Comparative Study of Induction Time and Heart Rate Changes During Induction with Halothane and Sevoflurane in Paediatric Patients

Shareena T[1], Renju Ninan[2], Manju Bobby Kurian[3]

ABSTRACT

Introduction: Induction of anaesthesia in paediatric age group is more challenging when compared to adults because of non availability of proper intravenous line, inhalational induction agents and non co-operation of the child.Inhalational Anaesthesia is the preferred technique of induction in the paediatric age group. Study objective was to find out induction time for halothane and sevoflurane in children aged between 2 years and 12 years

Material and methods: A total of 79 paediatric patients in the age group between 2 years to 12 years undergoing surgery under general anaesthesia were selected they were randomised to two groups using closed envelope method. GROUP H: induction was done with Halothane and GROUP S: induction was done with Sevoflurane

Results: Induction time and heart rate changes were observed. Induction time was 2mins and 8sec in halothane group and 1min and 17 sec in sevoflurane group was observed. Heart rate changes in halothane group was 116/ min and in sevoflurane group it was 130/min.

Conclusion: We conclucled that sevoflurane is a faster induction agent than halothane and showed more heart rate changes at the time of induction. The Heart rate decrease was more with Halothane Group than Sevoflurane.

Keywords: Induction Time, Heart Rate, Changes During Induction, Halothane, Sevoflurane, Paediatric Patients

INTRODUCTION

Induction and recovery from Anaesthesia is influenced by the choice of volatile anaesthetic agent. Agents with lower blood gas solubility have been associated with faster times of induction and recovery.[1-5] Halothane is a volatile anaesthetic agent which has been the most commonly used agent in paediatric anaesthesia. Sevoflurane has several properties which may make it a suitable agent for paediatric practice. In the recent times, inhalational induction is made popular with sevoflurane or halothane depending on the availability of the agent.[6-9] Ideal inhalational induction agent should have minimal respiratory irritation, negligible pungency, low blood gas solubility and easily available. Halothane with its negligible pungency and minimal effects on airway reactivity has been the corner stone of paediatric inhalational induction despite its propensity to cause bradycardia, hypotension and arrhythmias. Even though halothane was enjoyed as popular inhalation anaesthetic for more than half a century it had many disadvantages like myocardial depression, cardiac arrythmias and halothane hepatitis. Sevoflurane was introduced as it had minimal cardiac and hepatic side effects and the induction time was lesser.[10-15] Sevoflurane has taken the place of halothane in both induction and maintenance of anaesthesia inspite of its cost. It possesses several properties including low blood and tissue solubility, nonpungency, noninflammability and limited cardio respiratory depression that may be desirable for use in infants and children. Sevoflurane is the most suitable agent for paediatric age groups because of its rapid onset of action, few intra-operative and post-operative complications, and quick recovery. Induction of anaesthesia using sevoflurane can be done either by tidal breath or by vital capacity breath technique inhalation unlike haothane. With sevoflurane vital capacity induction can produce coughing, breath holding and laryngospasm which is possible with halothane tidal breath induction. Even though use of halothane is limited in tertiary care centre, it is still used as an induction agent in smaller centres.[16-21] There are plenty of studies related to the induction of anaesthesia with sevoflurane and halothane but most of the studies are related to induction, recovery characteristics, haemodynamic variabilities. Hence the present study is undertaken to know inhalational induction time as well as heart rate changes at the time of induction to compare between sevoflurane and halothane.

Study objectives were to find out induction time for halothane and sevoflurane in children aged between 2 years and 12 years and to find out the heart rate changes during the induction with either agent.

MATERIALS AND METHODS

Randomised comparitive study was done in Yenepoya Medical College Mangalore, Karnataka,, India on 78 sample randomly divided in to two groups, 39 children in each group selected by closed envelope method. Written informed consent was obtained from the parent. Pre anaesthetic evaluation and routine investigations were carried out before taking up the patient for surgery. Pre medications was

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given as oral administration of Triclofos 50 mg/kg/wt and atropine 0.02 mg/kg wt 2 hours before the induction, routine monitoring was done using - Electro-cardiogram, pulse oximetery, Etco$_2$ and Non invasive blood pressure.

1. Anaesthesia was induced with halothane and then sevoflurane based on their groups.
2. Selected vapour introduced in increments of every 3rd breath with oxygen and nitrous oxide till the patient was unconscious (when child was unresponsive to jaw thrust).
3. Induction time calculated in seconds using stop watch.
4. Heart rate was noted before induction and at the time of induction from placing the mask till no response to jaw thrust.
5. Atracurium (0.5 mg/kg wt.) was used for intubation and maintanence.
6. Fentanyl (1µgm/kg wt.) was used for intra operative analagisia. Source of data: Paediatric patients in Yenepoya Medical College Hospital, Mangalore who were admitted during the period of October 2013 to October 2015 underwent surgeries under general anesthesia by using the volatile anesthatic agents halothane and sevoflurane

Sample size: 78 children, 39 children in each group selected by closed envelope method.

