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Original Article

Comparison of Total Intravenous Anesthesia (TIVA) with Inhalation Anesthesia in Pediatric Bronchoscopy

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Abstract:

Introduction:
Because of airway stimulations during bronchoscopy and lack of direct access to the airway, preferred method of anesthesia for rigid bronchoscopy is already controversial. In this study we compared inhalation anesthesia with total intravenous anesthesia (TIVA) for rigid bronchoscopy.

Method and Materials:
30 patients aged 2-6 years were chosen divided into two same groups. Anesthesia in group I maintained with halothane and in group II maintained with remifentanil and propofol. Oxygenation, heart rate, respiratory rate, coughing, bucking, laryngospasm, bronchospasm were evaluated during and after surgery. Also operation success and surgeon's satisfaction were recorded as well.

Results:
Demographic findings were the same in both groups. Oxygenation and heart rate were more stable in group II (P=0.047 and P=0.026 respectively) but there was no significant difference in respiratory rate between two groups (P=1). Success rate was also similar in both groups but surgeon's satisfaction was significantly higher in TIVA (P=0.003). There was not any significant different between complications in two groups.

Conclusion:
We suggest TIVA for rigid bronchoscopy because of better oxygenation, more homodynamic stability, surgeon's satisfaction, lack of air pollution and less interference with surgeon's visual field.

Keywords:
Bronchoscopy, Inhalation Anesthesia, Total Intravenous Anesthesia.

Introduction

For the first time, Gustave Kilian used rigid bronchoscopy to extract a foreign body from right main bronchus in 19th century. This was performed on an awake patient without any anesthesia. Then cocaine was used to facilitate this procedure and now GA is commonly used for rigid bronchoscopy.

Indications of rigid bronchoscopy include extraction of foreign bodies, management of massive hemoptysis, management of external pressure on tracheobronchial tree, and treatment of benign tracheal and bronchial strictures by laser (e.g. Post-tracheal stenosis). But extraction of foreign body is the most common indication for rigid bronchoscopy in children (1).

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The main principles for optimal anesthesia for rigid bronchoscopy include: rapid induction, the least homodynamic instability, sufficient ventilation and oxygenation, Suppression of coughing, adequate maxillary and glottis relaxation for rapid placement of rigid bronchoscope and safe reversal with minimal postoperative complications.

Several methods of anesthesia are suggested including (1) IV sedation and use of muscle relaxants and maintenance by inhaling agents (2), induction and maintaining by inhaling agents with preserved spontaneous respirations (3), induction and maintaining by IV drugs with controlled or spontaneous ventilation (2-7) and pure intravenous method with jet ventilation (4).

When complete tracheal obstruction is probable and patient might not tolerate supine position, for example in giant parathyroid or para-tracheal tumors or foreign bodies that causes complete airway obstruction, it is better to use inhalation anesthesia with spontaneous ventilation to perform bronchoscopy (5) but now TIVA (total intravenous anesthesia) is the most common method for rigid bronchoscopy (2,5).

According to serious cardiovascular challenges during rigid bronchoscopy and probability of hyperventilation and hypoxia, light or deep anesthesia with halothane may cause arrhythmia so it's better not to use halothane (5,7) and because of prolonged apnea periods, it's better not to use N_2O too. Severe tracheal injury may occur because of bucking in rigid bronchoscopy so we should use muscle relaxants for adequate relaxation and controlled ventilation.

The other major problem is leak of inhaling anesthetic agents through eye piece of bronchoscope during extraction of foreign body .so according to inhibit environmental pollution, anesthetist would prefer total IV anesthesia. Since each of these two methods has advantages and disadvantages, in this paper we compare them for complications, the success and surgeon's satisfaction.

Materials and Methods

After Deputy of Research and Ethical committee approval, thirty patients 2 – 6 years old in ASA class I (American Society of Anesthesiologists) were included in this randomized study. They divided into two groups, inhalation anesthesia conducted on group I (n=15) and total IV method was used in group II (n=15).

Vital signs, indication of bronchoscopy and pulmonary symptoms before intervention were recorded and pulse-oximeter and monitoring was connected. Preoxygenation was done for 3 minutes in all cases. Induction by Fentanyl (2μg/kg) and Thiopental (3-5 mg/kg) and Succinylcholine (1-2 mg/kg) was done in group I. The patients received 1-2% halothane to maintain anesthesia after insertion of bronchoscope by Ear-Nose-Throat specialist. Succinylcholine was repeated if needed.

In group II Remifentanil (1 μg/kg), Propofol (2 mg/kg) and Succinylcholine (1-2 mg/kg) were used for induction and anesthesia was maintained by Remifentanil (0.2-0.3μg/kg) and propofol (50-100 μg/kg/min). Atracurium was used (0.3 mg/kg bolus) for prolonged operations.

