of the inhaled foreign body as well as respiratory complications following its removal.

All flexible bronchoscopies were performed under local anaesthesia with 2% lidocaine applied on the pharyngeal and laryngeal mucosa. Rigid bronchoscopy required general anaesthesia and jet-ventilation. A fiberoptic (Olympus, Tokyo, Japan) or rigid bronchoscope (Storz, Tuttlingen, Germany) was used to remove the foreign body.

Results

In 30 patients (69.8%) the aspiration of a foreign body was suspected prior to admission to hospital based on the medical history. In the remaining patients, bronchoscopy was performed because the radiologic image suggested lung tumour (2 patients), episodes of haemoptysis (3) and recurrent pneumonia (8). The time between aspiration and admission to hospital was < 24 hours in 11 patients (32.3%), > 24 h and < 1 week in 10 (23.2%), > 1 week and < 1 month in 3 (7%), and > 1 month in 13 (30.2%). In 6 patients, the length of that period was unknown and probably exceeded 1 month. In all the patients, the duration between the known time of aspiration and admission to hospital ranged from 1.5 hours to 12 months. In 13 patients with unsuspected foreign body, the aspiration to admission time was longer than one month (from 1 to 12 months, mean 4.9 months) and in 5 patients it was unknown. In the group with a known history, the time was shorter (from 1.5 hours to 12 months, mean 1 month) or unknown (1 patient).

Four out-patients (9.3%) were treated with flexible bronchoscopy. Their stay in hospital was no longer than 6 hours, including medical history, physical examination, removal of the foreign body and observation after the procedure. The mean time between aspiration and treatment was 16.5 hours (from 3 to 36 hours). No damage to the bronchial mucosa was found during bronchoscopy in this group. All patients reported for a follow-up visit five days after the bronchoscopy; no complications were observed.

The hospitalisation time of the remaining patients ranged from 1 to 23 days, mean 6 days, and was longer in the group of 13 patients with an unsuspected foreign body (from 2 to 23 days, mean 9.6 days) than in the group of 26 patients with a known history of aspiration (from 1 to 14 days, mean 4 days). A prolonged hospitalization was necessary for additional diagnosis (chest CT, repeated bronchoscopies with biopsies) and treatment of further complications.

Known risk factors for aspiration were found in 11 (25.6%) patients. All factors are presented in Table I.

The most common symptoms were cough (86%), dyspnoea (37%), fever (23%), wheezing (12%), haemoptysis (12%) and chest pain (5%). Three patients (7%) had no symptoms on admission. In three patients with a suspicion of lung tumour (2) and atelectasis (1), beside routine x-ray, a CT chest scan was performed. Radiological changes were found in 31 patients (72.1%), mainly pulmonary infiltrates (12) and atelectasis (10). In 13 patients (30.2%), the shape of the foreign body was noticeable (dentures, metallic and radiopaque objects).

All types of foreign bodies in our study are presented in Table II.

In 33 patients (76.7%), the foreign body was located in the right bronchial tree, in 7 patients (16.3%) in the left bronchial tree, and in 3 patients (7%) the foreign body was found in the trachea. The details of the foreign body location in the tracheobronchial tree are presented in Table III.

In 37 cases, the foreign body was visible during initial flexible bronchoscopy. In four patients, a tumour was suspected based on intraluminal granulations. Having removed the granulation tissue during rigid bronchoscopy, a real problem was found. In 2 patients there were no changes in the tracheobronchial tree.

Tab. I. Risk factors for foreign body aspiration

Risk factor	Number of patients
neurological diseases	4
psychiatric diseases	3
loss of consciousness	2
alcohol abuse	1
swallowing disturbances	1
no risk factors	32

Tab. II. Types of removed foreign bodies

Types of foreign bodies	Number of patients
fruits/vegetables	13
pieces of bone	12
fragments of dentures/dental crowns	6
metallic objects (pins, nails, endodontic needles)	6
tablets	3
plastic objects	2
stones	1

Tab. III. Locations of foreign bodies

Location	Number of foreign bodies
trachea	3
main stem bronchus	9
lobar bronchus	11
bronchus intermedius	7
segmental bronchi	11
lung parenchyma	2

Flexible bronchoscopy was used in 16 patients (37.2%). The foreign bodies were removed successfully with biopsy forceps "en mass" with a bronchofiberoscope, usually after the first few attempts.

Twenty-five patients (58.1%) underwent rigid bronchoscopy. The use of this procedure was necessary in cases of tough (metallic and plastic) objects with a slippery surface. The objects were retrieved with a foreign body, alligator or biopsy forceps, usually with optics (n = 17). The foreign body was removed through or "en mass" with a bronchoscope in 24 patients (96%). In one patient with a drawing pin in the left lower lobe bronchus, the procedure was unsuccessful. The sharp point of the pin was facing the rigid bronchoscope and was covered with granulations and oedema. After 30 min of unsuccessful attempts, thoracotomy was performed.

