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Research Article | Araştırma Makalesi

A SURGICAL PERSPECTIVE ON TWO ANESTHESIA TECHNIQUES USED IN CHILD AGE GROUP FOREIGN BODY ASPIRATION TREATMENT DURING RIGID BRONCHOSCOPY

ÇOCUK YAŞ GRUBU YABANCI CİSİM ASPİRASYONU TEDAVİSİNDE KULLANILAN RİJİT BRONKOSKOPİ ESNASINDA UYGULANAN İKİ ANESTEZİ TEKNİĞİNE CERRAHİ BİR BAKIŞ

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ABSTRACT

Objective: In our study, we aimed to reveal the advantages and disadvantages of inhalation and intravenous anesthesia techniques in the maintenance of anesthesia in pediatric patients whose tracheobronchial foreign body was removed by rigid bronchoscopy under general anesthesia.

Methods: The patients were divided into two groups with 34 individuals in each group, whose anaesthesia was maintained with sevoflurane inhalation or propofol infusion. Demographic characteristics of the patients, symptoms at presentation, radiological examinations, anaesthesia and surgical procedures, complications were analyzed. In addition, surgical difficulty and surgical comfort scales created from the experiences of our institution were used. The results obtained and the effects of inhalation and intravenous anaesthetics used in maintenance on the duration of the procedure, clinical, hemodynamic and surgical comfort were compared.

Results: Vital signs during the procedure were similar in both groups. The duration of bronchoscopy was shorter in the intravenous anaesthesia group (p=0.014), and secondarily, the duration of anaesthesia was longer in the inhalation anaesthesia group (p=0.027). While the surgical difficulty scale was similar in both groups, the surgical comfort scale was higher in the intravenous anesthesia group (p=0.017).

Conclusion: Anaesthesia maintenance with sevoflurane prolongs the duration of bronchoscopy and accordingly the duration of anaesthesia, and also reduces surgical satisfaction independent of processing time. For these reasons, we think that while rigid bronchoscopy is performed for the removal of childhood foreign body aspirations, propofol can be preferred for anaesthesia maintenance, resulting in a shorter procedure time and higher surgical satisfaction.

Keywords: Surgical comfort scale, surgical difficulty scale, rigid bronchoscopy

ÖZ

Amaç: Çalışmamızda genel anestezi altında rijit bronkoskopi ile trakeabronşiyal yabancı cisim çıkarılan çocuk hastalarda anestezi idamesinde inhalasyon ve intravenöz anestezi tekniğinin birbirlerine olan avantaj ve dezavantajlarını ortaya koymayı amaçladık.

Yöntem: Hastaların anestezi idamesi sevofluran inhalasyonu ile veya propofol infüzyonuyla yapılanlar olmak üzere 34'er kişiden oluşan iki grup oluşturuldu. Hastalara ait demografik özellikler, başvuru semptomları, radyolojik incelemeler, anestezi ve cerrahi işlemler bağlı özellikler, komplikasyonlar analiz edildi. Ayrıca kurumumuz tecrübelerinden oluşturulan cerrahi zorluk ve cerrahi konfor skalaları kullanıldı. Elde edilen sonuçlarla idamede kullanılan inhalasyon ve intravenöz anesteziklerinin işlem süresi, klinik, hemodinami, cerrahi konfor üzerine etkileri karşılaştırıldı.

Bulgular: İşlem esnasında vital bulgular her iki grupta benzerdi. Bronkoskopi süresi intravenöz anestezi grubunda daha kısaydı (p=0,014) buna sekonder olarak anestezi süresi inhalasyon anestezisi grubunda daha uzundu (p=0,027). Cerrahi zorluk skalası her iki grupta benzer iken, cerrahi konfor skalası intravenöz anestezi grubunda daha yüksekti (p=0,017).

Sonuç: Sevofluranla idame anestezisi bronkoskopi süresini uzatmakta ve buna sekonder olarak anestezi süresi uzamaktadır ayrıca işlem süresinden bağımsız olarak cerrahi memnuniyet azaltmaktadır. Bu nedenlerle çocukluk çağı yabancı cisim aspirasyonlarının çıkartılmasında rijit bronkoskopi yapılırken anestezi idamesinde propofolün tercih edilebilerek daha kısa işlem süresi ve daha yüksek cerrahi memnuniyet elde edileceğini düşünüyoruz.

Anahtar Kelimeler: Rijit Bronkoskopi, cerrahi konfor skalası, cerrahi zorluk skalası

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Introduction

Tracheobronchial foreign body aspiration (TBFBA) is a life-threatening condition that is frequently observed in childhood.[1,2] In the diagnosis and treatment of children TBFBAs due to the need for sedation and difficulty in cooperation in this process, rigid bronchoscopy (RB) is generally preferred under general anaesthesia instead of Flexible bronchoscopy (FB).[3-5] General anaesthesia induction and maintenance is accomplished with intravenous (iv.) or inhalation anaesthetics with spontaneous breathing or controlled breathing.[6] The choice of anaesthesia method or anaesthetic agent depends on the preference of the anesthesiologist.[3] In our study, we aimed to reveal the advantages and disadvantages of inhalation and intravenous anaesthesia techniques in the maintenance of anaesthesia in pediatric patients whose tracheobronchial foreign body was removed by rigid bronchoscopy under general anaesthesia, from both anaesthesia and surgical perspectives, different from the literature.

