ORIGINAL RESEARCH PAPER

Volume-7 | Issue-7 | July-2018 | PRINT ISSN No 2277 - 8179

INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

A COMPARATIVE STUDY OF SEVOFLURANE VERSUS HALOTHANE FOR GENERAL ANAESTHESIA IN PAEDIATRIC PATIENTS

Anesthesiology

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ABSTRACT

Introduction: Inhalational anaesthesia used in both adults as well as in paediatric population but now a days it has gained a special attention in paediatric population for induction purpose because of easy to administer and difficulty in cannulation in awake children. The present study was designed to compare induction and recovery characteristics of sevoflurane with halothane in paediatric patients, and to assess the hemodynamic profile during induction, maintenance and recovery phases of anaesthesia.

Material and Methods: A Hospital based Randomized Comparative Observational study was conducted on 60 patients of 1-8 year age, either sex or ASA grade I, II posted for elective surgeries like hernia, hydrocele and undescended testis. Children were randomly allocated into two groups receiving either sevoflurane or halothane in a mixture of O2 and N2O (50:50) after priming the circuit and in incremental manner for mask induction and maintenance of anesthesia. Induction time, intubation time, emergence time and haemodynamic changes were recorded. At the end of surgery post operative complications were noted and compared between two groups.

Results: Induction of anaesthesia was smooth and without any complications in both the group, but induction time and intubation time was significantly shorter in sevoflurane group. There was fall in heart rate in both the groups during induction, but significant fall in halothane group. Maintenance of anaesthesia was satisfactory in both the groups. Recovery from anaesthesia was significantly rapid with sevoflurane group than halothane group. None of the patients had any side effect.

Conclusion: We conclude that sevoflurane was superior to halothane for induction and maintenance of anaesthesia in paediatric patients. Recovery time was also significantly shorter in sevoflurane group.

KEYWORDS

Sevoflurane, Halothane, Paediatric Anesthesia, Induction, Intubation.

Introduction

General anaesthesia is divided in Induction, Maintenance and Emergence [1]. The aim of Induction is to render a patient unconscious as rapidly and smoothly as possible. General anaesthesia can be given by either Intravenous or Inhalational method.

The induction of sleep by inhalation by mask has a tradition in anaesthesia and induction of choice in children because it can be achieved easily, rapidly and better tolerated, less objectionable to most children than IV cannulation. Halothane with its negligible pungency and minimal effects on airway reactivity has been the cornerstone of paediatric inhalational induction.

Sweet smelling and non-irritant properties of sevoflurane has made inhalational induction very friendly. Its low blood gas solubility allows rapid induction and early emergence [2, 3]. Depth of anaesthesia can be quickly adjusted in a predictable way while monitoring tissue levels via end tidal concentration with stable vital parameters even at high concentration as much as 8% without producing airway secretions, cough and laryngospasm[4].

Methods

This hospital based randomized comparative observational study was conducted after approval of local institutional ethical committee and explaining the procedure to the parents of the selected cases in local language and obtaining written informed consent. Sample size was calculated assuming mean difference 20.09 and standard deviation 19.343 in induction time taking Alpha error 0.05 and 80% power, is 16 in each group. It was further enhanced and rounded off to 30 cases in each group for study purpose. 60 patients of 1-8 years age, weighing less than 20kg, ASA grade I-II and posted for elective surgeries like hernia, hydrocele and undescended testis under GA were randomly allocated by chit in box method into two groups. Patients with history of acute or chronic medical illness, difficult airway and surgeries for more than 2hrs duration were excluded. Patients of Group-A received Sevoflurane with 50% N_2O and 50% Oxygen by inhalation and Group-B received Halothane with 50% N_2O and 50% Oxygen by inhalation.

After checking PAC, consent and confirming fasting as per guidelines (6 hours for solid foods, 4 hours for semisolid foods and 2 hours for clear liquid), routine non-invasive monitors were attached and baseline parameters (HR, SBP, DBP, and SPO2)were noted. Induction was done with primed Ayres 'T' piece and appropriate size face mask with either sevoflurane or halothane in N_2O and O_2 in 50 and 50 ratio. Circuit was primed for approximately 3 minutes with 8% sevoflurane or 5% halothane in 2:1 ratio N2O:O2 at 6 L/m flow.

