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Comparison of Inhaled Anesthesia with Sevoflurane and Intravenous Anesthetics with Propofol in Children under Flexible Bronchoscopy

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Abstract: *Objective: Bronchoscopy is a diagnostic procedure. Due to lack of cooperation of children, pediatric bronchoscopy is necessarily accompanied by anesthesia. The most prevailing method of anesthesia in children is inhaled anesthesia, but since duration of anesthesia is long and there is involuntary respiration in this method, the amount of dispersed gas is high. The objective of this review is comparing inhaled anesthesia with sevoflurane and intravenous anesthetics with propofol in children under flexible bronchoscopy, in order to do a more appropriate and safe bronchoscopy and also to improve recovery after general anesthesia in children.*

Methodology: 80 children under the age of 10 who were going under flexible bronchoscopy, were randomly divided into two groups of 40 individuals. For anesthesia of one group inhaled sevoflurane was given, and for the second group intravenous propofol was given; then in both groups changes in blood pressure, heart rate, O2 saturation t, and recovery time were recorded and compared.

Findings: There is no significant difference in three times measurement of both anesthetics. In other words the average blood pressure shows no difference after anesthesia, start of bronchoscopy, and end of bronchoscopy in both anesthetics (P-value=0.771). Moreover, no significant difference was observed in three times measurement of both anesthetics. This means that the average heart rate shows no difference after anesthesia, start of bronchoscopy, and end of bronchoscopy in both anesthetics. Furthermore, the average o2sat is different after anesthesia, start of bronchoscopy, and end of bronchoscopy in both anesthetics (P-value>0.001).

Keywords: *bronchoscopy; sevoflurane; propofol.*

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Introduction

The term anesthesia was first proposed by Oliver Wendell Holmes (Haridas, 2016) on the basis of its Greek root meaning "no sense" to William Morton in 1846 (Morton, 1846). Even in deep anesthesia some basic senses continue to exist, so it is more appropriate to assume anesthesia as a stationary state without any kind of perception. As an easy definition, anesthesia is losing sense of pain or perception during a surgery. Anesthesia is classified into local, regional or general forms, and may vary depending on type of surgery and health conditions of the specific person (Bakan et al., 2014)

Types of anesthesia and their level of effect differ. Regional anesthesia creates analgesia effect, while anesthesia with Benzodiazepines creates sedative effects. General anesthesia may produce all effects of analgesia, sedation, and forgetfulness; its ultimate goal is to attain conditions in which surgical procedure is done in the best possible way with minimum risk. This goal is achieved through various but connected functions of medicines on nervous system of patient. For instance, the drowsiness impact of medication is created by affecting the central nervous system cells and activating state of sleep for the patient (Chen et al., 2016; Damian et al., 2019).

Injectable anesthetics are medicines injected to body through intravenous. Propofol is one of the most important of these medications. Propofol has no analgesic effect, it reduces blood flow of the brain, brain pressure and pressure of the eye. It also lowers blood pressure by dilating the arteries. Quick infusion of propofol causes apnea in patients (Dewhirst et al., 2013). It spreads in body rapidly and enters the Central Nervous System (CNS) as well. Its quick exit from CNS is a reason of its short-time effect. It is also metabolized in liver speedily (Hofmeister & Pille, 1977).

Inhaled anesthetics are chemical compounds having anesthesia properties and patient becomes unconscious by inhaling them. Sevoflurane is one of the important medications of this group. This medication quickly enters blood through lungs and leaves blood with the same speed, therefore has a rapid anesthesia and anesthesia return. Minimum alveolar concentration (MAC) is 4.1% in elderly and 3.3% in children (Larsen et al., 2012).