Methods

This study was planned retrospectively with the approval of Kocaeli University Faculty of Medicine Non-Invasive Ethics Committee, numbered 2021/69. Patients aged 0-18 years, who underwent RB under general anaesthesia (GAA) with the suspicion of TBFBA by the Department of Thoracic Surgery between 11.10.2020-10.10.2019 were included in the study. Before the procedure, the necessary laboratory and imaging tests were performed following the anamnesis and physical examination of the patients. Patients were kept under close observation until the procedure. Patients who are hemodynamically and respiratory unstable and who are too urgent to wait for a fasting period, who cannot be sure of adequate ventilation with repetitive bronchoscopy attempts and positive pressure ventilation, and therefore who do not use muscle relaxants, were excluded from the study.

It is recommended that the RB procedure be performed in the daytime than night conditions in clinically stable patients who are indicated for RB.[7] On the contrary, in our study, the procedures were performed by the same thoracic surgeon and anaesthesia team who knew each other and had experience in the procedure, at all hours of the day, taking into account the fasting period without acute conditions.

Patients were divided into two groups as anaesthesia maintenance was performed with sevoflurane inhalation (Group S) or propofol infusion (Group P). When the power analysis was performed with the G*Power program by taking effect size=0.8, α=0.05 and Power (1-β)=0.90, it was determined that a minimum of 34 people should be worked for each group. Two groups, each consisting of 34 individuals with sufficient data and suitable for inclusion and exclusion criteria, were formed. Whether premedication would be performed was determined according to the clinical condition of the patient. After standard anaesthesia monitoring (ECG, SpO2, blood pressure) was applied to the patients who were taken to the operating room, anaesthesia induction was achieved by inhalation of 100% oxygen and 8% sevoflurane with a gas flow of 5 L/min in both groups, and the concentration of sevoflurane was gradually reduced. Anaesthesia was maintained with the 100% O2 with 2.5-3.5% sevoflurane in Group S, and 100-150 µg/kg/min propofol infusion in Group P. 1 mg/kg methylprednisolone was administered intraoperatively in prolonged bronchoscopy (>30 min) and in cases where intubation was repeated more than 3 times with bronchoscopy. In patients with intense secretions in the intraoperative period or in case of bradycardia development iv. atropine (0.01 mg/kg) was administered. A rigid bronchoscope (Storz brand) of suitable size was inserted into the trachea by the thoracic surgeon 3 minutes after the muscle relaxant application. The foreign body was tried to be visualized by using 0 and 30-degree optics connected with the eye and the monitor through the working channel of the bronchoscope. Intraoperative ventilation was provided by controlled manual ventilation with 8-10 Lt/min 100% oxygen through a T-piece, one opening of which was connected to the ventilation port of the rigid bronchoscope and the other opening to the breathing circuit. Anesthesia was maintained with 2-5% sevoflurane-100% O2 inhalation in Group S, and propofol infusion of 100-150 µg/kg/min in Group P. The anaesthetic agent dose was titrated according to the patient's hemodynamic response. For analgesia, 0.1 µg/kg/min remifentanil infusion was administered to both groups. In cases where TBFB could not be seen clearly, manual ventilation was interrupted in coordination with the surgeon and only oxygen insufflation was applied with apnea periods. If the patient was desaturated during the bronchoscopy procedure, the procedure was interrupted and the RB was regressed to the trachea and manual ventilation was applied until the saturation increased. After the FB was seen, it was grasped with alligator forceps and removed from the RB lumen with forceps. After the TBFB was removed, for possible complications and residue FB, the trachea and bronchial systems were observed -checked by optics. When the procedure was over, anaesthetic drugs were discontinued, muscle relaxants were reversed in necessary patients, and the patient's respiration was manually supported with 100% oxygen until the patient's spontaneous respiration reached a sufficient level. At the end of the procedure, the patients were followed in the recovery unit until the Aldrete score reached 9 points, and then they were sent to their wards. In the meantime, the presence of pneumothorax and other possible pathologies was investigated by first taking a chest X-ray in patients who developed respiratory distress. Firstly, medical treatment (corticosteroid, humidified oxygen, nebulized adrenaline) was applied to patients who were thought to have oedema in the respiratory tract, and patients whose respiratory distress continued despite medical treatment were admitted to the intensive care unit (ICU) by endotracheal intubation.

Demographic data of patients, the passing time between TBFBA history and time of admission to the hospital (application time), symptoms at admission, features of anaesthesia applications (anaesthesia, awakening and recovery time), features of surgical practice (bronchoscopy time, surgical comfort scale and surgical difficulty scale), hemodynamic and respiratory parameters of the patient, characteristics of TBFB (structure, localization) intraoperative [patient movement, desaturation (desaturation of oxygen saturation below 90%), bradycardia (heart rate decrease below 20% of control values) and bronchospasm] and awakening and recovery complications (laryngospasm, desaturation, recurrent cough) were recorded. If symptoms and complications occurred more than once in the same patient, all were recorded.

In our study, 2 new parameters were used in terms of surgery. Surgical comfort scale and surgical difficulty scale were created by our clinic's long-term TBFBA experience and therefore they were named KOU Surgical Comfort Scale and KOU Surgical Difficulty Scale. KOU Surgical comfort scale is a partially subjective criterion that the main goal is to show the effect of anaesthesia application on the surgeon. 0 points were accepted as the lowest and 9 points highest comfort level in the scale, which is based on the principle of scoring between 0 and 9 points. Less than 5 points were considered low, 5-7 points were considered normal, and 7 points and above were considered high. With this scale, the surgeon is asked to evaluate those situations one day after the procedure; During the patient's manual ventilation, a) restriction of bronchoscope manoeuvres b) affecting the quality of observation, c) adverse effects of the airflow into the eyes d) Whether there is a decrease in performance at the time of the operation or the next day due to the pollution of the room air, or whether there are health problems such as headaches and inclination to sleep (Figure 1).

