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Comparative Study of Sevoflurane with Halothane for Anesthesia

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ABSTRACT

The new inhalation anesthetic agent sevoflurane introduced recently in the clinical practice, having lower blood gas solubility allow for rapid induction, has less myocardial depressant effects may make it a suitable agent for induction as well as maintenance of anaesthesia. Hence, the present study was undertaken to compare the induction, intubation, haemodynamic and emergence characteristics of sevoflurane and halothane. This comparative clinical study was carried out at Krishna Institute of Medical Sciences and Hospital, Karad after obtaining ethical committee clearance. The study population consisted of 80 healthy patients of both sex divided randomly into two groups of 40 each. Group I - Consisted of patients induced and intubated with incremental concentration of halothane 0.5% to 5% in nitrous oxide and oxygen mixture (50:50); and Group II - Consisted of patients induced and intubated with incremental concentration of sevoflurane 1% to 7% in nitrous oxide and oxygen mixture (50:50).From the present study it is seen that, Halothane in the concentration of 0.5-5% produces induction in 137.8 secs (SD 33.3secs) and sevoflurane in the concentration of 1-7% produces induction in 70.95 secs (SD 14.6secs). Thus sevoflurane produces significantly rapid induction compared to halothane ($p<0.05$).

Keyword: Sevoflurane, halothane, intubate, nitrous

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INTRODUCTION

Induction of anaesthesia using an inhalation agent had remained as an unpleasant experience for the patients in the earlier days when ether was used as a sole agent. To take the patient to the level adequate for intubation took a long time due to its high blood gas solubility. The main disadvantages of ether are its inflammability and prolonged and unpleasant recovery. The search for non-inflammable agents continued and many agents like chloroform, trichloroethylene, ethyl chloride and many fluorinated agents were tried. Inhalational induction gained popularity and was considered as safe anaesthetic practice by the introduction of halothane in 1951 and its clinical usage in 1956. Halothane is preferred because it is relatively nonirritant and produces a rapid and smooth induction even in children. However it has disadvantages like myocardial depression and cardiac arrhythmias, at high concentrations and may cause the rare, but serious complications like hepatitis and rarely triggers malignant hyperthermia.

In view of the above knowledge, the present study was undertaken to evaluate the induction characteristics, intubating conditions, haemodynamic profiles and emergence from anaesthesia with sevoflurane, and to compare it with that of halothane.

OBJECTIVES

The study objective is to compare sevoflurane with halothane for anaesthesia, in a clinical setting in healthy children and adults of both the sex, with respect to their:

1) Induction time and characteristics.
2) Intubation time and characteristics.
3) Haemodynamic responses
4) The time, pattern and events during emergence from anaesthesia.

REVIEW OF LITERATURE

In 2001, Klock. P.A., Czeslick. E.G.,[1] in a randomized double blind study involving 64 ASA Gr I and II patients who were to receive 1.0 and 1.8 MAC of sevoflurane or desflurane and stimulated the trachea by inflating and deflating cuff of endotracheal tube. They found a lack of airway responsiveness to sevoflurane at both MACs whereas desflurane at 1.0 MAC produced hemodynamic changes consistent with airway response.

In 2001, Swadia. V.N., Patel M.G.,[2] compared the induction and intubation characteristics of sevoflurane and halothane in 50 patients undergoing general surgical and urological operations. They also assessed the haemodynamic profile of both anaesthetic agents during induction and intubation.The author concluded, that sevoflurane gives rapid and smooth induction with good intubating conditions keeping stable haemodynamics. This makes sevoflurane a suitable alternative to halothane for induction of anaesthesia in children.

In 2004, Dedhia. K. N., Kudalkar A.,[3] compared the induction characteristics, haemodynamic stability and conditions for laryngeal mask airway insertion using sevoflurane and halothane. 60 ASA grade I and II children between 1-12 years of age were randomly divided into two groups. Group I patient were induced with halothane starting from 0.5% with gradual increment to 3.5% while patient group II were induced with sevoflurane starting with 1% with increment to 6%. Centralization of eyeballs were considered to be the end point of LMA insertion. Time interval from application of mask to eyeball centralization for group I was 249.83 ± 40.58 seconds and group II was 164.80 ± 29.73 seconds. Heart rate and B.P. were better maintained with sevoflurane with greater incidence of fall in B.P. and heart rate with halothane. The incidence of excitement and adverse airway events were few in both the groups. Thus, it can be concluded that sevoflurane has a rapid and smooth induction and is suitable alternative to halothane for inhalational anaesthesia in children.

