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# Comparison of Anesthetic Techniques on Outcomes of Pediatric Rigid Bronchoscopy for Foreign Body Removal

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***Abstract***

***Background***

Although both methods of spontaneous respiration and controlled ventilation during anesthesia are safe and effective for managing children with foreign body aspiration, there is no consensus from the literature as to which technique is optimal. This study aimed to determine the outcomes of anesthetic techniques in pediatric rigid bronchoscopy for foreign body removal.

***Materials and Methods***

In this retrospective cross sectional study, all children underwent rigid bronchoscopy for managing foreign body aspiration at Mofid hospital, Tehran, Iran from 2009 to 2015 were enrolled. Data gathering was done by a surgical technologist and using a structured checklist. The measured variables included gender, age, weight, and duration of anesthesia, duration of bronchoscopy, hospitalization in intensive care unit (ICU), and recovery time, and possible major and minor complications.

***Results***

Totally, 159 patients were assessed of whom 10 (6.5%) were maintained spontaneous respiration and 149 (99.35%) were given muscle relaxant. The mean ± standard deviation (SD) age of subjects was 27.21 ± 24.40 months, and also 61% (n=97) were male. The two groups did not differ in terms of age, gender and weight ($p>0.05$). Patients with controlled ventilation had a similar duration of anesthesia, duration of bronchoscopy, hospitalization in ICU, recovery time, and complications with the patients who had spontaneous respiration during bronchoscopy ($p > 0.05$).

***Conclusion***

Patients with spontaneous respiration and controlled ventilation during rigid bronchoscopy have a same outcome during and after the procedure. However, we strongly recommend further study in this regard.

***Key Words:*** Anesthetic technique, Children, Foreign body aspiration, Rigid bronchoscopy.

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## 1- INTRODUCTION

Foreign body aspiration can be a life-threatening emergency, which is commonly found among children between 1-3 years old (1). It is the most common cause of sudden death among children under four years of age (2). As reports, foreign body aspiration account for nearly 150-300 deaths per year in children in the USA, which the most of them occur because of complete airway obstruction (2, 3). Rigid bronchoscopy under general anesthesia is considered the gold standard for the diagnosis and management of foreign body aspiration (4). However, this procedure can be associated with minor and major complications such as asphyxiation, hypoxemia during foreign body removal from airways, bronchial rupture, pneumothorax and cardiac arrest (1, 2, 4). Hypoxemia, as most common adverse events during rigid bronchoscopy, often caused by improper airway manipulation, partial or complete obstruction of the airway, and inflammation secondary to the foreign body (5). Hence, anesthesia for rigid bronchoscopy has always been a challenge, as there are always risks of the possibility of laryngospasm and lack of access to the airway (6).

In this regard, there are two approaches for airway management in the general anesthesia (7-9). In first approach, there is no use of muscle relaxants and spontaneous respiration, which prevents the complete airway obstruction by a foreign body (1, 10). However, inadequate depth of anesthesia, low tidal volumes and vital signs instability are the disadvantages of this approach (7, 11). This method is also one of the anesthesia-related risk factors for laryngospasm (11, 12). On the other side, some experts believe that use of muscle relaxant and mechanical ventilation prevents the patient movement during the procedure, therefor increasing the likelihood of successful removal of the foreign body (13, 14). Moreover, oxygen delivery to the tissues can be assured and an adequate level of anesthetic depth is adjusted, and then shortened the duration of the bronchoscopy (1, 15). However, this approach may be associated with the risk of ball-valve mechanism, which can damage the lung and cause pneumothorax (3, 7). There is also the chance of displacing the foreign body in the patient's airway and complete obstruction because of positive pressure ventilation (2). Literature review indicates an inadequate evidence to achieve appropriate general anesthesia approach in these cases (7, 16).

AuBuchon et al. (2011) recommended that no muscle relaxant be used in patients with foreign body aspiration and rigid bronchoscopy, as it may cause complete airway obstruction (3); while Victor Baum et al. (2012) emphasized the use of muscle relaxants to remove of foreign body through rigid bronchoscopy (17). Also, in a review study by Fidkowski et al. (2011), conducting further studies to choice the best general anesthetic approach for removal of the foreign body has been recommended (2). Therefore, since the choice of the best anesthetic technique in rigid bronchoscopy for the foreign body removal is still controversial, this retrospective study aimed to determine the outcomes of anesthetic techniques in pediatric rigid bronchoscopy for foreign body removal.

## 2- MATERIALS AND METHODS

### 2-1. Study design and population

In this retrospective cross sectional study, all children underwent rigid bronchoscopy for managing foreign body aspiration at Mofid hospital, Tehran, Iran, from July 2009 to July 2015 were investigated. This study was approved by the Ethics Committee of Shahid Beheshti University of Science (ID number: 85M).