Altogether, thoracotomy was necessary in 3 patients (7%). In one patient mentioned above, bronchotomy was performed. In the remaining two cases, no changes in the tracheobronchial tree were observed in the initial bronchoscopy. In both patients, the foreign bodies (an endodontic needle and a nail) migrated peripherally to the lung parenchyma. They were removed by a simple incision of the lung after palpation of the parenchyma. The thoracotomy time ranged from 40 to 180 min, mean 95 min. After the removal of the foreign body, intrabronchial changes of the mucosa were examined, and included granulations (44.2%), laceration with bleeding (9.3%) seen after removing metallic objects or dentures, and scarring (7%). In 18 patients (41.9%) there were no changes in the bronchial mucosa except for some redness, usually caused by instrumentation. The granulation tissue was observed in most of the patients in whom diagnosis was made more than one week from aspiration (17/21 – 81%) and only in two patients with the time between aspiration and admission of less than one week (2/22 – 9%). In 5 patients (11.6%), pus was aspirated during and after bronchoscopy. The aspirate was taken for bacterial examination in 13 patients, in 5 cases *Streptococcus pneumoniae* or *Klebsiella pneumoniae* were isolated. They were treated with antibiotics according to the bacteriogram. Out of all the patients, 27 (62.8%) received antibiotics, usually second generation *cephalosporins* or *amoxicillinum + acidum clavulanicum*.

Four patients (9.3%) needed further hospitalization. They were hospitalized for 2-6 weeks after the removal of the foreign body due to stricture of the bronchus (2 patients), recurrent pneumonia (1) and chronic inflammation of the bronchial mucosa (1). The two patients with granulation-related stricture were treated endoscopically with argon plasma coagulation (APC) and made a full recovery. Pneumonia and local inflammation were successfully treated with antibiotics and inhalations.

Discussion

Since many cases remain undiagnosed, the real incidence of aspirated foreign bodies in adults is difficult to establish [3]. However, tracheobronchial foreign bodies seem to be rare in adults. In our hospital, foreign body was the reason for bronchoscopy in 0.14% of cases, which is similar to other studies (0.2-0.33%) [4, 5]. In our series, most of the inhaled foreign bodies were suspected prior to admission to hospital. According to the literature, the diagnosis is established at the moment of admission in 38-72% of patients [4-6]. The discrepancy may be a result of difficulties in obtaining the patient history as there are numerous cases with neurological or psychiatric disorders, and the information is frequently obtained from the patient's guardian. In adults, the trachea and main stem bronchi are wide, therefore foreign bodies rarely obturate the entire lumen and provoke dyspnea or asphyxia (unlike in children). After a short initial irritation of the respiratory tract (cough, shortness of breath), small foreign bodies move to peripheral bronchi, sometimes causing non-specific symptoms, where most of them are never discovered. Symptoms associated with foreign body inhalation are not characteristic, particularly if the event was accidental or not known. In the group of 13 patients with unsuspected foreign bodies, cough, dyspnoea and haemoptysis suggested an endobronchial lung tumour or pneumonia rather than a foreign body. The most common symptom observed in our series was cough, which is concordant with other studies [5, 7-9]. Intrabronchial granulations were found in 44% of patients, which was possibly the cause of the higher rate of haemoptysis in patients with foreign bodies [5, 10].

We found risk factors in one quarter of the patients. In our opinion, foreign body aspiration should always be considered in patients with accompanying persistent symptoms from the respiratory tract and history of loss of consciousness, drug/alcohol abuse or neurological/psychiatric disorders.

In our series, there were four out- patients. We recommend this way of treatment if the diagnosis is not late (< 48 hours), there is no damage to the intrabronchial mucosa or in the absence of associated complications (i.e. pneumonia, atelectasis, lung abscess). The patients who required general anaesthesia and rigid bronchoscopy were hospitalized for a short period of time, even if no complications occurred. In our centre, all removals of foreign bodies were performed late in the afternoon, once the planned procedures had been finished, hence it was difficult to discharge the patient at night. However, now, based on our experience, we believe that the ambulatory mode of treatment is also possible when rigid bronchoscopy is performed and slight mucous damage is observed.