In 2005, Choudhary et. al,[4] done a prospective study on 40 patients scheduled to undergo coronary artery bypass grafting with an objective to evaluate whether sevoflurane is suitable for anaesthesia induction in patients suffering from coronary artery disease. Patients were randomized to receive either 7% sevoflurane vital capacity inhalation induction or thiopentone induction. A 35 ± 2.49 seconds of induction time with sevoflurane found to be little longer than thiopentone, was not clinically significant. The induction complications of this drug were comparable to thiopentone. Sevoflurane gaseous induction was found to be cardiostable causing little change in heart rate, systolic and diastolic blood pressures during the period of induction and tracheal intubation. The authors concluded, that sevoflurane single breath vital capacity induction can be an effective alternative to the routine intravenous induction in patients who has to undergo coronary artery bypass grafting surgery.

Table 1: The Induction Time Observed by Various Authors.

Author	No. of patients	Induction time (secs) (Time to loss of eye lash reflex) (Mean± SD)	
		Halothane (H)	Sevoflurane (S)
Swadia et al[2]	H=13 S=16	103.67 ±39.87	97.27 ±45.68
Black et al[5]	H=39 S=42	137 ±43	101 ±35
Naito et al[6]	H=15 S=15	198 ±48	192 ±84
Lerman Jerrold et al[7]	H=125 S=250	96 ±66	78 ± 47.4
Piat Veronique et al[8]	H=17 S=17	108 ±42	90 ±36
Paris. S.T. et al[9]	H=50 S=50	114±30	90 ±36
Joel.B.Sarner et al[10]	H=40 S=40	102 ±36	96 ±42
Taivainen et al[11]	H=25 S=25	102 ±36	60 ±18
Present study	H=40 S=40	137.8 ±33.3	70.95 ±14.6 p<0.05

MATERIALS AND METHODS

A clinical comparative study of sevoflurane and halothane as inhalational agents for induction and intubation is carried out in normal patients including both children and adult age groups, of both sex at Krishna Institute of Medical Sciences and Hospital, Karad from November 2006 to September 2008, after obtaining ethical committee clearance.

The study population consists patients of both sex. They are randomly assigned into 2 groups:

Group I - Consisting of patients induced and intubated with incremental concentration of halothane 0.5% to 5% in 50% oxygen mixture and 50% nitrous oxide.

Group II - Consisting of patients induced and intubated with incremental concentration of sevoflurane 1% to 7% in 50% oxygen mixture and 50% nitrous oxide.

All patients are posted for surgeries under general anaesthesia, are randomly selected. Preanaesthetic evaluation is done a day before the proposed surgery in case of elective surgeries. Relevant history is taken, physical examination carried out and cardiovascular and respiratory systems are assessed for any abnormalities. Normal healthy patients belonging to ASA I and II are included in the study. Patients with moderate to severe systemic diseases i.e. ASA III and IV grade are excluded from this study.

Patients with allergy or sensitivity to either halothane or sevoflurane will be excluded. Patients known or suspected to develop malignant hyperthermia are also excluded.

Monitoring of vitals continued throughout the operative procedure. At the end of surgical procedure, inhalation agents were cut off and 100% oxygen given and reversal of neuromuscular blockade done with neostigmine and glycopyrrolate on body weight basis as standard procedure. Recordings of Heart rate, Blood pressure, SpO2 and MAP are done during induction, at intubation and immediately after intubation at 1 min, 2 min, 3 min, 4 min and 5 min, and during maintenance and continued till emergence. Electrocardiogram was monitored throughout the procedure for the presence of any type of cardiac arrhythmias

The quality of induction are assessed using the parameters as below:

Intolerance	Coughing
Breath holding	SPO2 < 90%
Salivation	Rigidity
Laryngospasm	Movement
Vomiting	Shivering

(As adapted from Bithal, Soudagar, Paul et al. IJA 2000)[12]

All patients are kept in recovery room for at least 1-2 hrs for the occurrence of any postoperative adverse effects as mentioned above and for the analgesic demand as and when required.

Statistical analysis of data is performed using students unpaired 't' test (for finding the significance of difference between means of two independent samples), Chi-square test (a test of association between two events in binominal samples) and correlation test (to study relationship between two or more variables at a time) P value less than 0.05 is considered to be statistically significant.

OBSERVATIONS AND RESULTS

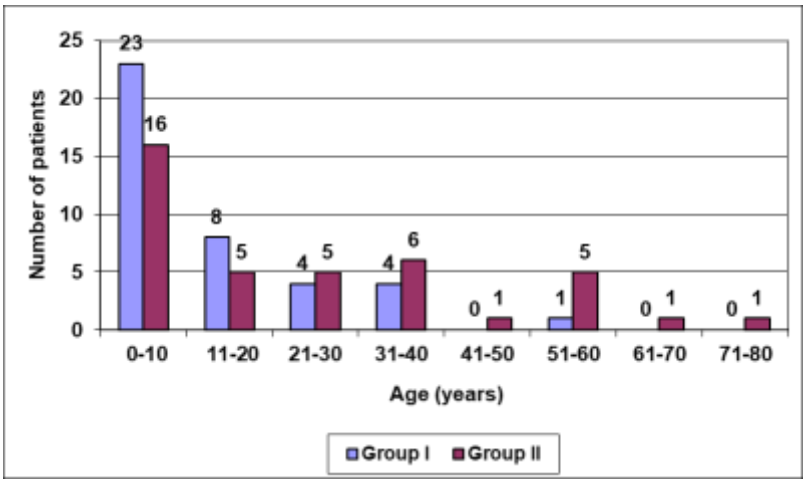

Figure 1: Distribution of patients as per age in the halothane and sevoflurane group.