Various studies are conducted in this field. For example, Chen et al. (2016) performed a research to determine effects of propofol and sevoflurane on cytokine levels in children with acquired pneumonia from a population under flexible fibrotic bronchoscopy. Results showed that in

children with acquired pneumonia from that population, the use of sevoflurane was dependent on low levels of interleukin 6 and 15 versus propofol. The intensity of pneumonia was reflected with higher levels of blood cytokine (Chen et al., 2016). Also, Rivenes et al. (2001) found out that halothane causes a significant reduction in the average pressure of ejection fraction and the heart index. Moreover, in a study done by Larsen et al. (2012) it became evident that Sevoflurane reduces regional area of infarction and improves hemodynamics in patients. Findings of a research conducted by Hasani et al. (2011) (Hasani et al., 2013) indicated that compared with propofol, sevoflurane could have similar and safe effects in non-relaxant intubation in children undergoing surgery (Moshiri et al., 2013).

Bronchoscopy is a diagnostic procedure and general anesthesia is required for doing it. Currently, flexible bronchoscopy is used for diagnosis of many lung diseases, in children due to the lack of child cooperation, bronchoscopy is inevitably done with anesthesia. Various anesthesia methods are used for this group of patients, the most prevalent of which is inhaled anesthesia. But since duration of anesthesia is longer in this method and there is involuntary respiration, the amount of dispersed gas is high. Intravenous methods are used as well. Propofol due to its short-acting effect can be helpful in such cases. Controlling duration of anesthesia as well as short-time effect of medication is amongst necessities of this method. To achieve this, the present study was performed with the objective of comparing inhaled anesthesia with sevoflurane and intravenous anesthesia with propofol in terms of hemodynamic and induction and preservative effects, and improvement features in children under flexible bronchoscopy in a pediatric medical hospital.

Materials and Methods

This study is a clinical trial and interventional, which was conducted on children with flexible bronchoscopy in a pediatric medical hospital. Research participants included 80 children with the age range of below 10 years old, and with physical condition of ASAI, II who participated in the research by having informed consent and observing all ethical issues, then based on random numbers table they were divided into two groups. During this study, these children were undergoing bronchoscopy to remove external objects from their tracheobronchial tree. They were randomly divided into two groups of A and B. Group A with n=40 included children who received 8% of sevoflurane for anesthesia and anesthesia continued the same. Group B with n=40 included children who received 2 mg/kg propofol for

anesthesia, and it continued with 200-300 mic/kg/min. The age, sex, weight and patients profiles as well as the details of their physical inspection along with findings of chest X-ray, were recorded in information collection forum.

Method of Research

After having access to the peripheral vein, all patients received 0.01 mg / kg atropine and 0.1 mg / kg dexamethasone and fentanyl 1 mic/kig. In group A. Drager Fabius Plus anesthesia machine equipped with sevoflurane was used for patients. Anesthesia induction was done by MAPELSON F system and face mask with inhalation of 100% oxygen and sevoflurane during involuntary breathing, and concentration of anesthetics was increased gradually in every 3 to 5 inhalation for sevoflurane at 2-4-6-8% concentration, respectively. In group B, anesthesia induction was done by propofol infusion at a dose of 2.5 mg/kg, and anesthesia continued with propofol infusion 25-100 mic/kg/min. To reduce pain in the injection area, propofol was diluted with lidocaine 2% with ration of 1: 1.

Before bronchoscopy, in all patients, lidocaine 2% with a maximum dose of 5 mg / kg was sprayed on the epiglottis and larynx and between the vocal cords and the upper part of trachea. The depths of anesthesia and bronchoscopy conditions were evaluated by clinical hemodynamic parameters including blood pressure, heart rate, cough, pushing and movement. When the procedure ended, inhaled medicines were stopped and bronchoscope was removed through airway. During involuntary breathing, children received %100 oxygen through Mask. The time interval between cutting the anesthetics medicines and opening the eyes or responding to non-painful stimuli was recorded. Any unfavorable effects such as Cough, laryngeal or bronchial spasm, shortness of breath or apnea were recorded. Postoperative croup and oedema of the upper respiratory system, if observed, were treated by inhalation of epinephrine and wet oxygen.