In Group A, sevoflurane was started at 1% and increased by 1% every 3-5 breath until loss of eyelash reflex or max inspired concentration up to 8 % reached. In Group B, Halothane was started at 0.5% and increased by 0.5% every 3-5 breath until loss of eyelash reflex or maximum inspired concentration up to 5% reached. Loss of eye lash reflex was elicited by gentle brushing of eyelashes of one eyelid with a finger. Following loss of eyelash reflex, vaporizer concentration was decreased to 5% for sevoflurane or 1.6% for halothane. Induction time was noted. Induction time was defined as time taken from putting of face mask on Child's face to loss of eyelash reflex.

After induction IV cannulation was done and Ringer Lactate infusion started. Injection Glycopyrrolate 0.004 mg/kg IV and fentanyl 2 mcg/kg IV were given. Inhalational agent was continued at the same concentration until loss of corneal reflex then patient was intubated with appropriate size endotracheal tube and Intubation time was noted. Intubation time was defined as putting of face mask on child's face to loss of corneal reflex associated with regular respiration and loss of limb movements. Corneal reflex was elicited by involuntary blinking of eyelid by stimulation of cornea using a cotton wick. Inj Atracurium 0.5 mg/kg IV loading dose given and vaporizer concentration was adjusted at 0.5% for halothane and 2% for sevoflurane.

Anaesthesia was maintained with O2: N_2O (50:50) and Atracurium 0.1 mg/kg IV. Depth of anaesthesia was clinically assessed by change in HR and BP during surgery and was maintained within 20 % of baseline values. Vital parameters (HR, SBP, DBP, MAP, and SPO2) were monitored at baseline, at induction, just before intubation, just after intubation and then every 5 min till end of surgery.

At the end of surgery all anaesthetic agents were discontinued and patient was taken on 100% oxygen. On regaining spontaneous respiratory efforts, patient was reversed with inj Neostigmine 0.05mg/kg IV and Inj Glycopyrrolate 0.004 mg/kg IV and extubated when the gag reflex returned and patient was breathing spontaneously and making purposeful movements. Emergence time was noted. Emergence time was defined as time taken from discontinuation of anaesthetic agents to hip flexion or bucking. Any complications like

desaturation, hypotension, spasm, were managed according to standard protocols.

Statistical analysis

Statistical testing was performed with the statistic package for the social science system version SPSS 21.0. Continuous variables are presented as mean ± SD, and categorical variables are presented as absolute numbers and percentage. The comparison of normally distributed continuous variables between the groups was performed using Student's t test. For within the group comparison, paired t test was used to see the change at different time points from baseline. Nominal categorical data between the groups were compared using Chi square test or Fisher's exact test as appropriate. P< 0.05 was considered statistically significant.

Results

Preoperative patient variables like age, sex, weight, ASA grade and baseline vitals were comparable in both the groups as shown in table 1. As depicted in table-2, Induction was faster in group-A (85.63±8.03 sec) in comparison to group-B (98.20±6.20 sec). The difference was statistically significant (P value <0.05). The mean intubation time was significantly lower in group-A (226.37±14.23 sec) in comparison to group-B (281.33±7.01). The emergence time was also significantly lower in group-A (237.97±11.36 sec) in comparison to group-B (373.70±14.54 sec).

There was no significant difference in the vital parameters (HR, MAP) of both the groups when taken just before induction and intubation but post-intubation MAP was significantly lower in group-B (59.6 ±3.49 mmHg) in comparison to group-A (62.8 ±3.49 mmHg). The postoperative heart rate was lower in group-B in comparison to group-A (P<0.05) as depicted in table-3. None of the case of our study had any adverse effects like cough, secretion, laryngospasm, vomiting, breath holding, and bronchospasm in both the groups.