Group H – Patients undergoing general anaesthesia using halothane

Group S - Patients undergoing general anaesthesia using sevoflurane

Inclusion criteria

A.Patients undergoing elective surgery under general anaesthesia induced with either Halothane or sevoflurane.
B.Patients of either gender between age of 2 years – 12 years
C.ASA grade 1 and 2.

Exclusion criteria

A.ASA grade 3 and 4
B.Emergency surgeries
C.Surgeries done under regional anaesthesia or intravenous induction.

STATISTICAL ANALYSIS

For statistical analysis of data within the groups, chi square test was used and for comparison of mean induction time and heart rate between two groups independent sample T test was used.

RESULTS

Present study was undertaken in 78 patients i.e 39 in each group of ASA I and II patients of either of sex between age group of 2- 12yrs scheduled for elective surgery under General Anaesthesia. Demographic data were comparable for gender (table-1, figure-1). On comparing gender of patients in both the groups, difference was 0.06 and p value was 0.81

	Group		Total
	Halothane	Sevoflurane	
Male	26(66.7%)	25(64.1%)	51(65.4%)
Female	13(33.3%)	14(35.9%)	27(34.6%)
Total	39(50.0%)	39(50.0%)	78(100.0%)
	Chi square value (df)= 0.06(1), p=0.81(NS)		

Table-1: Comparison of gender between the two groups: chi square test

Group	N	Mean	SD	Mean difference (95% CI)	t	Df	p-value
Halothane	39	1.33	0.47	-0.03(-0.24, 0.19)	-.235	76	0.81(NS)
Sevoflurane	39	1.36	0.48				

Table-2: Independent sample t test comparing age

	Group	N	Mean	SD	Mean difference (95% CI)	T	Df	p-value
Wt	Halothane	39	22.54	9.45	-0.05 (-4.12, 4.02)	-0.02	76	0.98(NS)
	Sevoflurane	39	22.59	8.61				

Table-3: Comparison of body weight between two groups: independent sample T test

	Group	N	Mean	SD	Mean difference (95% CI)	T	Df	p-value
Induction time (seconds)	Halothane	39	128.05	15.31	50.12(43.83, 56.41)	15.87	76	<0.001*
	Sevoflurane	39	77.92	12.43				

Table-4: Comparison of mean induction time in seconds between two groups; independent sample T test

	Group	N	Mean	SD	Mean difference (95% CI)	t	Df	p-value
Baseline heart rate / min	Halothane	39	135.00	22.39	-3.15 (-13.87, 7.56)	-0.59	76	0.56 (NS)
	Sevoflurane	39	138.15	25.05				
heart rate / min at Induction	Halothane	39	116.51	22.32	-13.71 (-24.31, -3.11)	-2.57	76	0.01*
	Sevoflurane	39	130.23	24.63				

Table-5: Comparison of mean heart rate/minute between the study groups: independent sample T test