Heart rate, respiratory rate and arterial oxygen saturation were controlled after induction and also 5, 10, 20 ,30 minutes after start of bronchoscopy and also in recovery room and at the time of entrance to the ward. Spo_2 more than 95%, $85<Spo_2<95$ and $Spo_2<85$ prolonged for at least thirty seconds considered normal, mild and severe hypoxia, respectively.

Intra and postoperative complications such as coughing, bucking, laryngospasm, bronchospasm, pneumothorax, cyanosis,

bradycardia and breath holding were recorded. Bronchoscopy success and surgeon satisfaction that was related to adequate muscular relaxation assessed at the end of the operation. The data was analyzed by chi-square, Fisher exact test and student T-test. P-value less than 0.05 considered significant.

Results

There wasn't any significant difference in age, weight and gender distribution between two groups (Table 1). The most common indication for bronchoscopy was foreign body (70%) (Table 2) and the most common pulmonary sign before operation was expiratory wheezing (21%) (Table 3).

Table1: Demographic data of the patients in both groups.

Variable	Inhalation Anesthesia	Totally intravenous Anesthesia	P-value
Age (y)	3.8±21.1	2.9±1.3	0.77
Weight (Kg)	12.2±0.9	11.1±2.6	0.93
Sex (M/F)	9/6	10/5	0.84

Table2: The causes of the bronchoscopy in both groups N (%).

Cause of bronchoscopy	Frequency
Foreign body	21(70)
Respiratory distress	4(13.3)
Tracheal stenosis	4(13.3)
Laryngeal injury	1(3.3)

Table3: The symptoms of the patients prior to the operation N (%).

Pulmonary symptoms before surgery	Frequency
Expiratory wheezing	10(33.3)
Respiratory distress	6(20.0)
Chronic coughing	5 (16.7)
Inspiration stridor	3 (10.0)
Others	6 (20.0)

Mean arterial O_2 saturations (SpO_2) in both groups are shown in figure 1. Variation of SpO_2 from normal base was more significant in group I. This difference was especially more significant in 5, 10 and 30 minutes after induction and mild to moderate hypoxia was reported. Spo_2 changes in group II was in normal range. Mean Spo_2 differences in 5, 10 and 30 minutes after induction were statistically different in two groups (P=0.005, P=0.033 and P=0.047, respectively).

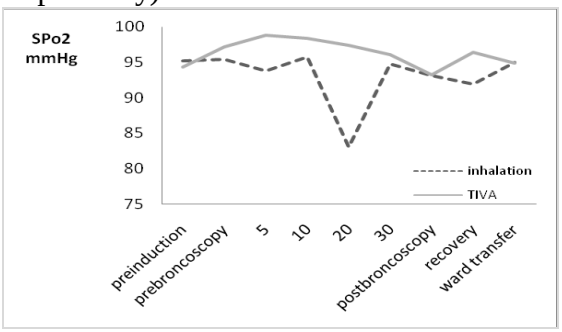

Fig 1: Peripheral O2 saturation changes during bronchoscopy (Mean)

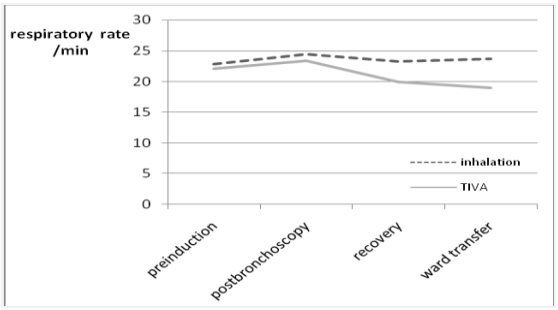

Fig2: Respiratory rate changes during bronchoscopy (Mean).

Among 15 cases in group I, hypoxia wasn't seen in 6 cases (40 %), 5 cases had mild hypoxia (33.3%) and 4 cases had severe hypoxia (26.6%) and among 15 cases in group II, hypoxia wasn't seen in 13 cases (86.6%) and only two patient had mild hypoxia (13.3%). There was not any statistically significant difference in Spo_2 between two groups after bronchoscopy and in recovery and the time of entrance to ward.

Respiratory rate was almost the same in both groups before and after bronchoscopy (P=1) and in recovery also there wasn't any significant difference (P=0.064).

Heart rate was increased after induction in group I and it reached to maximum after 20 minutes. HR was decreased after induction and in recovery in group II (fig. 3) that it was significantly different between two groups (P-value was 0.027,

0.045 and 0.026 in 5, 10 and 20 minutes after induction, respectively).