Criteria to participate in research include: being fast, patients must be connected to ECG and blood pressure measurement devices before anesthesia induction, aximetry pulse, recording heart, BP and arterial oxygen level in every 5 minutes, consent of patient to take part in the research, having no specific disease, and being conscience before surgery. Criteria to leave research include: lack of patient's consent, abnormal response to anesthetic medicines of study, patients with serious cardiovascular, liver, kidney and muscular diseases, children with a history of increased respiratory sensitivity and irritable airways and history of airway disease, and patients having cold and children with history of respiratory response to anesthetics.

Data Analysis Method

The collected data were recorded in SPSS data bank, and then analyzed on the basis of research objectives. Quantitative data were explained as mean, standard deviation, and qualitative variables as frequency or relative frequency. In order to analyze variables in groups in regard of quantitative data, repeated measures and independent sample t-test were used. P-value under 0.05 was considered as significant.

Ethical Observations

According to the principles of the Declaration of Helsinki, data were recorded confidentially and required explanations were given to the parents of patients. Besides that, all information of patients is secret and will not be available to any legal or natural person. Research conditions are explained to research participants and their parents and informed consent is taken from them. Moreover, before implementation of the study, coordination with the authorities of the surgery department and surgery room was done. No extra charge will be imposed on patients.

Research Findings

In table 1 a comparison of blood pressure mean in three times of measurement in the two kinds of anesthetics is represented. There is no significant difference between three times of measurement in the two kinds of anesthetics. In other words, blood pressure mean shows no difference after anesthesia, in the beginning of bronchoscopy and in the end of bronchoscopy (P-value=0.771) (figure 1).

Table 1. A comparison of Blood Pressure Mean in Three Times of Measurement in the Two Kinds of Anesthetics

	Anesthetics	Mean	Std. Deviation	N
Blood pressure mean after anesthesia	sevoflurane	75.7750	7.67405	40
	propofol	77.3000	6.20164	40
	Total	76.5375	6.97484	80
Blood pressure mean in the beginning of bronchoscopy	sevoflurane	77.1000	6.85553	40
	propofol	76.5333	6.39480	40
	Total	76.8167	6.59325	80
Blood pressure mean in the end of bronchoscopy	sevoflurane	76.0333	7.56013	40
	propofol	77.6667	5.79222	40
	Total	76.8500	6.74196	80

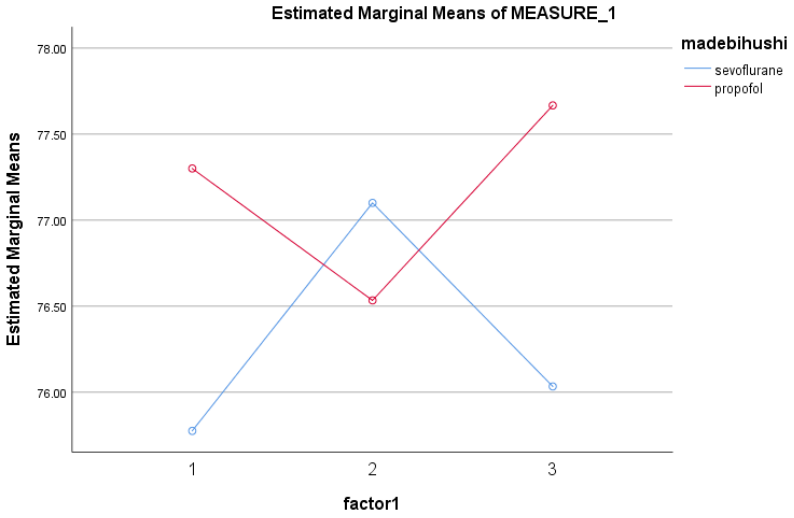

Figure 1. Rate of Changes in Sevoflurane and Propofol

Comparison of PR in three times of measurement in the two kinds of anesthetics in presented in table 2. According to the results of figure 2, there is no significant difference between three times of measurement in the two kinds of anesthetics. In other words, heart rate mean shows no difference after anesthesia, in the beginning of bronchoscopy and in the end of bronchoscopy (P-value=0.214).