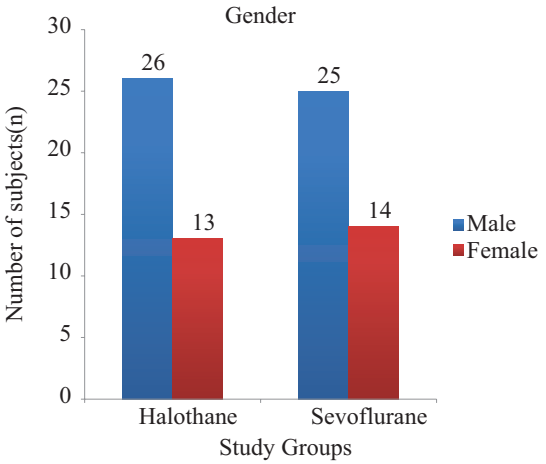

Figure-1: Comparison of gender between the two groups

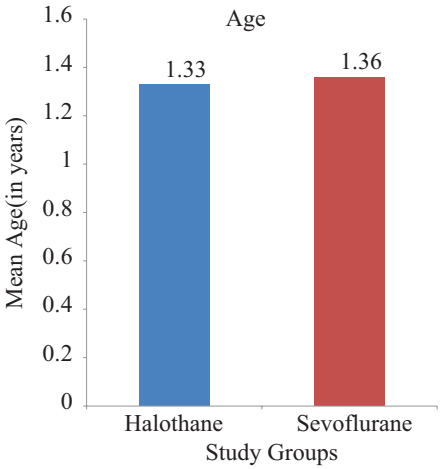

Figure-2: Comparison of mean age among two groups

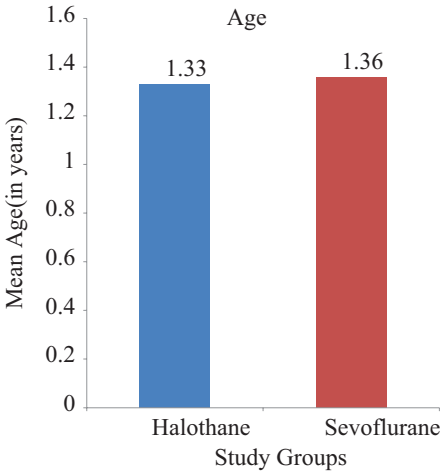

Figure-3: Comparison of body weight between two groups

which was statistically not significant. In comparing mean age of patients in both the groups difference was 76, p-value was 0.81 which was statistically not significant (table-2, figure-2). In relation to the weight of the patients, p value was 0.98 which was > 0.05 (table-3, figure-3). The results showed that both the groups were comparable considering weight of the patient. Mean induction time in halothane group was 128.05 seconds (2mins and 8 seconds), mean induction time in sevoflurane group was 77.9 seconds (1 min

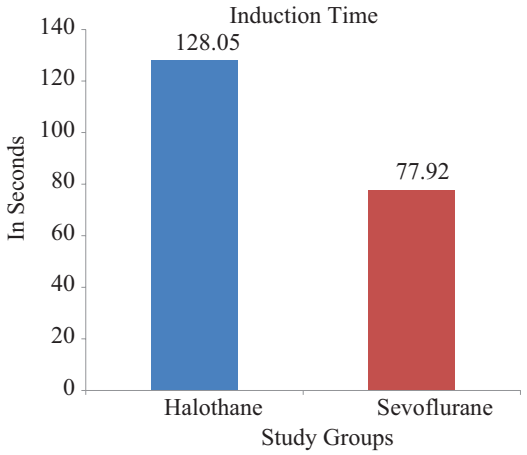

Figure-4: Comparison of mean induction time(seconds) between two groups; independent sample T test

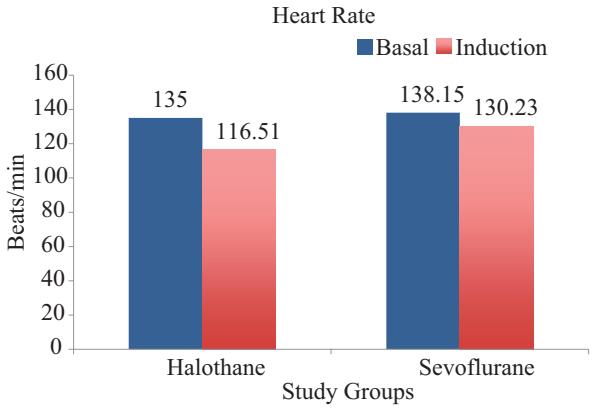

Figure-5: Comparison of mean heart rate between the study groups: Independent sample T test

and 17 seconds) difference was 76 and p value was <0.001 which was <0.05 which was both clinically and statistically significant (table-4, figure-4). The baseline heart rate in halothane was 135 per min while in the sevoflurane group it was 138.15 per min where the p value was 0.56 which was statistically not significant. At induction in halothane group heart rate was 116 per min and in sevoflurane group it was 130.23 per min and the p value was 0.01 and change in heart rate was found to be significant (table-5, figure-5).

DISCUSSION

Halothane has been the most commonly used inhalational agent for induction in children. Sevoflurane is a recent addition to induction inhalational agents, due to its low pungency, low blood gas solubility and limited cardio-respiratory depression.[22-25]

In our study we observed the induction time and the heart rate changes using both of this agents.

A total of 79 patients in paediatric age group aged between 2 to 12 years were studied and age, sex and weight of the children in both the groups were similar as the p value was not more than 0.05 they were randomly divided into two groups of 39 each. They were induced with halothane or sevoflurane based on the group of randomisation. Induction time and change in heart rate was noted in both the groups.[26]

Induction time

Induction was done with 50% nitrous oxide in 50% Oxygen with increments of either halothane or sevoflurane based on the group of randomisation, selected vapour was introduced in increments every 3rd breath till there was no response to the jaw thrust. The induction time obtained in our study was 1 minute and 17 seconds in sevoflurane group and 2 minutes and 8 seconds in halothane group. The mean induction time is more than double in the halothane group when compared with the sevoflurane group. Sevoflurane may be desirable for use in infants and children the overall quality of anaesthesia delivered with both halothane and sevoflurane was similar. The mean difference was 76% and the p value was less than 0.001, which is statistically highly significant.

