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Rigid bronchoscopies in pediatric patients with tracheobronchial foreign bodies: Our outcomes

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Summary

Aim: Tracheal or bronchial foreign body aspiration is a life-threatening emergency in children requiring immediate bronchoscopy under general anesthesia. The aim of this retrospective study was to evaluate the anesthetic management, hazards and complications of bronchoscopies performed because of suspicion of foreign body aspiration.

Material and Method: We retrospectively analyzed the history, clinical and radiological findings and complications of 401 children admitted to the pediatric surgery department due to suspicion of foreign body aspiration between January 2006 and June 2011. Children requiring diagnostic bronchoscopies were excluded. All brochoscopies were performed under general anesthesia. Inhalation or IV induction and maintenance, spontaneous or controlled mechanical ventilation were selected individually according to the circumstances. Clinical findings, physical examination, radiological findings, anesthesia methods and complications of the patients were evaluated.

Results: Cough (82%) and dyspnea (21.8%) were common symptoms of tracheobronchial foreign bodies. Most common radiological findings included air trapping (57%) and normal chest radiographs (21%). The aspirated foreign bodies were generally organic materials (80%) such as nuts, peanuts and seeds. The majority of foreign bodies lodged in the bronchial tree and the incidence of right sided (49.1%) foreign bodies was higher than that of the left sided (24.4%). Major complications during the anesthesia and postoperative period were desaturation, arrhythmia, hypercarbia and bronchospasm.

Conclusions: Many problems can be experienced in children with inhaled foreign bodies. Bronchoscopy must be performed under optimal conditions in these patients. *(Turk Arch Ped 2012; 47: 126-30)*

Key words: Foreign body, aspiration, bronchoscopy, anesthesia, pediatric

Introduction

Tracheobronchial foreign body aspiration is an important urgency which can lead to death in the childhood. Rapid diagnosis and bronchoscopy performed afterwards can be lifesaving. Patients who have undergone bronchoscopy are in a high-risk group, since the intervention is always urgent and carries a risk of severe complications and the procedure includes serious problems (1). Common use of the airway, hyperactive airway, hemodynamic disorder which can occur during the procedure, affection of ventilation and oxygenation during the intervention, decrease in PaO2, increase in PaCO2, increase in airway resistance, decrease in FEV1 (forced expiratory volume in one second) and FVC (forced vital capacity) and a patient who is not fully prepared, who has respiratory stress or whose adequate fasting time has not passed mean a high complication rate and increase the difficulty of the procedure (2,3).

In this retrospective study, children in whom foreign body extraction was performed by bronchoscopy were evaluated in terms of age, gender, clinical status, physical examination, radiologic findings and complications observed during and after the procedure.

Material and Method

In this study, patients in whom rigid bronchoscopy was performed because of foreign body aspiration in night and daytime conditions in Cerrahpaşa Medical Faculty Pediatric Surgery Operation Room between January 2006 and June

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2011 were retrospectively evaluated in terms of age, gender, symptoms, physical examination, radiologic findings, foreign body localization, anesthesia method and complications observed during and after the procedure. Patients who had no suspicion of foreign body, but in whom diagnostic broncoschopy was performed were not included in the study. Physical examination findings and radiological data of the patients were evaluated before the procedure. Broncoscopy was performed under general anesthesia providing known anesthesia monitorization (ECG, SpO2, ETCO2, uninterventional arterial monitorization) using intravenous or inhalation induction method in all patients. Neuromuscular blocker was used in all patients except for 16 patients. Anesthesia maintenance was provided by a mixture of 2-3% sevoflurane, oxygen and air and if necessary, by 100% oxygen. For analgesia very short-acting opioid infusion (remiphentanyle; 0.1-0.25 mcg/kg/min) or longer-acting ones (phentanyle; 1 mcg/kg) according to the preference of the anesthesiologist were used. Ventilation was provided manually by a device associated with the rigid broncoscope. After the procedure was completed, all patients were ventilated by performing intubation. After appropriate conditions were provided they were extubated and sent to the recovery room. The patients were monitored at least for 2 hours in the recovery room and sent to the ward following necessary treatments and monitoring. After bronchoscopy patients who had respiratory and hemodynamic instability were sent to the intensive care unit. Complications which developed during or after bronchoscopy including desaturation (SpO2≤95% for more than 60 s), bradycardia (heart rate≤60/min), tachycardia (heart rate≥160/min), bronchospasm (acutely developed desaturation accompanied by wheezing), laryngospasm, hypercarbia (ETCO2 ≥45 mmHg) and others were recorded.

