EUROPEAN JOURNAL OF BIOMEDICAL AND PHARMACEUTICAL SCIENCES
http://www.ejbps.com

ISSN 2349-8870
Volume: 10
Issue: 5
261-264
Year: 2023

A COMPARATIVE STUDY OF SEVOFLURANE, HALOTHANE AND ISOFLURANE IN PAEDIATRIC PATIENTS

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Article Received on 13/03/2023 **Article Revised on 03/04/2023** **Article Accepted on 24/04/2023**

ABSTRACT

Introduction: Sevoflurane is relatively newer inhalation anesthetic agent as compared to previously used Halothane and Isoflurane. The major problems associated with pediatric patients are smooth and safe maintenance of the airway. ***Methodology***: Present study is a prospective, randomized comparative study conducted within two year of time.60 pediatric patients are enrolled, undergoing a variety of surgical operations are randomly allocated in equally divided 3 groups based on induction inhalation agents like sevoflurane, halothane and Isoflurane. ***Results:*** Data shows that breath-holding was observed in each group, while laryngospasm was found in one case each in group Sevoflurane and Isoflurane, and 1 case of bronchospasm found Halothane group. ***Discussion:*** Pediatric anesthesia is an ever-challenging task especially for small children where intravenous canulation is difficult prior to anesthesia. Sevoflurane is better and acceptable alternative to halothane as it provides faster induction and recovery in children due to non-pungency and rapid psychomotor orientation.[2] Sevoflurane is an acceptable alternative to Halothane. The mean induction time of halothane was significantly more as compared to sevoflurane group.

KEYWORDS: Comparative study, Sevoflurane, Halothane Isoflurane, Paediatric patients.

INTRODUCTION

Sevoflurane is relatively newer inhalation anesthetic agent as compared to previously used Halothane and Isoflurane. It has low blood gas partition co-efficient that permits rapid induction and recovery from anesthesia. These properties make sevoflurane an attractive choice for anesthesia.

The major problems associated with pediatric patients are smooth and safe maintenance of the airway and of course, good pharyngeal and mandibular relaxation and suppression of laryngeal reflexes and rapid recovery with intact protective reflexes at the end of the surgery.

Regarding the pediatric patients, induction and intubation are better facilitated with inhalational anesthetics rather than muscle- relaxants due to their rapid blood gas concentrations along with spontaneous ventilation. Considering their onset, efficacy and cardiovascular stability, no single agent can assure the best operating condition in pediatric patients

This study was directed to compare efficacy and safety of Sevoflurane with Halothane and Isoflurane in pediatric patients.

METHODOLOGY

Present study is a prospective, randomized comparative study conducted within two year of time span from March 1999 to March 2001, Institutional ethics permission is not taken as it was not existing at the time of data collection. Present study performed on pediatric group, civil hospital. 60 pediatric patients are enrolled, undergoing a variety of surgical operations are randomly allocated in equally divided 3 groups based on induction inhalation agents like sevoflurane, halothane and Isoflurane. Their induction and emergence characteristics are recorded in predefined proforma. In this study maximum numbers are in age group 1month-5 year and weight group 2-20 kg.

1) Sevoflurane group: N2O (60%) + O2(40%) + Sevoflurane (2-7%)
2) Halothane group B: N2O (60%) + O2(40%) + Halothane (1-3.5%)

3) Isoflurane group C: N_2O (60%) + O_2 (40%) + Isoflurane (1-4%)

Routine pre-operative evaluation was done for respiratory complaints, biochemical markers and roentgenographic investigations. Intubation was done after taking patient in deeper plane to tolerate laryngoscopy and sympatho adrenal stimulation. If any complications like breath hold, laryngospasm, hypoxia etc. were noted and tackled.

All patients were extubated after gaining adequate protective reflexes and adequate respiration attained. Following extubation, oxygenation was done by facemask and patient was observed for 20 minutes for their modified Aldrete score and objective pain discomfort score.

RESULTS

A comparative study of 60 patients sample size was done within 3 years time span from march 1999 to march 2001, performed on pediatric patients undergoing variety of surgical operation cases were divided into 3 groups:
Group A: Sevoflurane used in 20 cases
Group B: Halothane used in 20 cases
Group C: Isoflurane used in 20 cases

Table 1: Induction characteristics of Sevoflurane, Halothane and Isoflurane. (in mins).

	Sevoflurane	Halothane	Isoflurane
a*-Range - Mean (in min)	3.2-4.2 3.75±0.52	4.1-5.6 4.75±0.59	4.08-5.06 4.7±0.62
b*-Range -Mean (in min)	3.3-5.2 4.5±0.58	4.4-6.2 5.35±0.81	4.6-6.1 5.25±0.56

a*- Duration between inhalation agent started to loss of eyelid, eyelash reflex.
b*- Duration between inhalation agent started to intubation, just after pupil comes in midline

Table 2: Complications during induction.

	Sevoflurane	Halothane	Isoflurane
Breath hold	1	1	1
Laryngospasm	1	-	1
Coughing	-	-	2
Hypoxia	-	1	-
Bronchospasm	-	1	-
Hypotension	-	-	-
Pulse abnormalities	-	-	-
Movements	-	-	-
Secretions	1	2	-
Vomiting	-	-	1
TOTAL	3	5	6

Above data shows that breath-holding was observed in each group, while laryngospasm was found in one case each in group Sevoflurane and Isoflurane, and 1 case of bronchospasm found Halothane group. Coughing was observed in 2 patients of isoflurane group and 1patient of hypoxia found in Halothane group. While hypotension, pulse abnormalities and movements were not observed in any group. Secretions was found in 1 patients of sevoflurane group and 2 cases of halothane group. While vomiting was observed in one case of isoflurane group.

