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Foreign bodies in the airways in children

Piotr Toman

Resident Doctor

WSzS in Biala Podlaska

Department of Otorhinolaryngology

Summary

Foreign bodies in the airways in children are a very important diagnostic and therapeutic problem. With these cases meet both emergency rooms, emergency departments, general pediatric wars and ENT wards. Aspiration of a foreign body is a frequent factor causing respiratory diseases along with its inefficiency and one of the more frequent causes of sudden deaths in children up to 6 years of age. In the majority of retrospective studies, aspiration of foreign bodies concerns children aged 1-3 years, with a male predominance. The main clinical symptoms accompanying the presence of a foreign body in the airways are cough, dyspnoea, vomiting. IIn each case, diagnostic imaging should be carried out. The basic test is a chest X-ray. In cases of prolonged inflammation of the respiratory tract in children, despite the negative history and no changes in chest radiological examination, the aspiration of the foreign body should be considered. In any case of suspicion of a foreign body, an absolute indication is bronchoscopy.

Key words: foreign body, children, airways, bronchoscopy

Differences in anatomical construction of the respiratory tract in children and adults

Significant differences in the upper respiratory tract should include among others: horizontally-oriented nasal passage, the absence of molars, the relatively large tongue and epiglottis, and high, located on two vertebrae higher than in the adult, larynx arrangement at C3.

The shape of the larynx in children is funnel-shaped, cylindrical in adults. The angle of the both plates of the thyroid cartilage in the infant is obtuse and amounts to approximately 110 deg., while the adult plates form an acute angle [7].

The narrowest section of the larynx of newborn, infant and young child is limited by a small cricoid cartilage subglottic area. This ratio is maintained for up to approx. 8 years of age. In adults, in turn, the narrowest floor of larynx is glottis.

The mucosa of the larynx of younger people, containing a large number of connective tissue with components of the lymphatic tissue is loosely associated with the substrate and therefore has a high tendency to swelling [5].

Epidemiology

Foreign bodies are most common in children aged 1-3 years (approx. 60%), much less frequently in infants and school-age children [9]. Male gender dominates [2, 15].

Most aspirated foreign bodies are localized in the bronchi - 70-94,1% in the trachea - 4.2%, and larynx - 1.7% (in the last two total - up to 6-17%).

Mortality due to foreign body aspiration in the studies, is in the range 3-70% depending on the population studied.

The most frequently aspirated foreign bodies are: nuts (40%), sunflower seeds (25%), ears of cereal grasses, fruit stones, pieces of bone, fragments of toys [2, 9]. In more than 90% of foreign bodies they are of plant origin. They are especially dangerous because of its fragility, prone to swelling (some seeds increase their volume even twice) and toxic effects on the bronchial mucosa.

Defense mechanisms and risk factors.

Defense mechanisms protecting the respiratory tract from aspiration of a foreign body is: normal act of swallowing, cough, laryngospasm, and apnea [7].

In children, the aspiration of a foreign body into the bronchial tree most commonly occurs at moments of emotion intensity and distraction of the child, for example, while playing, crying, talking. It also binds with the impaired reflex of closure of the glottis, inadequate swallowing reflex, and the habit of putting objects into the mouth.

Clinical symptoms

The most common symptoms suggesting the presence of a foreign body in the airways are: dyspnea, cough, respiratory stridor [6]. On further places there are symptoms of bronchitis and / or pneumonia, atelectasis, emphysema, which are often accompanied by elevated temperature.

In the case of aspiration of a foreign body to the respiratory tract, it can be distinguished 4 periods [2, 7]:

- period of acute airway obstruction,
- oligosymptomatic period - the presence of the so-called subacute foreign body,
- period of acute inflammatory complications of the bronchi and lungs,
- period of permanent bronchopulmonary damages.

Ad. 1) Period of acute respiratory obstruction.

This period is dominated by acute, turbulent symptomatology: a sudden, brief coughing or repeated bouts of coughing. The highest reflex sensitivity concerns the upper part of the lower respiratory tract, i.e. splitting of the trachea and bronchi. The more the body is positioned peripherally, the cough reflex is less. Both the cough reflex and other symptoms slowly decrease or disappear when the foreign body finally settles in the bronchial tree and is surrounded by swollen mucosa.

The symptoms of dyspnoea depend on the location of the foreign body. Wedging the aspirate in the larynx or trachea causes acute respiratory failure due to airway obstruction or reflex cardiac arrest.

Other symptoms are: feeling of choking, hoarseness, inspiratory, or inspiratory-expiratory swish, cyanosis, apnea [10].

Clinically, the acceleration of the breath with its shallower, prolonged exhalation and cough is usually maintained. The characteristic phenomenon is the intensification of the above symptoms, as well as the deterioration of the comfort of breathing in the supine position.

Acute symptoms last from a few to several minutes.

Ad. 2) The oligosymptomatic period.

As soon as a foreign body is located in the bronchi (wedging), it is surrounded by swelling mucous membrane. Symptoms gradually disappear depending on the size of the bronchi.

The obstruction of the segmental or lobar bronchi may not produce clinical symptoms except for occasional cough. Typically, low-degree shortness of breath, prolonged exhalation and malaise are maintained.

In the thoracic examination, the symptoms of atelectasis of the peripheral part of the closed bronchi or the weakening of the alveolar murmur in the case of emphysema and overly overt percussion sounds are found.

Ad.3) Period of acute inflammatory complications.