### 2-2. Methods

The study was based on the patients' medical record information. Hence, medical records of all patients who referred to the emergency department of Mofid children hospital in the time of study were reviewed.

### 2-3. Data measurements

Data gathering was performed by a surgical technologist and using a structured checklist. The measured variables included gender, age, weight, type of aspiration (acute or chronic), duration of fasting, location of foreign body, type of induction, duration of anesthesia, duration of bronchoscopy, hospitalization in intensive care unit (ICU) and recovery time. Moreover, possible major complications including death, cardiac arrest, bronchial rupture, pneumothorax, low oxygen saturation (less than 80%), hospitalization in the intensive care unit, and complications associated with prolonged hospitalization and possible minor complications including coughing, shortness of breath, sore throat, tooth fractures and voice hoarseness that was not associated with prolonged the duration of hospitalization, were evaluable and recorded.

### 2-4. Ethical consideration

This study was approved by the Ethics Committee of Shahid Beheshti University of Science. Also, necessary permission was given from the authorities and medical record department to access the medical records.

### 2-5. Inclusion and exclusion criteria

In a period of 6 years, all cases that had our inclusion criteria including definitive diagnosis of foreign body aspiration, age below 18 years, full recorded data, treated by rigid bronchoscopy, and anesthesia with either of the two methods studied were included. Also, patients with incomplete recorded data and those who their diagnosis was not confirmed after bronchoscopy were excluded.

### 2-6. Data Analyses

Data obtained were analyzed using SPSS version 22.0 software (IBM Corporation, Armonk, NY, USA). Descriptive statistics was used to describe data. Kolmogorov–Smirnov test was used for checking normality of data. The t-test was used to compare the normally distributed data, whereas the Mann Whitney u test was used to compare the non-normally distributed data. The level of statistical significance was set at P-value <0.05.

## 3-RESULTS

In this study, 185 cases were evaluated that 19 patients (10.5%) were excluded from the study due to incomplete recorded data, and 7 patients (3.5%) due to unsuccessful visualization of foreign body after bronchoscopy. Finally, the data of the 159 (86%) cases were reviewed. The mean ± standard deviation (SD) age of participants was 27.21 ± 24.40 months. Among them 61% (n=97) were male and 39% (n=62) were female. The mean ± SD patients' weight was 13.2 ± 6.2 kg.

The results showed that 93.7% (n=149) patients underwent muscle relaxant anesthesia with control breathing, and the rest (6.3%, n= 10), were anesthetized without the use of muscle relaxant, and they had spontaneous respiration. **Table.1** shows the distribution of gender, age, weight, type of aspiration, fasting, and location of foreign body in patients under the two anesthesia approaches. The two groups did not differ in terms of these variables (p>0.05).

Also, the type of induction, duration of anesthesia, duration of bronchoscopy, the number of ICU admission and the recovery time were compared in **Table.2**. The only significant difference was related to the medication used in induction (P=0.005).

Also, there was no statistically significant difference between two in term of major and minor complications in two anesthesia approaches (**Table.3**).

**Table-1**: Demographic characteristics of the patients in controlled and spontaneous groups

| Variables | | Groups | | P- value |
|---|---|---|---|---|
| | | Controlled ventilation Number (%) | Spontaneous respiration Number (%) | |
| Gender | Male | 91 (61%) | 6 (60%) | 0.94 |
| | Female | 58 (39%) | 4 (40%) | |
| Age, (month) | | 27±24 | 23±12 | 0.6 |
| Duration of aspiration | Acute | 109 (73%) | 8 (80%) | 0.99 |
| | Chronic | 40 (27%) | 2 (20%) | |
| Weight, (kg) | | 13±6 | 12±3 | 0.5 |
| Fasting condition | Complete | 143 (96%) | 10 (100%) | 0.99 |
| | Incomplete | 6 (4%) | 0 (0%) | |
| Location of aspiration | Supraglottic | 1(0.65%) | 0 (0) | NS |
| | Glottic | 1(0.65%) | 0 (0) | |
| | Tracheal | 18 (12.2%) | 1 (10%) | |
| | Right main bronchus | 74 (49.5) | 5 (50%) | |
| | Left main bronchus | 55 (37%) | 4 (40%) | |

NS: Not Significant.