Results

Bronchoscopy was performed in 401 patients because of foreign body aspiration in Cerrahpaşa Medical Faculty Pediatric Surgery Operation Room between January 2006 and June 2011. The data obtained are shown in Table 1 and 2. 298 (74%) of the patients were male and 103 (26%) were female. The mean age was 3,71±2,48 years. 325 (81%) of the procedures were performed during the day and 76 (19%) were performed in night time and urgent conditions. Foreign body could not be found in 71 (17%) of the bronchoscopies performed. 35 (9%) of the patients presented with findings of recurrent or treatment-resistant lung infections, while 366 (91%) presented with acute findings and history. The most common findings included coughing which began acutely (329; 82%) and dyspnea (88; 21.8%). Among physical examination findings, wheezing was found in 164 (40.9%) patients, stridor was found in 90 (22.5%) patients and decrease in lung sounds unilaterally was found in 132 (33%) patients. Radiological findings included air trapping in 229 (57%) patients, normal lung appearance in 84 (21%) patients and foreign body appearance in 57 (14.2%) patients.

Mostly organic materials were extracted during bronchoscopy. 64% of these were nuts, peanuts and walnuts, 23% were pits and 17% were other organic materials. In 82 of the patients (20%), the foreign body was found to be an inorganic material. The most common inorganic materials included needles and part of toys and pens. The common localizations of foreign bodies were as follows in order: the right main brochus (49.1%), the left main bronchus (24.4%) and the subglottis and the trachea (8.7%). In 71 of the patients (17.7%) no foreign body was found by bronchoscopy.

In all patients, bronchoscopy was performed under general anesthesia. In 16 of these, general anesthesia was provided by inhalation anesthesia plus remifentanyle infusion without using neuromuscular blocker. In the other 385 patients, inhalation anesthesia was performed by controlled mechanic ventilation, induction maintenance of anesthesia was provided by opioid (phentanyle or remifentanyle) and muscle relaxant. 5 of the patients were intubated after bronchoscopy and taken to the intensive care unit. A patient who developed cardiopulmonary arrest during the procedure was referred to the intensive care unit after the procedure. 2 patients were reintubated after the procedure because of recurarization and laryngospasm and they were extubated after recovery.

Table 1. Data of the bronchoscopies performed between 2006 and 2011 in the operation room of Pediatric Surgery in Cerrahpaşa Medical Faculty

Age of the patient (years) (mean±SD)	3.71±2.48
Gender	N (%)
Male	298 (74%)
Female	103 (26%)
Symptoms	
Acute cough	329 (82%)
Dyspnea	88 (21.8%)
Wheezing	28 (7%)
Cyanosis	10 (2.5%)
Physical examination	
Wheezing	164 (40.9%)
Stridor	90 (22.5%)
Decrease in lung sounds unilaterally	132 (33%)
Normal lung sounds	80 (20%)
SpO2 %95	48 (12%)
Lung graphy findings	
Air trapping	229 (57%)
Atelectasia	20 (5%)
Foreign body appearance	57 (14.2)
Normal appearance	84 (21%)
Pneumiae	32 (8%)
Pneumothorax	8 (2%)
Localization	
Right main bronchus	197 (49.1%)
Left main bronchus	98 (24.4%)
Other	35 (8.7%)
No foreign body	71 (17.7%)

Table 2. Complications observed during bronchoscopy

Complications observed during anesthesia	N (%)
Desaturation	320 (80%)
Arrhythmia	289 (72%)
Hypercarbia	108 (27%)
Broncospasm	88 (22%)
Complications observed after anesthesia	
Laryngeal edema	152 (38%)
Desaturation	80 (20%)
Laryngospasm	32 (8%)
Continuing cough	28 (7%)
Brochospasm	20 (5%)

The most commonly observed complications during anesthesia included desaturation (SpO2<95%) in 320 patients (80%), arrhythmia (bradicardia, tachycardia, ventricular extrasystoles) in 289 (72%) patients, hypercarbia in 108 (27%) patients, bronchospasm in 88 (22%) patients. After extubation laryngeal edema was observed in 152 (38%) patients, desaturation was observed in 80 (20%) patients, laryngospasm was observed in 32 (8%) patients, persistent cough was observed in 28 (7%) patients and bronchospasm was observed in 20 (5%) patients. In 288 patients, steroid was used before or during the procedure. In 157 patients, bronchodilatator was used during the procedure.