Table 2. A Comparison of PR in Three Times of Measurement in the Two Kinds of Anesthetics

	Anesthetics	Mean	Std. Deviation	N
PR after anesthesia	sevoflurane	126.1750	24.29085	40
	propofol	121.3000	21.67854	40
	Total	123.7375	23.00674	80
PR in the beginning of bronchoscopy	sevoflurane	127.8750	26.02187	40
	propofol	123.0000	20.78461	40
	Total	125.4375	23.52798	80
PR in the end of bronchoscopy	sevoflurane	127.3750	24.75489	40
	propofol	123.3000	20.33590	40
	Total	125.3375	22.60276	80

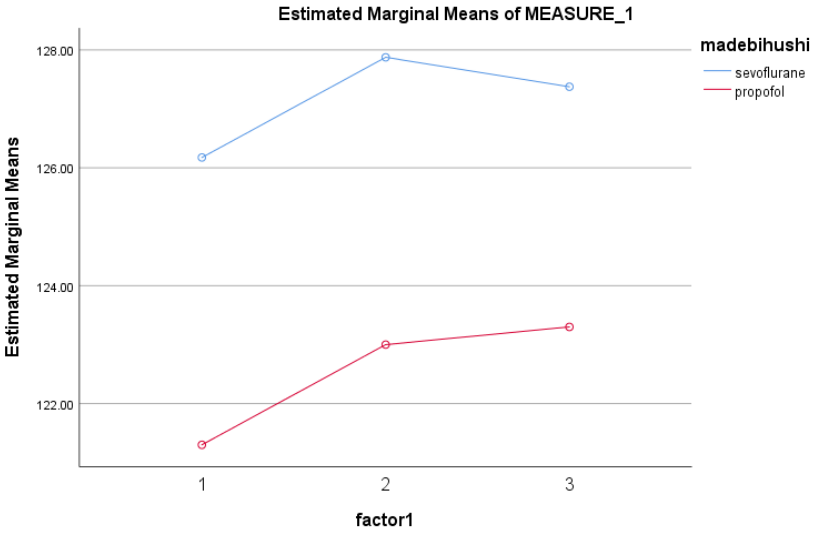

Figure 2. PR Changes of Sevoflurane and Propofol

Comparison of O2SAT in the two kinds of anesthetics in presented in table 3. According to the results of figure 3, there is a significant difference between three times of measurement in the two kinds of anesthetics. In other words, O2SAT mean is different after anesthesia, in the beginning of bronchoscopy and in the end of bronchoscopy in the two kinds of anesthetics (P-value<0.001).

Table 3. A Comparison of O2 SAT in the Two Kinds of Anesthetics

	Anesthetics	Mean	Std. Deviation	N
O2 SAT after anesthesia	sevoflurane	97.5000	4.64648	40
	propofol	97.3000	3.79068	40
	Total	97.4000	4.21450	80
O2 SAT in the beginning of bronchoscopy	sevoflurane	91.2000	7.25435	40
	propofol	97.2000	5.21929	40
	Total	94.2000	6.96719	80
O2 SAT in the end of bronchoscopy	sevoflurane	87.7250	9.68739	40
	propofol	96.8000	5.72534	40
	Total	92.2625	9.13020	80