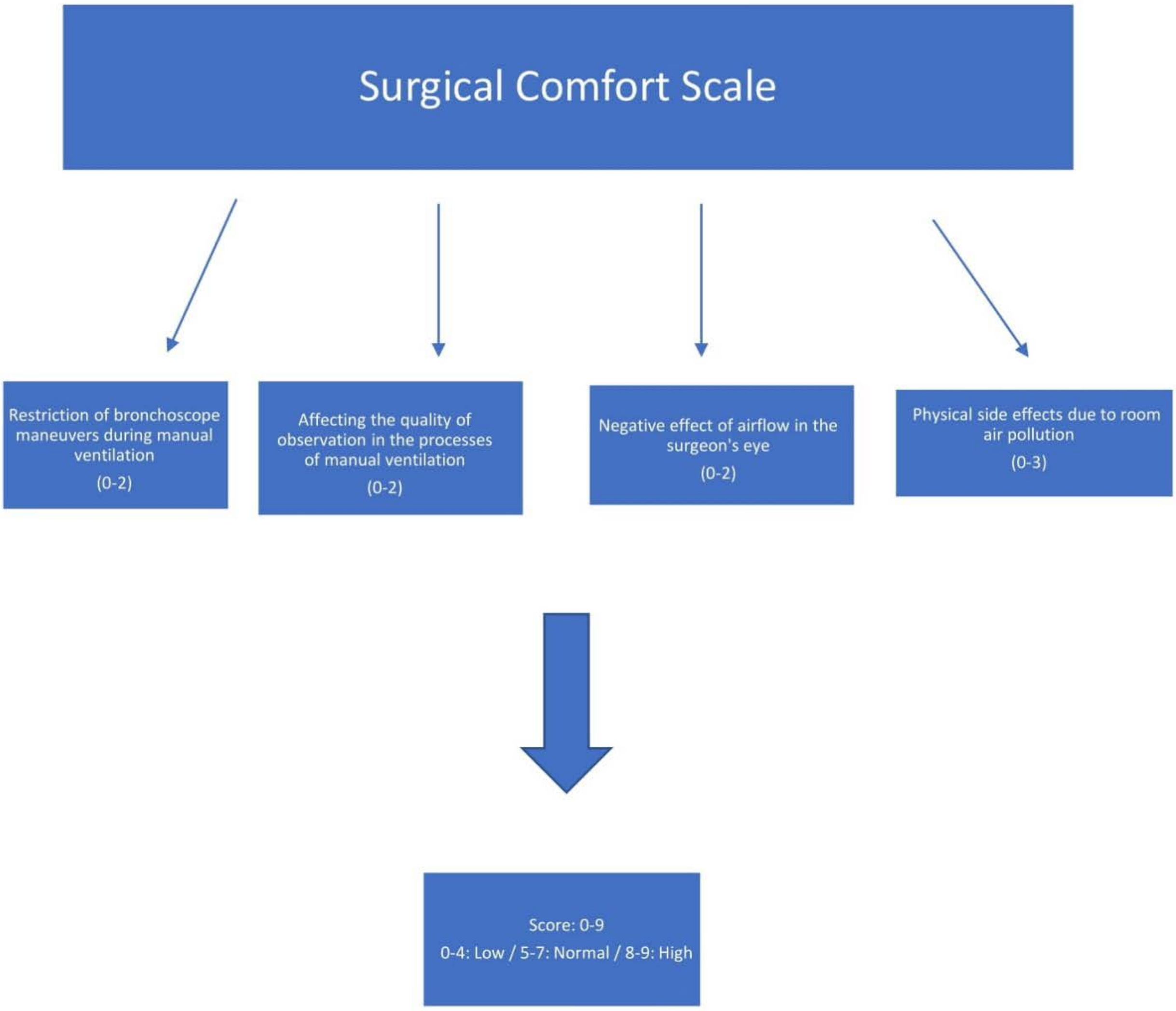

Figure 1. Surgical comfort scale

In the calculation of the Surgical Difficulty Scale; the nature of the foreign body, number of pieces, size, localization, granulation tissue formation due to foreign body in the bronchial tree, rigid bronchoscope size and subjective score reported by the surgeon (temperature-gas of the room, difficulties experienced due to the equipment used as a result of covid measures, etc.) were used. 8 points and below were accepted as easy, 9-12 points as medium, 13 points and above as difficult. (Figure 2).

