ENDOTRACHEAL INTUBATION WITH SEVOFLURANE IN SURGICAL PEDIATRIC PATIENTS: INCREMENTAL VERSUS HIGH CONCENTRATION INHALATION INDUCTION

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ABSTRACT

Background

Sevoflurane is a preferred anesthetic agent for induction and maintenance of pediatric anesthesia. Many studies have been undertaken to show the optimal technique of induction with sevoflurane. In this study we compare the optimal time needed for successful tracheal intubation with immediate high concentration sevoflurane and incremental sevoflurane induction in surgical pediatric patients.

Patients and Methods

With the approval of the Research Scientific and Ethic Committee of the School of Medicine at Sulaimani University at 18th of May 2011, and the informed written consent from the parents, we studied 100 patients of ASA (American Society of Anesthesiologists) physical status I and II elective pediatric surgical patients aged 2-7 years, patients admitted to Sulaimani Teaching Hospital at the Otorhinolaryngology, Head and Neck Surgical Department, from the first of June 2011 to the first of September 2011. Sevoflurane has been used for induction in children who were scheduled for elective adenotonsillectomy operations. Patients were randomly divided into two equal groups, group 1 (G1) 50 patients, using incremental induction with sevoflurane (1-8 %) in 100% O2, the vapor concentration is increased by 1% every few breaths, and group 2 (G2) 50 patients, using high concentration of sevoflurane for induction, (8%) in 100% O2 from the beginning of induction. Intubation is done when the pupils are miotic and centered, after establishing a good muscle relaxation with no movements in response to laryngoscopy and tracheal intubation. The time from induction to successful tracheal intubation is recorded.

Results

We have found that the mean time for tracheal tube insertion was shorter in (G2) 208.4 seconds ± 44.5 (SD), than (G1) 265.8 seconds ± 44.4 (SD), and this was statistically significant with a P value of less than 0.001, Vital signs were stable in both groups.

Conclusion

In healthy pediatric patients undergoing mask induction of general anesthesia with sevoflurane, the induction time can be significantly shortened using a high concentration compared with a conventional, incremental induction method.

Keywords: *Induction, Intubation time, Sevoflurane, Pediatrics.*

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INTRODUCTION

Inhalational induction of anesthesia is a commonly used induction techniques in children younger than 10 years [1].

Sevoflurane is the most recently introduced inhalational anesthetic, it has low tissue and blood solubility, which allows for rapid induction and emergence. It permits a smooth inhalational induction, and is particularly useful in pediatric anesthesia, it can be used for both the induction and maintenance of anesthesia and it becomes popular in day surgery [2].

There appears to be a relatively low level of myocardial depression even when given at maximum vaporizer output for induction of anesthesia. Its safety and efficacy have been well established in hundreds of studies from around the world [3]. Sevoflurane is associated with the least respiratory depression [4].

In spite of its excellent clinical track record, concerns about the possible accumulation of toxic metabolites in a rebreathing circuit at low fresh gas flows, flows of 2 L/min or greater are recommended. Sevoflurane is also relatively expensive compared with the other inhalation agents. In addition any agent with low solubility (i.e., rapid awakening) is accompanied by a high rate of postoperative excitement [4].

Sevoflurane may be used starting at inspired concentration of 8% which achieves more rapid induction than its use incrementally [5]. Sevoflurane, with its non-irritant odour, can be given in a high concentration quickly or even from the start [3].

Tonsillectomy represents an important part of the pediatric anesthesia cases; two thirds of all anesthetics for children 1–4 years of age are given for ear, nose and throat procedures [6].

Sevoflurane is a preferred anesthetic agent for induction and maintenance of pediatric anesthesia [7]; it has a lower solubility in blood, and a pleasant smell, permitting smooth induction and tracheal intubation without neuromuscular blockade [8, 9].

It has rapid induction properties, and acceptable cardiovascular profile [10, 11]. Mean time for tracheal tube insertion is lower than 5 minutes in the majority of studies [12]. It has a shorter mean time for tracheal tube insertion than the other inhalational agents used. Sevoflurane may be used starting at inspired concentration of 8% which achieves more rapid induction than its use incrementally [8].

Our objective in this paper is to compare the optimal time needed for successful tracheal intubation with immediate 8% sevoflurane and incremental sevoflurane induction in surgical pediatric patients undergoing adenotonsillectomy without using muscle relaxants or opioids.