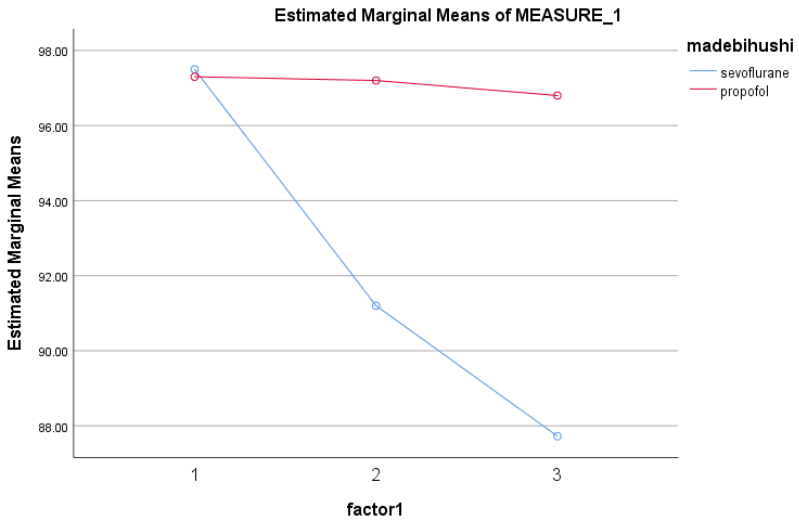

Figure 3. Changes of O2 SAT of Sevoflurane and Propofol

Comparison of age, weight, and recovery time in both groups with independent sample t-test showed that there is no significant difference in the age mean (P-value=0.732) of patients in the two kinds of anesthetics which is indicative of proper homogenization in two groups. There is no significant difference in the weight mean (P-value=0.423) of patients in the two kinds of anesthetics which is indicative of proper homogenization in two groups (table 4). Furthermore, results of table 5 show a significant difference (P-value<0.001) between recovery time in two groups. In other words, recovery time mean is different in two groups. The mean is higher in sevoflurane anesthetics.

Table 4. Difference between Age and Weight in Two Groups of Sevoflurane and Propofol

	Anesthetics	N	Mean	Std. Deviation	Std. Error Mean
age	sevoflurane	40	3.7500	2.80339	.44325
	propofol	40	3.9500	2.39069	.37800
weight	sevoflurane	38	17.9211	7.96744	1.29249
	propofol	40	19.2000	5.83183	.92209

Table 5. Difference in Recovery Time in Two Groups of Sevoflurane and Propofol

	Anesthetics	N	Mean	Std. Deviation	Std. Error Mean
Recovery time (minute)	sevoflurane	40	32.1250	5.45935	.86320
	propofol	40	19.5000	4.77708	.75532

Discussion

Statistically there is no significant difference in demographic variables (age, weight) of two groups, so it seems that homogenization of groups has been appropriate and in this regard there are no confounding factors in this research. As can be seen, systolic and diastolic PR and BP variables were measured in both groups in the beginning, during and the end of surgery. After anesthesia induction, patients of both groups showed a slight increase in heart rate and decrease in blood pressure. But this rate of increase and decrease required no special clinical measurement. At the same time, statistically there is no significant difference in any one of the groups and between the two groups before, during, and after surgery. It seems that cardiovascular stability rate of both kinds of anesthetics is similar and in this regard both can be safe.

There is a significant difference in propofol and sevoflurane groups between in full consciousness time and recovery time. In sevoflurane group, recovery time is nearly doubled. It seems that in terms of recovery time and full consciousness, propofol is preferred and can reduce recovery time of patients. Side effects (sough, apnea, spam) were more in propofol group than sevoflurane group, but they are not statistically significant. By increasing sample size, contradictory results may be obtained, therefore it seems that prescribing these medications does not escalate complications; in this regard if any complication is observed, it is due to the procedure itself and not because of type of anesthesia and anesthetics used. Apparently both medications are suitable for patients with foreign object endoscopy and scientifically both of them are safe.

In a research conducted by Kaynar et al. (2011), diverse effects of propofol and sevoflurane on heart beat rate were observed. While propofol decreased blood pressure and heart beat depending on the depth of hypnosis, sevoflurane showed no prominent effect on hemodynamic indices. Despite the mentioned studies, in this research no significant difference was observed in heart beat rate of patients in two groups. Of course, it must be emphasized that hypnosis level is not measured and investigated in the

present research. There is evidence that indicates some patients develop tachycardia after receiving propofol; but this study showed no difference in heart beat rate of patients. Potocnik et al. (2011), in a study, investigated and compared propofol and sevoflurane impacts on hemodynamic indices of patients under thoracotomy. It was also observed that hemodynamic indices are more stable in the group receiving propofol and patients of this group need less ephedrine (Cai et al., 2013).

In a research Barthi and et al compared effects of sevoflurane and diets having propofol. Their findings indicated that sevoflurane is superior to propofol in maintaining cardiovascular stability; they also observed a shorter recovery time in the group receiving sevoflurane (Bharti et al., 2012). This finding is contrary to our research findings according to which patients receiving sevoflurane and ketamine had shorter recovery time than propofol and ketamine. Glaisyer and Sury (2005) observed in a study that recovery time in the group receiving propofol and remifentanil, was 19 minutes shorter than propofol, sevoflurane and nitrate oxide recipients. Their finding is consistent with results of this study.