**Table-2**: Data related to anesthesia and after bronchoscopy of the patients in controlled and Spontaneous groups

| Variables | Controlled Ventilation (n=149) | Spontaneous respiration (n=10) | P-value |
|---|---|---|---|
| Induction (volatile/IV) | 31/118 (21% / 79%) | 6/4 (60% / 40%) | 0.005 |
| Duration of anesthesia (minute) | 77±22 | 67±24 | 0.19 |
| ICU admission (number) | 4 (3%) | 1 (10%) | 0.28 |
| Recovery Time (minute) | 20±7 | 21±7 | 0.71 |
| Bronchoscopy Time (minute) | 42±21 | 36±20 | 0.41 |

**Table-3**: Difference in term of major and minor complications in two anesthesia approaches

| Variables | Muscle Relaxant Positive (n=149) | Muscle Relaxant Negative (n=10) | P-value |
|---|---|---|---|
| Complications | 16 (11%) | 1(10%) | 0.98 |
| Major Complication | 4(3%) | 1(10%) | 0.3 |
| Minor Complication | 12 (8%) | 0 (0%) | 0.99 |

## 4- DISCUSSION

In this study, 159 children with a definite diagnosis of foreign body aspiration and under rigid bronchoscopy were investigated. The anesthesia with or without muscle relaxant was considered by an anesthetist, and there were no clear criteria. Given that in Mofid hospital, Tehran- Iran, most anesthesiologists prefer to use muscle relaxant, so that patients without use of muscle relaxant, and spontaneous respiration was much less than that of controlled breathing. In this study, there was no significant difference between the two groups in the incidence of postoperative complications, recovery time, and duration of hospitalization.

This issue could be due to the lack of proper distribution, and the heterogeneity of the groups. Therefore, the absence of any difference between the two groups can be due to the small number of samples in the spontaneous respiration. However, one out of ten (10%) ICU admission patients in group who did not muscle relaxation, and four out of a hundred and fifty nine (3%) in muscle relaxant group, could suggest that by a specific algorithm, we can identify patients who benefit from muscle relaxants. In most similar studies, the superiority of one of these two methods of anesthesia in rigid bronchoscopy of foreign body aspiration has not been proven. Litman et al. (2000) assessed the association between the type of airway management during anesthesia and the rate of complications in 94 children with bronchoscopy to treating foreign body (7).

In this retrospective study, no difference was found between the use of muscle relaxant and spontaneous respiration. Soodan et al. (2004), in a prospective study, the relationship between type of anesthesia and bronchoscopy was investigated in 36 cases with foreign body aspiration (18). In this study, all cases where spontaneous respiration was preserved, muscle relaxant was obligatorily used due to low oxygen saturation or lack of appropriate depth of anesthesia. They concluded that all patients require a relaxant to remove of foreign body by bronchoscopy. However, there is a possibility of error in judgment, and so we will need a larger study to make a decision. Chen et al. (2009) in a retrospective study of 384 cases observed that patients in the spontaneous respiratory group had the more likely occurrence of motion, respiratory retention, significantly lengthened the wake-up phase of anesthesia, reduced the chance of removing the foreign body, and increased the probability of developing laryngospasm (5). AuBuchon et al. (2011) reported that spontaneous respiratory during remove of foreign body should be established. Because it may cause complete airway obstruction, and with regards to cricoid anatomy and the possibility of blockage in this place in children, it may not be able to maintain airway even with cricothyrotomy (3).

While Baum (2012) in his study confirmed safety and advantages of muscle relaxants for all patients required bronchoscopy (17). In another study by Fidkowski (2010) et al., 12,979 cases of bronchoscopy were reviewed, which the results showed that there is still insufficient information to prefer controlled or spontaneous respiration (2). Liu et al. in their meta-analysis did not observed significance different between the anesthesia approaches (19). However, they noted lower Laryngospasm and duration of bronchoscopy in patients undergoing mechanical ventilation. Therefore, the previous studies and finding of this study, the authors believe that for the proper management of these patients, consideration of the accompanying factors is necessary. These factors are skill in bronchoscopy, anesthesiologist's skill in managing the patient without the relaxant, as well as the ability of an anesthetist to

identify and address the threats posed by muscle relaxant. In addition, the anesthetic management of these patients can be influenced by the aspiration event time and the level of shortness of breath in the child. In this study, minor complications were not reported in patients who did not receive muscle relaxant. In addition to the type of anesthesia, this can be due to low number of samples. Therefore, larger study needs to investigate the minor complications in spontaneous group. In this study, we tried to evaluate most of the variables and overcome the limitation of retrospective studies by examining all the involved variables. The retrospective nature of the study also led to the loss of information due to the lack of record. In addition, we had to refer the contents of the recorded data and the matching the two groups were not possible.

## 5- CONCLUSION

The outcome of spontaneous respiration and controlled ventilation during anesthesia does not differ in patients under rigid bronchoscopy. However, due to limited data in spontaneous respiration group, future controlled prospective studies are needed to choice of the best anesthesia approach.

## 6- CONFLICT OF INTEREST: None.

## 7-ACKNOWLEDGMENTS

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