Chest radiographs were diagnostic only in the case of radiopaque foreign bodies, e.g. dentures and metallic objects (30% of patients). This value depends of the number of radiopaque bodies and ranges in the literature from 7% to 60% [4-6, 9, 11, 12]. The most common findings in our study were pulmonary infiltrates and atelectasis, also confirmed by many other authors [4, 9, 13, 14]. However, in our series there were no radiographic changes in 27.9% of cases, so even with a negative chest x-ray we could not exclude a foreign body. Foreign bodies were commonly found in the lower lobar and segmental bronchi. In this group, 59% of patients had a positive history of aspiration (81% in the group of patients with another location). We have concluded that if the foreign body is located in wider bronchus it can be more often suspected prior to admission to hospital. As in previous studies, we observed a considerable group of patients who aspirated dentures or dental crowns [4, 5, 13]. These types of foreign bodies are of clinical importance as they usually require the use of a rigid bronchoscope.

The diagnosis should always be confirmed by flexible bronchoscopy, which in our experience, is very useful in removing organic pieces of food. We were able to remove foreign bodies with flexible bronchoscope and local anaesthesia in 37% of patients. It is a safe and straightforward procedure and we recommend it for small foreign bodies which are not surrounded or covered by granulations. Few authors demonstrated a high rate of successful flexible bronchoscopy (even over 90%), however some of the patients required general anaesthesia and the insertion of the endotracheal tube [4, 5, 15]. In our opinion, rigid bronchoscopy in experienced hands provides better opportunities for removing large foreign bodies than the endotracheal tube, without a higher incidence of complications (damage to teeth, vocal cords or trachea). In our practice, we often pass a flexible bronchoscope through a rigid one to obtain better local assessment before and after the removal of a foreign body. In our series, 58% of patients underwent rigid bronchoscopy, usually in cases of pieces of bones covered by granulations, dentures, metallic and plastic objects. The management of granulations and bleeding is easier with larger forceps and rigid bronchoscope tools. The removal of sharp objects (metallic ones, dentures) with the same procedure is safer for the bronchial wall. There were no complications in our series connected with the insertion of the rigid bronchoscope. The mean time of rigid bronchoscopy (and general anaesthesia) was 31 min, so the procedures were quick. In our experience, only in one case (a drawing pin in the common basal bronchus), the procedure was unsuccessful and the patient required bronchotomy. Some authors report a high rate of successful rigid bronchoscopy [12, 16] and some use this procedure routinely in foreign body removing [8]. In our opinion, the flexible bronchoscope has only one advantage over the rigid one, i.e. the foreign body can be removed without general anaesthesia.

Only three patients (7%) required thoracotomy, due to peripheral migration of the foreign body or unsuccessful rigid bronchoscopy. None of the patients required resection of lung parenchyma. In the literature, the rate of thoracotomies ranges from 1.2% to 5% [5, 8, 10, 15]. In one study the rate was 36% but the authors only described cases referred to the thoracic surgery ward after failed attempts to extract the foreign body with flexible fiberoptic bronchoscopy [6]. We agree that lung parenchyma should always be preserved and resection should only be performed when irreversible changes are observed [6]. Peripheral migration of a foreign body to the lung parenchyma was observed only when sharp and thin metallic objects were aspirated (an endodontic needle, a nail) (Fig. 1). In both cases they were removed surgically due to pressure from the patient. In our opinion, other important indications for thoracotomy include persistent symptoms (i.e. haemoptysis) or irreversible changes in lung parenchyma (abscess, lung cirrhosis). In cases where there are no symptoms or significant comorbidities, conservative treatment and observation should be considered.

Although in 19 patients (44%), granulation tissue was observed after the removal of a foreign body, only two of them required repeated hospitalization and treatment. The stricture caused by granulation is a result of delayed diagnosis. In our study, granulation was found in most of the patients in whom diagnosis was made more than one week after aspiration (81%) and in only two patients with the aspiration to admission time of less than one week (9%). We conclude that diagnosis and interventional bronchoscopy with the removal of a foreign body should be performed as soon as possible to avoid granulations. Aspirated bones, tablets, metallic and plastic objects caused the most irritation. As observed in our series, the granulation tissue, although hampering the extraction, does not constitute a serious further problem once the foreign body has been completely removed. Even in cases of repeated hospitalization, it can be successfully treated with argon plasma coagulation or laser therapy [17].

Conclusions

1. Persistent symptoms from the respiratory tract in patients with alcohol abuse, neurological or psychiatric disorders, or with a history of loss of consciousness should always be considered as a potential result of foreign body aspiration.

2. Negative history and radiologic imaging do not exclude the possible presence of foreign bodies.
3. Interventional bronchoscopy with the evaluation of the bronchial tree and removal of the foreign body should be performed as soon as possible to avoid granulation.
4. Most foreign bodies can be removed with flexible or rigid bronchoscopy (> 90%); thoracotomy is required in few cases only.
5. We recommend the out-patient mode of foreign body removal if the diagnosis is not late (< 48 hours) and there is no damage to the intrabronchial mucosa or associated complications.
6. Even in cases of endobronchial granulation tissue being formed as a result of delayed diagnosis, further implications can be treated with argon plasma coagulation.

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