Different studies have been conducted to evaluate various anesthetic techniques and compare anesthetics about the difference between propofol as an injectable medication and sevoflurane as an inhaled medication, butthe implemented procedures have been different.For example, in Glaisyer's study, this comparison is made during painful oncology procedures. In the research of (Liao et al., 2010), during rigid bronchoscopy, in Boninn's study (D'Arienzo et al., 2011) in fibropetic intubation, and in the study of Kogan (Kogan et al., 2003) various surgeries were performed on air data including rigid bronchoscopy and micro-laryngeal bronchoscopy and laser treatments on air data. In our study type of surgery has been constant and flexible bronchoscopy is done for all patients, therefore this confounding factor of surgery type is decreased in achieving results of the study. In various studies different combinations of data are used. The study of Glaisyer and Sury (2005) compared effects of propofol, sevoflurane and nitrozoxide combination with total IV propofol and remifentanil combination. This is while in this research, similar to studies of Liao et al. (2010) and Boninn (D'Arienzo et al., 2011), two groups of sevoflurane and propofol medications are compared separately; in this way the impact of medications overlapping effects is eliminated and evaluation and comparison of the two medications is made easier and safer. In the study of Glaisyer and Sury (2005) the sample size was of 22 persons, it was of 64 individuals in the study of Liao et al. (2010), and of 52 persons in the research of Bonnin (D'Arienzo et al., 2011),. Each of the studies used premedication. In the

present study sample size was of 80 individuals, which is superior to other studies in this respect.

In the study of Glaisyer and Sury (2005) variables of age, procedure duration, recovery time, and parents desire for kind of anesthetics are evaluated. However in the present study, homogenization, homogeneous age groups and children's weight, recovery time, HR, BP, SPO2, and postoperative complications were evaluated. Variables used by Liao in the study (Liao et al., 2010) included PR, HR, BP, induction time, and the need to intubation. Therefore, it seems that our research is superior to the studies of Glaisyer and Liao in respect of homogenization of demographic variables and evaluation of hemodynamic and arterial oxygen depletion and evaluation of anesthesia and recovery time. Research findings of Glaisyer study showed that recovery time in propofol group was much shorter than sevoflurane and propofol combination, and patients' parents were more willing to use propofol, but other variables was almost the same in each group. Therefore, in respect of recovery time, this study is consistent with findings of Glaisyer's study, and in regard of hemodynamic stability, similar to Glaisyer's study, both medications acted the same. However, in the research of Liao, induction and recovery time in group receiving sevoflurane was reported to be shorter which is contrary to our findings. No difference between the two medications, in respect of induction and recovery time as well as hemodynamic variables is reported in the study of Bonnin.

Referring to time spent in recovery, as expected, this time was significantly lower in the sevoflurane group, the reason can be due to inhalation method of sevoflurane and the chemical and pharmacokinetic properties of thisanesthetic medication. Two cases of nausea and vomiting were observed and recorded in the sevoflurane group. However, no cases of nausea and vomiting were observed in the propofol group, which was expected as well and is related to antiemetic effect of propofol. Of course, this difference was a statistical one, and since patients with nausea and vomiting in sevoflurane group needed any special treatment, so there was no significant clinical difference in respect of nausea and vomiting in two groups.

Conclusion

It seems that both medications have been suitable for patients with foreign object endoscopy and scientifically both of them are safe. But the appealing finding of this study was that in the propofol group, both the speed of anesthesia and recovery were higher in patients. Accordingly, it

seems that, referring to time, prescription of propofol can make the duration of time safer for us, and is preferable in this regard. About hemodynamic variables both medications are safe and suitable in respect of anesthesia induction in bronchoscopy patients. The use of propofol causes less contamination of surgery room, better recovery, and in general reduction in costs for the patient.

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