Discussion

Foreign body aspiration is one of the most important causes of death in the 1- 3 years age group. This age group is at risk because of anatomic properties and immature airway reflexes. The reasons for presentation may range from suspicious aspiration history, nonspecific findings, normal physical examination and radiologic findings to severe respiratory distress and respiratory arrest. In our study, the most common findings included coughing which started suddenly, dyspnea and wheezing. On physical examination wheezing, decrease in respiratory sounds unilaterally, stridor and normal examination findings were found. Coughing, wheezing and decrease in lung sounds unilaterally which begin suddenly have been reported to be the most common signs and symptoms in foreign body aspiration also in the literature (2,4). In radiological evaluation of the patients presented in this article, the most common findings included air trapping and normal lung graphy in order. In our retrospective evaluation, normal lung graphy and physical examination findings were found to be common in foreign body aspiration. In the study performed by Chen et al.(5) in which 142 patients were undergone bronchoscopy, foreign body was found in 6% of 31 patients who had normal physical examination and radiologic findings. The rate of absence of foreign body on bronchoscopy was found to be 17.7% (n=71) in our study. 93% (n=66) of these patients had a history of coughing which started suddenly while eating and 7% had a history of suspicious aspiration or nonhealing pneumonia lasting longer than 2 weeks.

Rigid bronchoscopy is the recommended treatment method in foreign body aspiration (2). In addition, there are centers which prefer flexible bronchoscopy. Although flexible bronchoscopy is considered as an option in foreign body aspiration because it does not require general anesthesia, sedation is sufficient, it can demonstrate distal airways and it decreases hospitalization time, the golden standard is rigid bronchoscopy in presence of findings including asphyxia, radioopac foreign body, unilaterally decreased lung sounds, mediastinal shift or emphysema (3,6). To prevent unnecessary bronchoscopies flexible bronchoscopy is performed primarily in operation room conditions and then rigid bronchoscopy is performed, if necessary in some centers (5). In children with normal physical examination and radiologic findings, clinical follow up is recommended. Different anesthesia techniques can be performed during bronchoscopy. For maintenance of ventilation during the procedure different methods can be adopted. Apneic oxygenation, maintenance of spontaneous respiration, controlled mechanical ventilation and high frequency jet ventilation are recommended as appropriate methods for bronchoscopy by different centers (7). In a retrospective study including 94 patients, no difference was found between different ventilation methods in terms of complication rates. The anesthesiologist can prefer different methods according to the individual patient based on his/her own experience. In this sense, there is no consensus on an ideal ventilation method for bronchoscopy (8-10).

In the study presented, the procedure was completed using remifentanyle infusion and by supporting spontaneous respiration with sevoflurane anesthesia without using neuromuscular blocker in 16 patients. The reason for preferring this method was localization of foreign bodies mostly in the proximal airways and the prediction that broncoscopy procedure would last for a short period. In the other patient group, maintenance of anesthesia was provided by controlled mechanical ventilation using sevoflurane and adding neuromuscular blocker to opioid. This method was preferred, since it provides the best oxygenation in the ventilation part of bronchoscopy and provides a more convenient working opportunity for the surgeon by suppressing the movements and reflexes of the patient completely. However, this method has also some disadvantages including dirtiness in the operation room and requirement of pausing ventilation while extracting the foreign body. In the study performed by Soodan et al. (9) in which spontaneous respiration and controlled mechanical ventilation were compared in children in whom bronchoscopy was performed, it was found that SpO2 decreased in both groups