Table 3: Emergence characteristics of sevoflurane halothane and isoflurane.

	Sevoflurane	Halothane	Isoflurane
c*-Range -Mean(mins)	7.8-11.2 9.3±1.5	12.8-16.1 14.2±1.31	10.1-16.1 13.6±1.8
d*-Range -Mean(mins)	7.8-11.6 9.3±1.5	12.8-16.6 14.5±1.3	11.1-16.6 13.3±1.88
e*-Range -Mean(mins)	9.4-15.6 12.0±2.32	15.1-18.4 16.7±1.62	12.4-18.2 15.3±1.7

c- duration between inhalational agent stopped to extubation
d- duration between inhalational agent stopped to recovery
e- duration between inhalational agent stopped to full consciousness.
Above data shows that emergence and recovery were faster in Group sevoflurane as compared to Halothane Group and Isoflurane Group.

Table 4: Modified aldrete score (20 minutes after extubation).

Scores: n/10	Sevoflurane (n)	Halothane (n)	Isoflurane (n)
7/10	7	5	7
6/10	10	8	8
5/10	3	6	5
<5	0	1	0

Regarding consciousness and recovery, higher scores suggested better outcome. Thus Group Sevoflurane showed better outcome than Halothane and isoflurane group.

***Modified aldrete score:**

		0	1	2
1	Level of consciousness	Not	To stimuli	Awake
2	Respiration	Apnoea	Dyspnoea	No difficulty
3	Activity	Unable to move	Able to move	Voluntarily
4	Circulation (Systolic BP)	20%	10.20%	<10%
5	Temperature(Axillary)	35°C	35.3-35.5°C	35.6-37.5°C

Table 5: Objective pain discomfort scores (20 mins after extubation).

Scores:n/10	sevoflurane	halothane	Isoflurane
3/10	3	10	4
4/10	11	9	8
5/10	5	1	8
>5	1		

Above data shows that significant pain was felt more than score 5 only in case 1 of sevoflurane Group , where child was operated for adenotonsillectomy.

*Objective pain discomfort score:(**20 mins after extubation)**

		0	1	2
1	Blood Pressure	20%	10-20%	<10%
2	Crying	Cry, not responding to tender stimuli	Cries responding to stimuli	No crying
3	Movement	Threashing	Restlesness	None
4	Agitation	Hysterical	Mild	Calm
5	Verbal evaluation (if child able to)	Moderate pain	Mild pain	No pain

DISCUSSION

Pediatric anesthesia is an ever-challenging task especially for small children where intravenous canulation is difficult prior to anesthesia.

In present study, 60 patients were premedicated with anticholinergic injection Glycopyrolate 0.5mcg/kg IV 5min prior to surgery. The induction time(duration between start of in halation agent to loss of eyelash reflex, and the duration between start of inhalation agent to intubation was minimum i.e. 3.75±0.52 with sevoflurane while it was more with isoflurane i.e. 5.25±0.56 and maximum with halothane i.e. 5.35±0.81 it suggests that sevoflurane has fastest induction time. The speed of inhalation induction is not only determined by anesthetic's airway irritation but also by its solubility, maximum inspired concentration and the rate at which maximum inspired concentration is achieved.[1]
Sevoflurane is better and acceptable alternative to halothane as it provides faster induction and recovery in children due to non-pungency and rapid psychomotor orientation.[2]

Sevoflurane is an acceptable alternative to Halothane. The mean induction time of halothane was significantly more as compared to sevoflurane group.[3]

In this study, there was minimal variation of pulse rate and blood pressure with sevoflurane while more with halothane and isoflurane. Suggesting different properties of three inhalational agents which may have resulted from differences in delivered anesthetic dose.[4]

Sevoflurane decreased respiratory resistance and was not associated with any major airway complications and there were few instances of coughing, breath holding, secretion and excitement. The cause of excitement is unknown but maybe similar to excitement phase with diethyl ether induction.[5] So hemodynamic stability and least airway complications made sevoflurane a reasonable alternative to halothane in pediatric patients.[6]

Sevoflurane has a low blood gas solubility co-efficient than halothane. This increases wash out of anesthetic gases and will speed up recovery. Hemodynamic

changes during induction with halothane tends to decrease HR and BP, while isoflurane increases HR and BP. These changes were marked in initial 5 min, while sevoflurane had no major changes in the HR and BP, suggesting that is less myocardial depressant, so can be safely used for induction and maintenance in pediatric patients.[7]

In our study, post operative restlessness and agitation were almost similar in three groups but higher with sevoflurane. This could be because of pain during emergence and immediate post operative period, this phenomenon might reflect the rapidity and completeness of emergence from sevoflurane anesthesia.[8]

None of the patients in sevoflurane and halothane and one patient in isoflurane had post operative vomiting. Vomiting is major cause of delayed discharge from recovery room and unscheduled overnight admissions. Its low incidence in pediatric anesthesia should encourage the use of these anesthetic agents in pediatric ambulatory surgery.[9]

In this study, emergence and recovery was fastest with sevoflurane and faster with isoflurane and halothane. This well explained by hepato-cellular integrity by measurement of serum glutathione transferase alpha concentration, produced in sevoflurane metabolism which was significantly greater than with halothane.[10]

In this study, there was early recovery after sevoflurane than halothane, though discharge time were similar. These findings were compared to earlier studies[11,12]

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