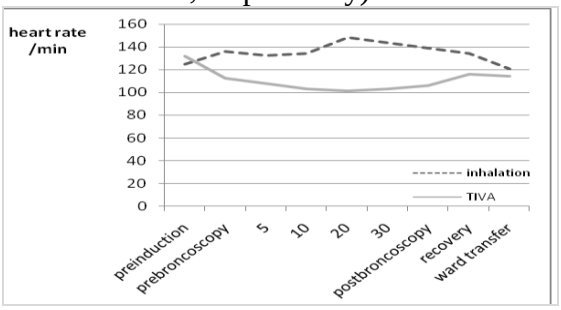

Fig 3: Heart rate changes during broncho-scopy (Mean)

The complications were compared on table 4 and there are no significant differences. Outcome of the bronchoscopies were good in 10 cases (66.6%) of group I and in 8 cases (53.3%) of group II and totally, there wasn't significant difference between success rate in two groups (P=0.637).

Surgeon satisfaction was significantly higher in the group II and poor satisfaction wasn't reported in this group (Table 5).

Table4: The frequencies of the post-intubation complications. N (%).

Complications	Coughing	Bucking	Laryngospasm	Bronchospasm	Muscular rigidity
inhalation anesthesia	5 (33.3)	7 (46.7)	3 (20)	1 (6.7)	1 (6.7)
Total intravenous anesthesia	4 (26.7)	1 (6.7)	1 (6.7)	0 (0.0)	3 (20)
P value	P= 1	P= 0.74	P= 0.267	P= 0.78	P= 0.856

Table 5: The rates of success of the operation and surgeons' satisfaction rate. N (%)

	Group	Good	Moderate	Poor	P value
Bronchoscopy success	I	10 (66.7)	2 (13.3)	3 (20)	P=0.637
	II	8 (55.3)	4 (26.7)	3 (20)	
Surgeons' satisfaction	I	4 (26.7)	5 (33.3)	6 (60)	P=0.003
	II	11 (77.3)	4 (26.7)	0 (0)	

Discussion

During rigid bronchoscopy the field of operation is out of reach of anesthetist while airway is manipulating during these operations, so a safe anesthesia method to maintain good oxygenation and stable homodynamic, with the least complications, is challenging for anesthetists.

Perrin et al (5) suggested IV anesthesia with propofol and Spontaneous assisted ventilation. They recommended muscular relaxation may be dangerous because of near complete tracheal stenosis and lack of tolerance supine position in giant paratracheal or mediastinal tumors in these patients.

Natalini et al (4) compared the effectiveness of two modalities of external ventilation during rigid bronchoscopy: intermittent negative pressure ventilation (INPV) and external high-frequency oscillation (EHFO). As compared to SAV, INPV in patients during rigid bronchoscopy reduces need to administration of opioids, shortens recovery time, prevents respiratory acidosis, excludes the need for manually assisted ventilation and affords optimal surgical conditions.

Hanowell et al (8) used controlled ventilation and muscle relaxants. Hypoxia was seen in 20%, re-intubation in 21%, need for extubation in recovery or ICU because of prolonged relaxation was reported in 47% of these patients.

Taha et al conducted a study in 2005 to compare intubating conditions and cardiovascular changes following induction of anesthesia and tracheal intubation in patients receiving either lidocaine-remifentanil-propofol (group P) or lidocaine-remifentanil-thiopental (group T) prior to induction. They concluded that Lidocaine-remifentanil-propofol is superior to lidocaine-remifentanil-thiopental for tracheal

intubation without muscle relaxants. However, it induces more hypotension and bradycardia. While in our study, comparing HR in two groups, we saw higher rate of tachycardia in group I, especially 5 and 20 minutes after induction and at the end of bronchoscopy. But there was not any significant difference in recovery room and transferred to ward. Three cases of bradycardia were reported in total intravenous method that was controlled by decreasing infusion rate of Remifentanil. Bucking, coughing and laryngospasm were the most common complications in the first group against muscular rigidity and coughing which were the most common complications in the second group.

Perin et al suggested light anesthesia and surgical technique as common causes of coughing, that is manageable by lidocaine and avoiding physical stimulations during surgery, they also reported that bucking should be prevented by increasing the depth of anesthesia to avoid painful stimulations during motion of rigid bronchoscope in tracheobronchial tree (1).

We didn't use lidocaine in our study and might be inadequate depth of anesthesia in group I was the reason for higher incidence of bucking in this group and also Remifentanil might be the cause of muscular rigidity in group II, although, the frequency of complications wasn't statistically different between two groups. Another complication during anesthesia with inhaling agents is environmental pollution and interference with surgeon's sight during rigid bronchoscopy because of evaporation of the substance and threat of eye piece contamination (9).

We observed less success of bronchoscopy in inhalation anesthesia method because of interference with surgeon's sight, but there wasn't any significant difference in final outcomes of the bronchoscopy between two groups in our study. But according to several factors such as better visual filed, muscular relaxation and lack of unpleasant odor, the surgeon satisfaction rate was significantly high in group II comparing to the other one.

Conclusion

Better oxygenation and more homodynamic stability were reported in total IV method and Bucking and Laryngospasm were less common in this group. As air scavenging systems were not accessible in most of operation rooms in our country and for higher satisfaction of surgeons, we insisted on total intravenous anesthesia for rigid bronchoscopy.

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