PATIENTS AND METHODS

With the approval of the Scientific Research and Ethic Committee - school of Medicine -Sulaimani University on15th May 2011, number 8, and informed written consent from the parents, we studied 100 pediatric surgical patients admitted to Sulaimani Teaching Hospital in the Otorhinolaryngology, Head and Neck Surgical Department, from the first of June 2011 to the first of September 2011. Children aged 2-7 years of either sex, ASA physical statuses I and II (ASA I: a healthy normal patient, while ASA II: a patient with mild systemic disease with no functional limitations) were scheduled for elective adenotonsillectomy operations. They were randomly divided into two equal groups according to the induction method.

Group 1 (G1) using incremental induction with sevoflurane (1-8 %) in 100% O_2, the vapor concentration is increased by 1% every few breaths.

Group 2 (G2) high concentration of sevoflurane (8%) in 100% O_2 from the beginning of induction.

None of them is given premedication or any other adjunct drugs until successful intubation is done. If upper airway obstruction occurred, an oropharyngeal airway was immediately inserted. Attempts were made to obtain venous access before laryngoscopy. All patients monitored with electrocardiography (ECG), noninvasive blood pressure monitoring (NIBP), pulse oximetry, and temperature measurements.

Children with extreme weight, suspicion of difficult airway, moved during laryngoscopy, or more than one trial of laryngoscopy needed were excluded from the study.

Ventilation was controlled till the time of laryngoscopy; the vocal cords were completely visible in all patients. The time from induction until successful tracheal intubation is recorded.

Data analyzed statistically using Statistical Package for the Social Sciences (SPSS) Version 13 for Microsoft Windows; P value was calculated by T test. P value of less than 0.05 is considered significant.

RESULTS

After comparing between the two groups regarding age, we have found that mean age in (G1) is 4.6 years. Mean age in (G2) is 4.39 years. Mean age in both groups is 4.47 with a (SD) of 1.461, with a range of 5, and this was statistically insignificant with a *P* value 0.396 (Table 1).

Maximum time for tracheal intubation in (G1) was 324 seconds, and minimum time was 150 seconds with a range of a 174. While maximum time for tracheal intubation in (G2) was 268 seconds, and minimum time was 142 seconds with a range of 144. Mean time in both groups was 273.1 seconds, maximum time was 324, and minimum time was 124 seconds with a (SD) of 44.45 and a range of 200 (Table 2).

We have found that the mean time for tracheal tube insertion was significantly shorter in (G2) 208.4 seconds ± 44.5 (SD), than (G1) 265.8 seconds ± 44.4 (SD), and this was statistically significant with a *P* value of less than 0.001 (Figure 1).

Vital signs were stable in both groups. During our inductions and single intubation attempts, there were no significant complications, such as vomiting, hypoxia, bradycardia, hypotension, and cardiac dysrhythmias requiring treatment, other than sinus tachycardia. No patient developed bronchospasm or required any special airway manipulation.

Table 1. Showing minimum, maximum and mean for age in (G1), (G2) and both groups.

		Number	Range	Minimum	Maximum	Mean	Standard Deviation	P value
Age (years)	G1	50	5	2	7	4.60	1.471	0.396
	G2	50	5	2	7	4.39	1.451	
	Both	100	5	2	7	4.47	1.461	

Table 2. Showing minimum, maximum and mean time for tracheal intubation in (G1), (G2) and both groups

		Number	Range	Minimum	Maximum	Mean	Standard Deviation	P value
Time/sec	G1	50	174	150	324	265.8	44.5	Less than 0.001
	G2	50	144	124	268	208.4	44.4	
	Both	100	200	124	324	273.1	44.458	