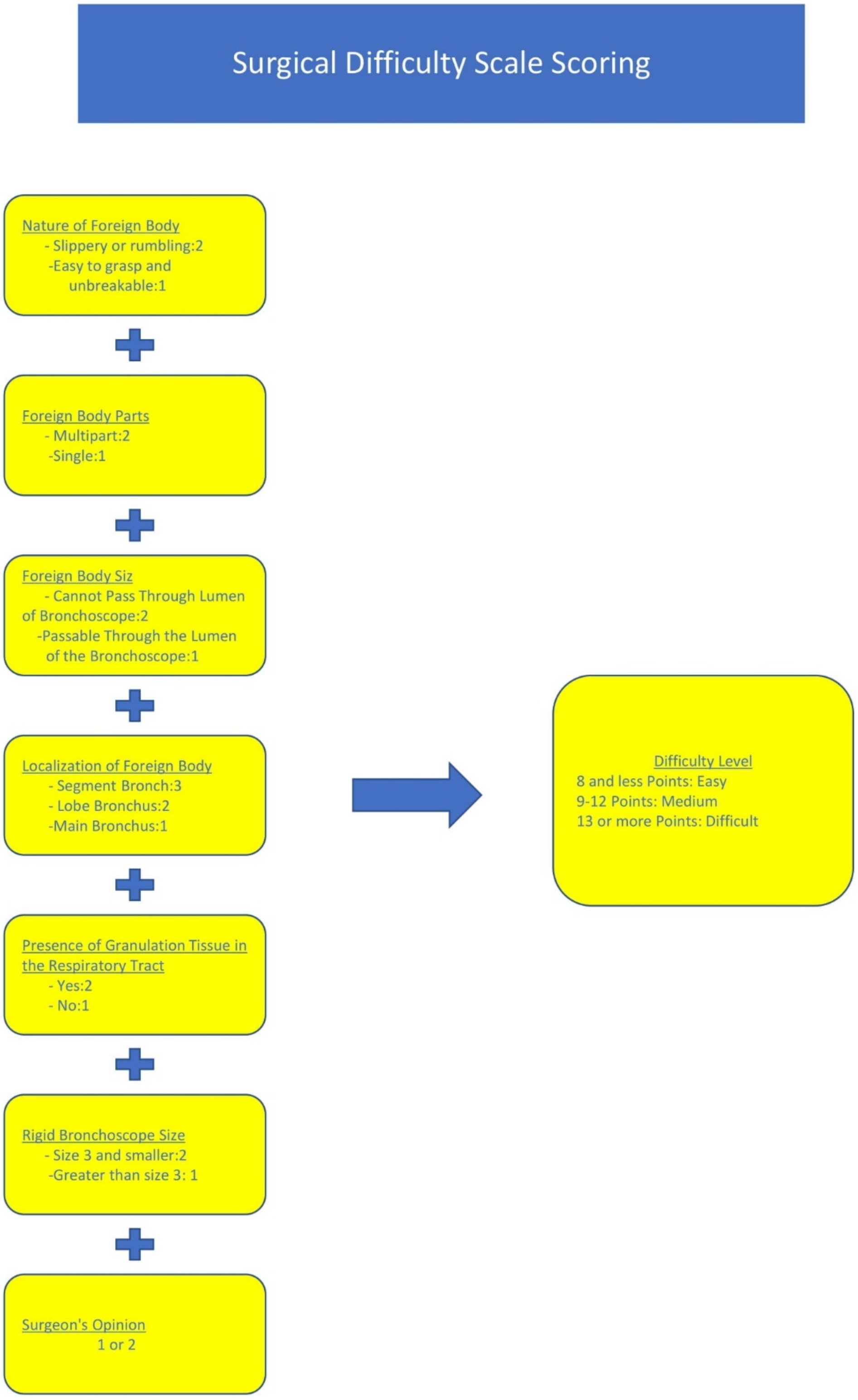

Figure 2. Surgical difficulty scale

Statistical Analysis
All statistical analyses were performed using IBM SPSS for Windows version 20.0 (SPSS, Chicago, IL, USA). Kolmogorov-Smirnov and Shapiro-Wilk tests were used to assess the assumption of normality. Numeric variables were presented with mean±standard deviation and median (25th-75th percentile). Categorical variables were summarized as counts (percentages). Since normality assumption did not hold, comparisons of numeric variables between groups were carried out using Mann-Whitney U test. Binary logistic regression analysis was used to determine the factors affecting the outcome variable. Association between two categorical variables was examined by Chi-square test. A *p*-value<0.05 was considered statistically significant.

Results

The data of 104 patients were analyzed retrospectively, 14 patients were excluded from the study, 34 patients whose anaesthesia was maintained with sevoflurane and 34 patients whose anaesthesia was maintained with propofol were randomly selected and analyzed.
Demographic characteristics, medical history and application time of the patients were similar in both groups (Table 1).

Table 1. General Features

	Total (n=68)	Group S (n=34)	Group P (n=34)	p
Age (month), mean±SD	25.19±23.11	24.26±24.65	26.12±21.80	0.372[a]
Sex, n (%)				0.460[b]
Male	40(58.8)	22 (64.7)	18 (52.9)	
Female	28(41.2)	12 (35.3)	16 (47.1)	
Weight (kg), mean±SD	13.93±6.10	13.68±6.64	14.19±5.59	0.639[a]
Disease history, n (%)				0.617[b]
Absent	54 (79.4)	27 (79.4)	27 (79.4)	
Pulmonary	6 (8.8)	3 (8.8)	3 (8.8)	
Cardiovasculer	2 (2.9)	2 (5.9)		
Other	6 (8.8)	2 (5.9)	4 (11.8)	
Application time (day), mean±SD	3.88±11.32	2.10±2.34	5.66±15.76	0.735[a]

[a]Mann-Whitney U Test, [b]Chi-Square Test, n: Number, SD: Standart Deviation

Preoperative symptoms, examination and imaging findings of the patients were similar in both groups (Table 2).