Our study was comparable to a study conducted by Kajal dedhia[1] et al who had done the study in children to compare the induction characteristics of sevoflurane and halothane, and ease of LMA insertion in paediatric patients and they had obtained induction time with sevoflurane group 1min and 9 seconds and in halothane group 1 min and 46 seconds and concluded that sevoflurane is a suitable alternative to halothane for inhalational induction of anaesthesia in children. Similar results were obtained in the studies conducted by MMA Wadud et al where induction time was 1min and 50 second in Halothane group and 43 seconds in Sevoflurane group. One more study conducted by S Iomata et al[27] had induction time of 2min and 27 sec in sevoflurane and 3 min and 40 sec in Halothane. Study by Ebstine RH et al[18] had induction time of 1min 37 sec in sevoflurane group and 2min in Halothane group which was also comparable to our study. One more study conducted by Kanta meena[1] et al compared induction and recovery characteristics of sevoflurane versus halothane in preschool children undergoing cleft lip and palate repair and had obtained that induction time in sevoflurane group was 1 min and 11 seconds and the halothane group 1 min and 27 seconds and concluded that induction and recovery time was faster with sevoflurane anaesthesia when compared to halothane which was similar to our study.

Hussein Al-Khraysha et al[2] did a study and conducted a study the induction and recovery characteristics associated with halothane and sevoflurane anaesthesia in infants undergoing herniotomy and he observed that the mean induction time of halothane was 1 min and sevoflurane group is 51 seconds. One more study ST paris[19] et al compared sevoflurane and halothane for outpatient dental anaesthesia in paediatric children and he observed that the induction time in sevoflurane is 1 minute 5 seconds and in halothane group is 1 minute 9 seconds in both of this studies no much difference in induction time was noted with both the agents.

Significant changes in induction time was noted in both the groups because the blood gas partition coefficient is much lesser in sevoflurane (0.69) than in halothane (2.5).

Heart rate changes

The heart rate was recorded before induction and during induction with either sevoflurane or halothane, end of induction was considered when there was no response to jaw thrust in paediatric patients.

The basal heart rate recorded was 135 ± 22.39 per minute in the halothane group and 138 ± 25.05 per minute were in the sevoflurane. Heart rate changes recorded at the time of induction were 130 ± 24.63 per minute with sevoflurane and 116 ± 22.32 per minute with halothane group. The mean difference was 76 and P value is <0.001, which is highly significant both clinically and statistically.

Nagwa M Ibraheem[16] et al conducted a study to compare haemodynamic response during induction and maintenance of sevoflurane or halothane anaesthesia in children undergoing

general anaesthesia while breathing spontaneously via a laryngeal mask and they had obtained that the heart rate observed in the sevoflurane group was 98/minute and in the halothane group was 86/minute. There was a similar study done by Epstein RH[18] et al to compare vital signs and the speed of induction and emergence with sevoflurane versus halothane in paediatric patients it was observed that heart rate at the time of induction in the halothane group was 136/minute and sevoflurane group was 115/minute, these results were comparable to this study.

MM A Wadud[22] et al compared the haemodynamic response during induction of sevoflurane and halothane and observed that the heart rate changes during induction in the sevoflurane group was 96/min while in the halothane group was 91/minute. S Inomata[27] et al studied the induction time required for tracheal intubation with equipotent inspired concentrations of 5% sevoflurane and 2.5% halothane in oxygen and they observed that the heart rate changes in the sevoflurane group is 120/minute and that in halothane group 121/minute which was not significant. In a similar study done by Santosh Kumar Bhaskar[17] et al he had conducted to compare the haemodynamic variability and emergence characteristic of sevoflurane with halothane for general anaesthesia in paediatric patients and had obtained that the sevoflurane group during induction was 117/minute and while comparitively in sevoflurane was also 117. /min. ST Paris[19] et al conducted a study where HR with sevoflurane was 146/min and Halothane was 138/min. Vital signs like heart rate, systolic blood pressure, and diastolic blood pressure remain quiet stable during maintenance with sevoflurane, he had observed that the patients of halothane group showed wide fluctuation in heart rate, and had concluded that Sevoflurane provides better haemodynamic stability and smooth emergence without emergence delirium by use of good peri-operative analgesia concomitantly.

Known complication of halothane is myocardial depression hence the heart rate changes were significantly low in halothane group compared to sevoflurane group but no bradycardia was noted.

Complications like Breath holding, laryngospasm and desaturations were not noticed in any of the patients in both the groups, at the time of induction.

CONCLUSION

In this study we have included 78 paediatric patients divided into two groups of 39 in each group. They were induced with either sevoflurane or halothane and we had observed that the induction time and heart rate changes in both the groups, the following conclusion was obtained.

Mean induction time was more than double in the halothane group when compared with sevoflurane group. The decrease in the heart rate from the baseline to induction was more in Halothane Group. The change in heart rate at the time of induction between sevoflurane group and halothane group was significant both clinically and statistically. There was no complications at the time of induction.

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