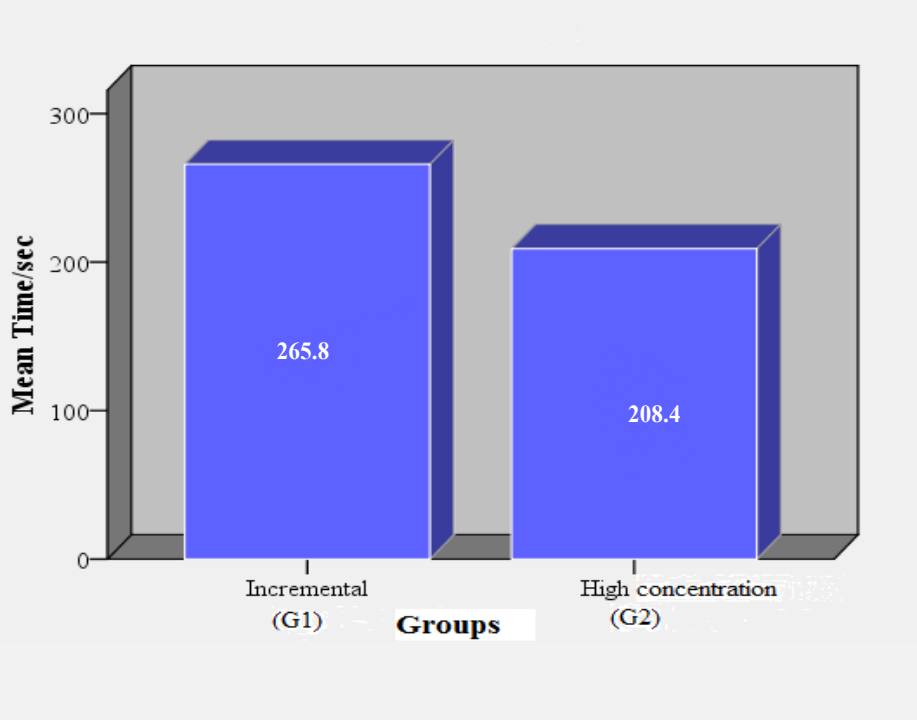

Figure 1. Showing Mean time for Tracheal Intubation in (G1) and (G2).

DISCUSSION

Neonates, infants, and young children have relatively higher alveolar ventilation and lower Functional Residual Capacity (FRC) compared with older children and adults. This higher Minute Ventilation (MV)-to-(FRC) ratio with a relatively higher blood flow to vessel-rich organs like (lungs and brain) contributes to a rapid rise in alveolar anesthetic concentration and speeds inhalation induction [4].

Our study was designed to determine the induction time for achieving successful tracheal intubation in children, by using sevoflurane, under conditions that mimic our own clinical practice.

Successful prediction of good intubation conditions may avoid early initiation of laryngoscopy, which might lead to laryngospasm, bronchospasm, and avoids unnecessarily excessive induction time and anesthetic depth.

We have found that the mean time for tracheal tube insertion was significantly shorter in (G2) than (G1) and the explanation of this could be at equilibrium; CNS partial pressure equals blood partial pressure, which in turn equals alveolar partial pressure:

$P_{CNS}=P_{Blood}=P_{Alveoli}$ (Where P is partial pressure).

The greater the inspired concentration of an inhaled anesthetic the greater is the alveolar concentration and the rate of the rise and this rise in alveolar anesthetic concentration most rapid with the least soluble anesthetics like sevoflurane [3].

Our study agrees with the following studies:

Epstein RH et al. studied 40 unpremedicated ASA physical statuses I and II children aged 4 months to 15 years undergoing elective surgical procedures with general anesthesia, the mean time for induction of anesthesia was shorter in high concentration than incremental induction [13].

Victor C. Baum et al. studied 46 patients aged 6 months to 8 years either sex, ASA physical statuses I or II, scheduled for elective ambulatory surgery under general anesthesia patients had anesthesia induced by sevoflurane, there were no significant complications, immediate inhalation of 8% sevoflurane well tolerated and results in significantly faster induction of anesthesia than incremental sevoflurane induction [14].

Our study did not agree with Dubois MC et al. They have compared the three techniques of sevoflurane induction, group 1 incremental increases in sevoflurane (2%, 4%, 6%, and 7%) in 100% oxygen 23 patients, group 2 induction with high concentration sevoflurane (8%) in O_2 22 patients, and group 3 induction with

high concentration of sevoflurane in 1:1 mixture of N_2O and O_2 20 patients. Time to tracheal intubation was identical in the three groups; there were minimal differences among the three approaches [15]. The cause of this discrepancy could be:

1. Use of nitrous oxide in their study and augmenting effect of the second gas effect.
2. The maximum sevoflurane concentration was 7%.
3. The number of patients in their study was lower than the number in our study.

Conclusion and Recommendation

In healthy pediatric patients undergoing induction of general anesthesia with Sevoflurane, the time required for intubation can be significantly shortened without an increase in complications using a high concentration compared with a conventional, incremental induction method.

We recommend using 8% concentration sevoflurane as a sole anesthetic agent for induction and intubation in surgical pediatric patients undergoing adenotonsillectomy.

Conflict of interest

Non to declare

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