Table 2. Before Operation Symptoms and Radiological Imaging

	Total (n=68)	Group S (n=34)	Group P (n=34)	p
Preoperative Symptoms, n (%)				
Dyspnea	3(4.4)	1 (2.9)	2 (5.9)	NA
Cough	51(75)	27 (79.4)	24 (70.6)	0.575[a]
Wheeze	32 (47.1)	13 (38.2)	19 (55.9)	0.224[a]
Difference between breath sounds on auscultation	19 (27.9)	10 (29.4)	9 (26.5)	1.00[a]
Wheezing	7 (10.3)	3 (8.8)	4 (11.8)	1.00[a]
Chest X-ray Findings, n (%)				0.438[a]
No pathological image	30 (44.1)	14 (41.2)	16 (47.1)	
Aeration difference	32 (47.1)	16 (47.1)	16 (47.1)	
Atelectasis	3 (4.4)	3 (8.8)		
Appearance of foreign body	3 (4.4)	1 (2.9)	2 (5.9)	
Thorax CT, n (%)	4 (5.9)	1 (2.9)	3 (8.8)	NA

[a]Chi-square test, n: Number, NA: Not applicable

Awakening and recovery times and the ratio of drugs used were similar in both groups. Anaesthesia duration was significantly longer in Group S compared to the other (p=0.027) (Table 3).
During the procedure, heart rate and blood pressure were similar in both groups, and peripheral oxygen saturation was significantly lower in Group P at 15 and 25 minutes (p=0.023; p=0.027, respectively) (Figure 3).
The duration of bronchoscopy was statistically significantly shorter in Group P compared to the other group (p=0.014). While the surgical difficulty scale score was similar in both groups, the surgical comfort scale score was significantly higher in Group P (p=0.017). The sizes of RB used during bronchoscopy, localization and nature of TBFB, and residual TBFB were similar in both groups (Table 4).
Intraoperative complications (movement, bradycardia and desaturation), and postoperative complications were similar in both groups. The number of patients requiring manual ventilation by interrupting the procedure during the bronchoscopy procedure, and the number of patients requiring intubation was similar in both groups (Table 5).

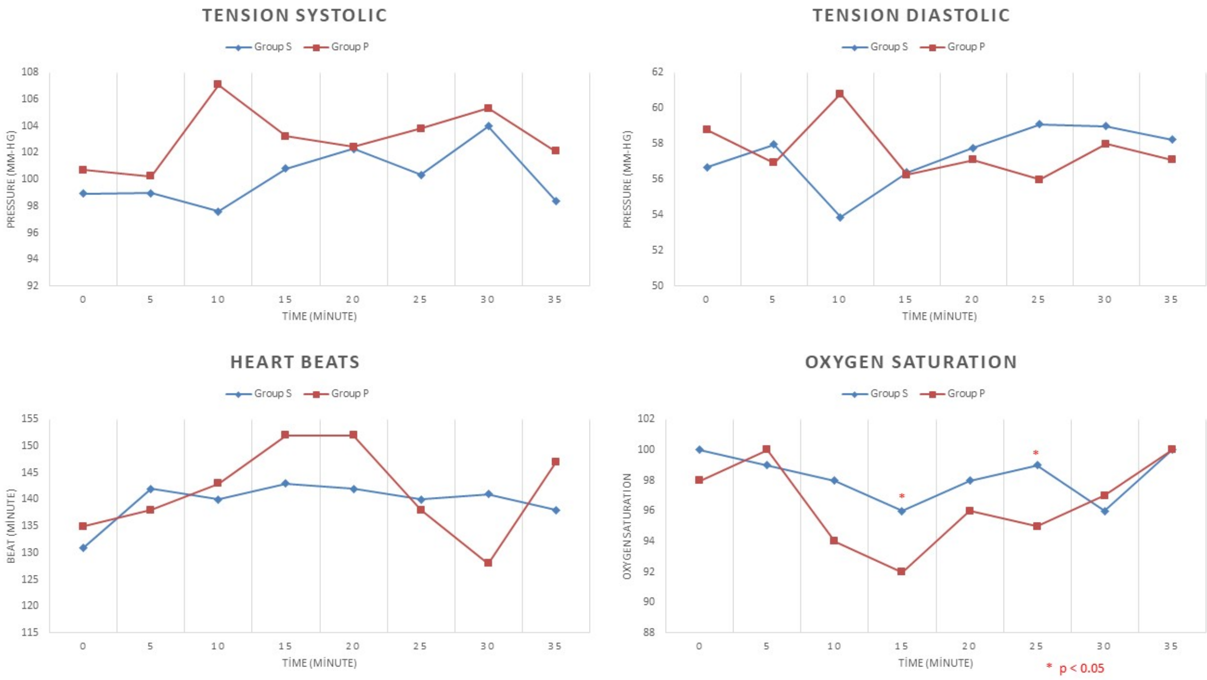

Figure 3. Vital values

Discussion

In our study, we compared two methods (inhalation-intravenous) used in the maintenance of anesthesia in rigid bronchoscopy procedures performed for foreign body aspiration, both in terms of anesthesia and surgery. While doing this, unlike the literature, we used our own scoring systems, except for the epidemiological standardization and routine surgical features.

The results of our study show that similar hemodynamic and respiratory results are obtained with inhalation or intravenous anesthesia maintenance, bronchoscopy time and accordingly anesthesia duration are longer with sevoflurane and this is not reflected in recovery and recovery times, awakening and recovery times are similar, intraoperative and postoperative complications are similar, intravenous anesthesia showed that higher surgical satisfaction scores were obtained with its maintenance.