Discussion

Inhalational induction is a commonly used technique for induction of anaesthesia in children. Halothane was most commonly used inhalational agent for induction in children until a recent addition of sevoflurane. Halothane is a potent anaesthetic with a MAC of 0.74%. Its blood/gas partition coefficient of 2.4 makes it an agent with moderate induction and recovery time. It is not a good analgesic and its muscle relaxation effect is moderate[5]. Induction using sevoflurane in a mixture of nitrous oxide and oxygen without additional muscle relaxation provides sufficiently good conditions for a smooth endotracheal intubation and insertion of LMA [6]. Due to its low pungency, low blood gas solubility and limited cardio respiratory depression, sevoflurane may be desirable for use in infants and children [7, 8]. Neonates, infants and young children have relatively higher alveolar ventilation and low functional residual capacity as compared to older children and adults. So, 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 speed of inhalation induction[9].

In our study, the patients were not given any sedatives and IV cannulation was done after induction. So, acceptance of mask was same for both the groups. This showed that both the agents were non-pungent and equally acceptable to the children, unlike Sigston et al [10] who found sevoflurane as a more pleasant inhalational agent. Use of high concentration of sevoflurane helps faster induction but is associated with considerable amount of excitement and adverse airway reactions, as seen by Sigston et al [10] who used 8% Sevoflurane after priming the circuit with Sevoflurane. To avoid this excitement phase of induction, gradual increase in concentration was carried out in the present study. Addition of nitrous oxide helps to decrease MAC, as shown by Katoh et al [11], and decreases adverse airway events and excitatory phase as seen by Hall et al[12].

The faster induction time and intubation time of sevoflurane group in our study could be related to its low blood: gas solubility (0.69 versus 2.5) and it correlated with the study done by Epstein RH et al [5] and kajal et al [13]. Early recovery is an essential prerequisite for the expanding outpatient surgical concept. Inhalational agents with high blood: gas partition coefficient and tissue: gas partition coefficient tends to have slower elimination [14]. Our results of faster recovery and emergence time in sevoflurane group correlated with the results of kataria B. Epstein R et al [14], and Shruti redhu et al [16]. They found rapid recovery in sevoflurane group as compared to halothane group. Thus we found that sevoflurane is a safe inhalation induction agent in children for smooth and faster induction and early recovery than halothane without causing any adverse effect.

Table-1: Demographic data of patients

	Group A		Group B		P value	Significance
	Mean	SD	Mean	SD		
Age (years)	3.60	2.06	3.93	2.12	0.543	NS
Sex (M+F)	29+1	-	28+2	-	1.0	NS
Weight (kg)	13.35	4.08	14.34	4.28	0.363	NS
ASA (I+II)	27+3	-	27+3	-	1.0	NS

Table-2: Comparison of study variables of patients

Variable	Group A (Mean±SD)	Group B (Mean±SD)	P value	Significance
Induction time (sec)	85.63±8.03	98.20±6.20	0.000	S
Intubation time (sec)	226.37±14.23	281.33±7.01	0.000	S
Emergence time(sec)	237.97±11.36	373.70±14.54	0.000	S

Table-3: Vital parameters of the patients

Parameter And time interval	Group A		Group B		P value		Significance	
	Heart Rate (Mean ±SD)	MAP (Mean ±SD)	Heart Rate (Mean ±SD)	MAP (Mean ±SD)	Heart Rate	MAP	Heart Rate	MAP
BASE LINE	118.56 ±7.63	66.36 ±4.72	115.46 ±5.11	68.26 ±4.37	0.069	0.111	NS	NS
At Induction	124.27 ±10.91	62.13 ±4.18	120.4 ±8.34	62.2 ±4.16	0.128	0.948	NS	NS
Pre Intubation	111.47 ±7.01	61.8 ±3.83	114.13 ±7.05	61.13 ±3.83	0.148	0.548	NS	NS
Post Intubation	112.33 ±7.36	62.8 ±3.49	110.2 ±5.11	59.6 ±3.49	0.198	0.004	NS	S
Post Operative	115.90 ±6.19	64.33 ±2.96	112.2 ±6.42	65.9 ±4.25	0.026	0.102	S	NS

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