Another period of the disease occurring after a few to a dozen or so days after aspiration is the appearance of symptoms typical for pneumonia, occurring in the area of pulmonary tissue supplied by the obstructed bronchi.

Radiographic examinations reveal features of atelectasis, or emphysema, inflammatory changes recurrent in the same place, or persistent despite the use of antibiotic therapy [10].

Ad. 4) Period of permanent bronchopulmonary damages.

Chronic inflammation in the area supplied by obstructed bronchi leads to permanent damage in the form of: bronchiectasis, post-inflammatory cyst, fibrosis and cirrhosis of the pulmonary parenchyma, lung abscess or pleural empyema.

Organic foreign bodies more often and more quickly cause bronchopulmonary complications (most often up to 80% - pneumonia) compared to inorganic bodies [7]. The consequence of the presence of organic bodies even for a relatively short time is a strong, purulent inflammatory reaction associated with putrefaction. Inorganic foreign bodies are in most cases responsible for the occurrence of irreversible bronchopulmonary changes.

The dominance of symptoms is determined by the time of presence of a foreign body in the airways. In the case of foreign bodies, with a short history of aspiration, the symptoms of atelectasis or emphysema dominate, while in the case of foreign bodies that reside for a longer period of time, symptoms of bronchitis and pneumonia that are not subject to anti-inflammatory treatment predominate.

Diagnostics

- interview - accurate gathering of the interview from the Parents or guardians of the child (asking about the course of sudden dyspnoea, choking, cyanosis, vomiting, facial flushing). According to Paksu et al. neither clinical symptoms nor changes in chest radiograph are as sensitive and specific as a positive interview [3],
- signs - cough, dyspnoea, weakness of alveolar murmur, wheezing, increased body temperature, laryngeal stridor, cyanosis - we usually have to deal with a situation where symptoms are isolated,
- imaging examinations:
  - chest X-ray - basic examination performed in the AP position, lateral position, showing the neck and lifting the chin at the maximum inhalation and exhalation - (so-called Holzknecht-Jacobson's sympotom, the symptom of an air trap) [3, 10].

The presence of non-contrasting foreign bodies is mainly manifested by indirect symptoms. When the bronchus is completely closed by a large foreign body, it comes to the atelectasis of the distal lung section, and with partial obstruction the image of the emphysema is created. In about 30% of cases there are no changes in the X-ray. Since the correct X-ray of the chest does not exclude the aspiration of a foreign body, further diagnostics are necessary.

- bronchoscopy / bronchofiberoscopy - the most important diagnostic and basic method of treatment in the case of aspiration of a foreign body [3, 5, 6, 12].

In the studies by Emir et al. in children without a positive history concerning the aspiration of a foreign body, with the clinical and radiological features of the chronic inflammatory process of the lower respiratory tract and bronchiectasis, during the bronchoscopy the percentage of confirmed foreign bodies was about 25% [6]. These tests confirm the need for bronchoscopy in any case of even the slightest suspicion of a foreign body of the airways.

- CT and virtual bronchoscopy - according to many authors, equally sensitive and specific to classic bronchoscopy. Its correct result avoids classic bronchoscopy [3].

Treatment

Suspicion of an acute aspiration of a foreign body into the airways is always an indication for the implementation of directoscopy and bronchoscopy. In the USA, in the case of sudden aspirations of a foreign body that completely closes the airway (larynx, trachea), the Heimlich maneuver is recommended. In extreme cases (e.g. wedging of a foreign body in the larynx, facial trauma), it is required to perform a cricothyrotomy or tracheotomy for life indications [7].

Bronchoscopy. It is performed in the operating room conditions under general anesthesia. The operating room should be equipped with a complete endoscopic apparatus with a set for general anesthesia, breath control, intubation and resuscitation. The basic method of removing foreign bodies is bronchoscopy using a rigid (classical) bronchoscope [7, 12].

Bronchofiberoscopy, according to the literature, in most cases serves only for the initial assessment of the bronchi and finding or excluding the presence of a foreign body, although according to some authors it was helpful in the diagnosis and removal of foreign bodies lying in peripheral bronchi in children [12].

After removal of a foreign body, bronchoscopic control of the bronchial tree is always necessary.

The use of rigid bronchoscopy is widely recognized as the best method for removing foreign bodies from any segments of the airways in children [7].

Summary

Recognition of aspiration of a foreign body is not usually a problem if the fact of aspiration was observed by someone from the child's environment and the kid was referred to the doctor at an early stage. Later, clinical symptoms and the results of auxiliary tests are non-specific. Since there is no typical set of symptoms that allow you to recognize a long-standing foreign body, always remember this possibility. Thus, in the case of recurrent bronchitis or pneumonia, especially when they relate to one area, chronic cough, low-grade fever, persistent auscultatory changes of the same location, the aspiration of the foreign body should be considered.

Based on the chest and neck X-ray examination, you can only confirm or exclude the presence of shading foreign bodies. In other cases, the presence of a foreign body may be suspected on the basis of symptoms indirectly indicating abnormal bronchial patency. Suspicion of the aspiration of a foreign body, even in the absence of radiological symptoms, is an indication for bronchoscopy, which fulfills both a diagnostic role and is the basic method of treatment. In special cases, when it is impossible to remove a stuck foreign body with a bronchoscope, it is necessary to perform a tracheotomy, or thoraco- and bronchotomy.

Because long-standing foreign bodies in the airways lead to irreversible changes of the type of bronchiectasis, post-inflammatory cysts, fibrosis and cirrhosis of the lungs, rapid medical intervention becomes extremely important.

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