The goals of anesthesia management during TBFB removal are adequate oxygenation and ventilation, adequate depth of anesthesia with minimal airway secretions, stable hemodynamics, controlled cardiorespiratory reflexes during bronchoscopy, rapid return of upper airway reflexes, and prevention of pulmonary aspiration.[8] Anesthesia management is difficult for the anesthesiologist because the airway is shared with the surgeon and general anesthesia is administered without tracheal intubation and the depth of anesthesia is tried to be maintained.[9]

Anesthesia technique and ventilation method (spontaneous or controlled) should provide the least risk of mortality and complications for the patient.[10] There is no clear consensus on which of these methods is ideal.[7,11]

Factors such as the characteristics of the working institution, the experience of the anesthesiologist, the localization of the foreign body, the nature of the foreign body, the level of obstruction in the airway, and the medical condition of the patient are effective in anesthesia management.[6,12]

General anaesthesia maintained is performed by intravenöz or inhalation anaesthetics with spontaneous breathing or controlled breathing. Sevoflurane is preferred because of its rapid induction and less respiratory tract irritation in inhalation anaesthesia.[6,11] In some studies, it has been reported that the induction time with propofol and sevoflurane is similar[13,14] and in some studies, the induction time with sevoflurane is shorter.[15] In the induction phase, we prefer spontaneous breathing continues until ventilation is assured, and if there is no contraindication we prefer sevoflurane inhalation with 100% oxygen in because there is no irritant effect on the respiratory tract.

There is no definite consensus in the literature regarding the administration of premedication to patients who undergo RB due to TBFBA. Because of the sedative and respiratory depressant effects of midazolam, its routine use in TBFBA removing operations is not recommended, as it may worsen existing respiratory distress.[6] In our clinic, premedication with midazolam is not routinely applied to patients who apply with the suspicion of TBFBA before RB, and the decision is made according to the clinical condition of the patient and the preference of the anesthesiologist. It has been reported that atropine may be beneficial in reducing airway secretions, preventing vagal-induced bradycardia, and alleviating cholinergic-mediated bronchoconstriction during airway manipulation.[6] Corticosteroid use is recommended before and during bronchoscopy due to its reducing effect on airway inflammation and subglottic oedema.[16,17] While some authors have recommended the prophylactic use of dexamethasone, others have suggested its intraoperative administration.[6,18] Li et al.[19] administered methylprednisolone prophylactically before induction. Apa et al.[20] was started the steroid treatment before bronchoscopy and continued for 24 hours postoperatively. Zhang et al.[18] suggested intraoperative methylprednisolone or dexamethasone use. As can be seen, there is no consensus in the literature about which corticosteroid should be administered and for how long. In our clinic, we use dexamethasone (maximum 8 mg) in prolonged bronchoscopy (>30 min.), in case of recurrence of more than 3 intubations with bronchoscope in the intraoperative period, and methylprednisolone prophylactically in cases of chronic TBFBA. We prefer atropine in cases with intraoperative bradycardia or hypersecretion.

Although inhalation anaesthetics are widely used in the maintenance of anaesthesia in pediatric patients, the infusion of intravenous anaesthetics has also started to gain popularity recently. For this purpose, propofol is used alone or in combination with other drugs in the short-term procedures of pediatric patients.[21]

When the effects of sevoflurane and propofol are compared on the cardiovascular system and hemodynamics during anaesthesia there are some studies reporting more stability is achieved with sevoflurane[14,] on the contrary with propofol better hemodynamics was obtained,[22] or similar hemodynamic effects.[23,24] Hemodynamic side effects may also be related to the drugs used together. For example, providing more stable hemodynamics of sevoflurane was attributed to the synergistic effect of remifentanil given with propofol.[14, 25]

Different results were also obtained when propofol and sevoflurane were compared in terms of their relationship to respiratory parameters. While respiratory parameters were stable with sevoflurane in the study of Liao et al.[14], lower oxygen saturation values were found with Sevoflurane in the study of Maleki et al.[23], but respiratory complications were found to be similar.[14,22] In our study, similar hemodynamic and respiratory changes were detected with sevoflurane and propofol in addition to remifentanil infusion. The number of desaturated patients during the procedures was similar. Although the oxygen saturation at the 15th and 25th minutes were statistically significantly lower in the propofol group, we did not consider it clinically significant since it was within the reference range.

Possible gas leaks from the bronchoscope during the procedure require high gas flows to maintain the depth of anaesthesia, and this condition can pollute the atmosphere of the operating room.[14,26] Important advantages of propofol are that it is not cumulative when used for a relatively short period of time, and during the removal of the FB period that is the ventilation system is on, surgeon don't be exposed to anaesthetic vapours.[27] Propofol-based total intravenous maintenance with remifentanil, a super-short-acting opioid, is a suitable method for pediatric patients and has been shown to provide a stable level of anaesthesia.[24,25]

Complications such as laryngospasm, apnea and SpO2 reduction are frequently seen during TBFB removal.[28-30] Regardless of the ventilation method, the most frequently reported complications during the procedure are hypoxia and arrhythmia.[11] In our study, the most common intraoperative complication was desaturation with a rate of 33.3%. In our clinical observations, it was seen that patients were mostly desaturated during the removal of distal foreign bodies, desaturation occurred especially during the advancement of the RB from the main bronchus to the distal. When the relationship between intraoperative complications and anaesthetic methods is investigated, the results also differ. In one study, less cough was detected in the use of sevoflurane during bronchoscopy than in the use of propofol, and this was explained by the myorelaxant effect of sevoflurane.[24] In another study, it was reported that remifentanil together with propofol may be preferred to sevoflurane because it causes less cough and recovery agitation.[22] Farrell et al.[12] reported that the chosen anaesthetic method may be inhalation or IV-based, as there is no evidence of the superiority of one approach over the other. In our study, the rate of movement, bradycardia and desaturation, which we defined as intraoperative complications, were similar with both inhalation and intravenous methods.