and desaturation was found to be present because of cough, breath holding or apnea in the spontaneous respiration group and in periods when ventilation was paused in the other group. In our study, the most common complications during anesthesia included desaturation (80%), arrhythmia (72%) and hypercarbia (27%). Hypoventilation caused by common use of the airway by the anesthesiologist and the surgeon, pausing of oxygenation while extracting the foreign body and continuous bronchial aspiration were thought to lead to both hypoxia and hypercarbia. Factors including disruption of oxygenation, stimulus on the tracheobronchial area by the bronchoscope and superficial anesthesia were thought to trigger arrhythmia during the procedure. According to our experience airway complications including bronchospasm, laryngospasm and laryngeal edema during or after anesthesia were observed more commonly in children with a chronic history and organic material (walnut, peanut, wheat, chestnut) aspiration, in foreign bodies which led to trauma in the pulmonary parenchyma (needle, bone, pen tip, toy parts), in prolonged bronchoscopies (>1 hour), in children who had active lung infection or upper respiratory tract infection during the procedure. Hence, it was found that the five patients who were gone to the intensive care unit had severe hypoxia and hypercarbia before the procedure, aspirated organic materials and developed pulmonary parenchymal damage during bronchoscopy. In our study, bronchospasm was observed to develop less commonly after extubation. The reason for this was thought to be related to treatments administered considering possible complications which might develop during the procedure.

The anesthesia method preferred for bronchoscopy should be the safest one for the patient and the one which will ease the surgeon's work during the procedure. In this group of patients, mostly inhalation anesthesia is used for maintenance of anesthesia. Sevoflurane is the frequently preferred inhalation agent, since it provides rapid induction and irritates the airway minimally (10,11). Maintenance of anesthesia may be accomplished only by infusion of intravenous agents (propofanol and remifentanyle) or by short-acting opioid infusion in addition to inhalaton. When the two methods were compared, the sevoflurane group was found to be more stable hemodynamically and induction and recovery were provided more rapidly in this group, though they had more agitation during wakening period (11). In Cerrahpaşa Medical Faculty, inhalation with sevoflurane is generally preferred in maintenance of anesthesia in bronchoscopy. In addition, infusion with fentanyle or remifentanyle which is a very short acting opioid is administered to suppress the hemodynamic response and to provide analgesia.

Mortality rate of bronchoscopy has been reported to be 0.42% (10). Many factors affect mortality and morbidity. Factors including hypoxemia before or during the procedure, age, type of the foreign body (organic or inorganic), inflammation caused by the foreign body and duration of this inflammation, size of the foreign body, sharp-pointed foreign body, damage in the surrounding tissue caused by the foreign body, previously present pneumonia and long procedure time increase the mortality and morbidity and affect the prognosis during and after the anesthesia (12,13). In addition to the present pathology, bronchospasm, pneumothorax, unilateral lung ventilation, hypoxia and hypercarbia are the other factors which increase the risk (11,13,14).

Trauma which develops in the airway after bronchoscopy and previously present or increased mucosal edema may increase respiratory distress. Therefore, the patient should be assessed carefully and necessary treatments should be administered. While dexamethasone, humidified oxygen and nebulized racemic epinephrine are recommended to decrease stridor and stress after operation, it is emphasized that especially steroids should be used only if necessary (15).

The time of bronchoscopy is another challenging subject. Especially patients with inadequate fasting period and respiratory stress are in the risk group in terms of aspiration and complications. Therefore, bronchoscopy is recommended to be performed when the most appropriate conditions are provided in terms of anesthesia and in daytime conditions by an experienced surgeon and anesthesiologist, if the patient is comfortable in terms of respiration and can wait (16). In Cerrahpaşa Medical Faculty, bronchoscopy is preferred to be performed in daytime operation room conditions in patients who have no respiratory distress or hypoxia and in whom the foreing body localization is not thought to be problematic. In this sense, it is observed that the mortality rate and the rate of internalization to the intensive care unit are low. In addition, when the patients who were internalized to the intensive care unit were evaluated, it was observed that previously present pathologies including pneumonia or hyperactive airway affected the complication rate and need for intensive care.

In foreign body aspiration, the most common findings include history of aspiration and coughing and decrease in lung sounds unilaterally which starts suddenly. However, it should be kept in mind that patients may have normal physical examination and radiological findings and anamnesis is very important in the justification of bronchoscopy (17). In case of suspicious foreign body aspiration, bronchoscopy should be performed without delay and it should be kept in mind that chronic cases increase the risks related to the patient and the need for intensive care. The anesthesiologist should prefer the most appropriate and safe method considering many factors including the general status of the patient, the duration of the procedure and type and localization of the foreign body. Conclusively, bronchoscopy is a serious and risky intervention which can lead to severe complications related to the airway and other systems. Therefore, it should be performed by an experienced team after providing the best conditions possible in terms of the patient to decrease the mortality and morbidity.

Conflict of interest: None declared.

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