Since the surgeon is directly involved in ventilation during RB, it also affects the anaesthesia management of the patient.[24] In this process, the surgeon has to be manoeuvred the foreign body without disturbing the ventilation, and the anaesthetist has to provide sufficient depth of anaesthesia.[7] Apneic oxygenation applied during the procedure makes facilitates manoeuvres, especially to distal foreign bodies.[13] For these reasons, communication between the surgeon and anesthetist is important during ventilation management.[29] The selection of the ventilation method to be applied by the anesthesiologist during rigid bronchoscopy is important because it can become a difficult situation to provide ventilation and necessary oxygenation in the pediatric age group.[31]

There are studies advocating different views on the ventilation method to be applied. The use of muscle relaxants may vary according to the localization of TBFB, and spontaneous respiration is generally preferred in proximal FBs.[32,33] The reason for this is that it allows ventilation to continue while trying to remove the FB and prevents the foreign body from causing obstruction by moving in the bronchial tree with positive pressure ventilation.[34,35] The disadvantages of the spontaneous breathing technique are the difficult prevention of cough, and patient movement.[6,27] The advantage of controlled ventilation is that it provides better oxygenation and ventilation and prevents movements that may cause complications such as coughing and moving of the patient during airway manipulation. The disadvantage is that despite preoxygenation, rapid desaturation develops and the foreign body may move distally and cause obstruction due to positive pressure.[6] On the other hand, there are also studies reporting that there is no adverse effect with positive pressure-controlled ventilation.[36,37] The use of muscle relaxants can provide an even and adequate depth of anaesthesia for rigid bronchoscopy and reduce the anaesthetic effects on cardiac output.[36,37] Except for patients with proximal TBFB which is located proximally or has almost completely closed the trachea where we cannot be sure that we will be able to adequately ventilate with positive pressure ventilation according to TBFB localization, the thoracic anesthesiologists we work with prefer rocuronium bromide because which is more hemodynamically stable as controlled ventilation and muscle relaxant.[38]

After TBFB is removed, If the general condition of the patient is not bad before bronchoscopy airway edema has not developed and pulmonary gas exchange is not impaired, the patient is awakened by applying mask ventilation until adequate spontaneous ventilation is achieved, in some cases positive pressure ventilation may be required by intubating.[39] One of the common complications after the procedure is laryngospasm, its incidence has been reported to be 8% to 21.5% in the literatüre,[3,11,36] and it was seen in 19.1% of patients in our study. There is no significant difference between the two maintenance methods in terms of the distribution of complications. One study reported that complications were not directly related to the anesthetic agent but to the duration of bronchoscopy.[40] In our study, although the duration of bronchoscopy was longer in maintenance with sevoflurane, complications were similar to maintenance with propofol. Recovery time has been defined as one of the risk factors associated with intraoperative or postoperative hypoxemia in the RB procedure.[41] Maleki et al.[23] found a shorter recovery time in maintenance with propofol and Liao et al.[14] found a shorter recovery time in maintenance with sevoflurane, and no statistically significant difference was found in either study in terms of complications. There are also studies reporting that recovery times are similar.[42,43] Recovery times and complications were similar both methods in our study.

The most important effect of the anesthesia method used on the surgery is the movement of the foreign body, affecting the surgeon's angle of view, comfort, and difficulty of the procedure, and consequently affecting the performance of the procedure. Leaks around the bronchoscope in inhalation anesthesia can cause the desired depth of anesthesia to not be achieved and pollute the room air.[6,7,13] This may cause a decrease in the comfort of the surgeon.[44] The decrease in the comfort of the surgeon may lead to prolongation of the procedure time and an increase in the risk of complications. In his article on which he shared his personal experiences, Bould stated that in the sharing airline procedures they preferred to use intravenous agents in order to partially avoid the airline partnership and not be affected by the gas pollution of the operation team.[45] Although the surgical difficulty scale which includes bronchoscope size, localization of TBFB and features of TBFB in our study was similar in both groups, the surgeon comfort scale score was found to be lower with sevoflurane. The reason for this is the disturbing effect of sevoflurane gas coming directly from RB during bronchoscopy and the effects of spreading this gas into the room air. The long duration of anesthesia with sevoflurane maintenance can be explained by the fact that the surgeon interrupts the procedure for short periods due to the effect of the gas. Prolonging the duration of anesthesia and bronchoscopy with the maintenance of sevoflurane is important in terms of increasing the cost, although it does not affect the recovery and recovery times of complications. No study has been found in the literature reporting results with surgical comfort scales, which include a large number of parameters, as in our study. This scale consisted of parameters that could negatively affect the process of the procedure by disturbing the comfort of the surgeon during the procedure, affecting the quality of life after the procedure, and causing dissatisfaction with the procedure. In the study of Zhang et al.,[24] it was observed that they used a limited surgical satisfaction score, and no significant difference was found in the comparison made in terms of inhalation-intravenous anesthesia.

For stable patients, some authors recommend that the procedure be performed in daytime conditions, by experienced teams, and under optimum conditions.[29,45] However, it is reported that in this case, the complications of the procedure are also no different from the complications in the acute intervention period.[29] In our study, the procedure was performed at any time of the day, taking into account the fasting period, and our complication rates were consistent with the literature. For this reason, it was thought that the procedures to be done with an experienced team could be done at any time of the day.

The limitations of our study are its retrospective nature, not controlling the depth of anesthesia with BIS and the number of patients was partially limited. The fact that the surgical comfort scale and difficulty scale used in standardization between groups are partially subjective can be considered as another shortcoming.

In general anaesthesia maintained with sevoflurane inhalation or propofol infusion for removal of TBFB by RB in pediatric patients, it was detected that similar effects on complications, hemodynamics, respiratory parameters, awakening and recovery times. Anaesthesia maintenance with sevoflurane prolongs the duration of bronchoscopy and accordingly the duration of anaesthesia, and also reduces surgical satisfaction independent of processing time. For these reasons, we think that while RB is performed for the removal of childhood FBA, propofol can be preferred for anaesthesia maintenance, resulting in a shorter procedure time and higher surgical satisfaction.

Table 3. Features Based on Anesthesia Applications

	Total (n=68)	Group S (n=34)	Group P (n=34)	p
Anesthesia Time (minute), mean±SD	19.59±16.92	22.94±18.83	16.24±14.27	**0.027**[a]
Awakening Time (minute), mean±SD	12.67±13.54	9.07±5.82	16.27±17.65	0.417[a]
Recovery Time (minute), mean±SD	18.21±7.74	19.32±10.03	17.09±4.29	0.265[a]
Medicines, n (%)				
Methylprednisolone	48 (70.6)	24 (70.6)	24 (70.6)	1.00[b]
Midazolam	30 (44.1)	21 (61.8)	17 (50)	0.464[b]
Sugammadex	61 (89.7)	28 (82.4)	33 (97.1)	0.105[b]
Atropine	20 (29.4)	12 (35.3)	8 (23.5)	0.864[b]

[a]Mann-Whitney U Test, [b]Chi-Square Test, n: Number, SD: Standard Deviation

Table 4. Features Based on Surgical Applications

	Total (n=68)	Group S (n=34)	Group P (n=34)	p
Bronchoscopy Time (minute), mean±SD	15.34±16.02	18.00±17.23	12.68±14.48	**0.014**[a]
Bronchoscope Size, n (%)				0.314[b]
3.5	33 (48.5)	17 (50)	16 (47.1)	
3.7	17 (25)	6 (17.6)	11 (32.4)	
4	13 (19.1)	9 (26.5)	4 (11.8)	
5	5 (7.4)	2 (5.9)	3 (8.8)	
Surgical Difficulty Scale, n (%)				0.679[b]
Easy	29 (42.6)	13 (38.2)	16 (47.1)	
Medium	20 (29.4)	10 (29.4)	10 (29.4)	
Difficult	19 (27.9)	11 (32.4)	8 (23.5)	
Surgical Comfort Scale Score, n (%)				NA
1	7 (10.3)	4 (11.8)	3 (8.8)	
2	2 (2.9)			
4			2 (5.9)	
6	2 (2.9)	1 (2.9)	1 (2.9)	
7	7 (10.3)	7 (20.6)		
8	19 (27.9)	11 (32.4)	8 (23.5)	
9	31 (45.6)	11 (32.4)	20 (64.5)	
Foreign Body Localizations, n (%)				0.096[b]
Absent	19 (27.9)	7 (20.6)	12 (35.3)	
Trachea	2 (2.9)		2 (5.9)	
Right Main Bronchus	19 (27.9)	10 (29.4)	9 (26.5)	
Right Intermediate Bronch	4 (5.9)	2 (5.9)	2 (5.9)	
Right Lower Lobe Bronchus	7 (10.3)	4 (11.8)	3 (8.8)	
Left Main Bronchus	11 (16.2)	9 (26.5)	2 (5.9)	
Left Lower Bronchus	6 (8.8)	2 (5.9)	4 (11.8)	
Nature of Foreign Body, n (%)				0.461[b]
Hazelnut	14 (28.7)	6 (17.6)	8 (23.5)	
Peanut	11 (22.45)	6 (17.6)	5 (14.7)	
Walnut	13 (26.53)	9 (26.5)	4 (11.8)	
Other	11 (22.45)	6 (17.6)	5 (14.7)	
Total Inability to Remove (Residue), n (%)	5 (7.4)	3 (8.8)	2 (5.9)	1.00[b]

[a]Mann-Whitney U Test, [b]Chi-Square Test, n: Number, SD: Standard Deviation, NA: Not applicable

Table 5. Complications and Airway Management

	Total (n=68)	Group S (n=34)	Group P (n=34)	p
Intraoperative Complications, n (%)				
Movement	5 (7.4)	3 (8.8)	2 (5.9)	NA
Bradycardia	2 (2.9)	-	2 (5.9)	NA
Desaturation	23 (33.8)	13 (38.2)	10 (29.4)	0.192[a]
Manual ventilation by stopping the bronchoscopic manipulation, n (%)	31 (45.6)	18 (52.9)	13 (38.2)	0.657[a]
Postoperative Complications, n (%)				0.402[a]
No symptoms	52 (76.5)	28 (82.4)	24 (70.6)	
Broncho or Laryngospasm	13 (19.1)	4 (11.8)	9 (26.5)	
Hypoxemia- Desaturation	3 (4.4)	2 (5.9)	1 (2.9)	
Cough	10 (14.7)	5 (14.7)	5 (14.7)	
Postoperative Ventilation, n (%)				1.00[a]
Face Mask	63 (92.6)	31 (91.2)	32 (94.1)	
Intubation	5 (7.4)	3 (8.8)	2 (5.9)	

[a]Chi-square test, n: Number, NA: Not Applicable

Compliance with Ethical Standards

The study protocol was approved by the Kocaeli University Ethics Committee (Date: 18.3.2021/Number: 2021-69).

Conflict of Interest

The author declares no conflicts of interest.

Author Contribution

All the authors equally contributed to this work.

Financial Disclosure

None

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