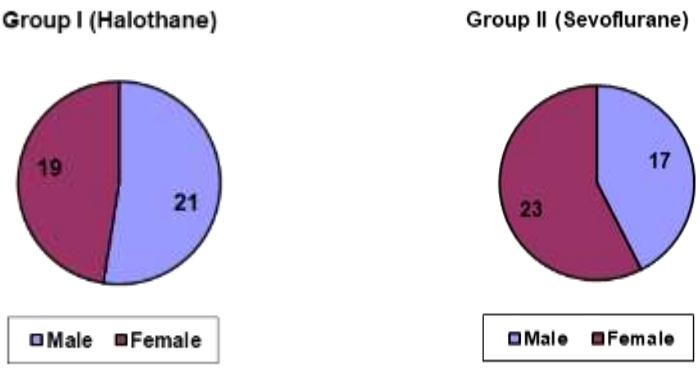

Figure 2: The distribution of sex in the halothane and sevoflurane group.

A comparative study of the induction characteristics of sevoflurane and halothane was carried out at KIMS and Hospital. Each group consisted of 40 patients.

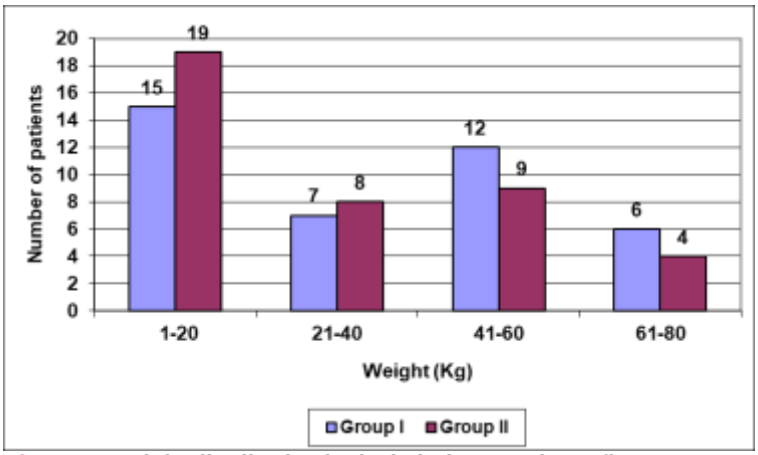

Figure 3: Weight distribution in the halothane and sevoflurane group.

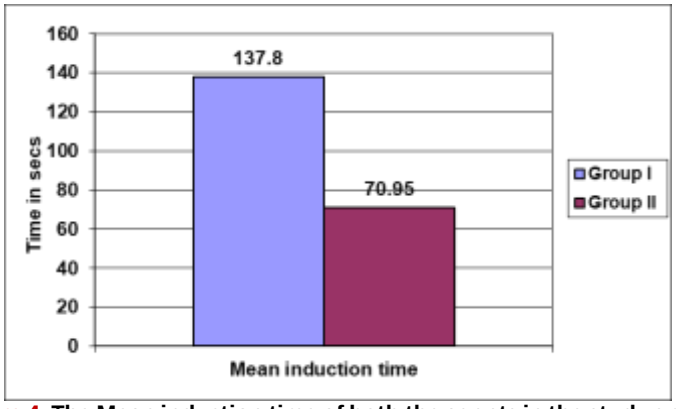

Figure 4: **The Mean induction time of both the agents in the study group.**

Induction time

It is the time interval between the placements of facemask to loss of eyelash reflex. In the present study the above definition was employed for induction time. Mean induction time with halothane was 137.8 sec (SD 33.3 sec) and with sevoflurane 70.95 sec (SD 14.6 sec). When these data was submitted for comparison by unpaired 't' test the result is $p<0.05$, indicating the difference between halothane and sevoflurane induction time was statistically significant. Sevoflurane thus has a faster induction characteristics compared to that of halothane.

Induction characteristics

A number of characteristics were studied during the induction of anaesthesia with the two agents and each character was graded on a scale 0-3, as detailed in Materials and Methods. The results obtained is as shown below.

Table 2: **Induction characteristics of the two groups.**

Induction characteristic	Grade	Group I n=40	Group II n=40	P value
Intolerance	0	32	31	>0.05
	1	8	9	
	2	-	-	
	3	-	-	
Coughing	0	32	36	<0.05
	1	8	4	
	2	-	-	
	3	-	-	
Salivation	0	39	38	>0.05
	1	1	2	
	2	-	-	
	3	-	-	
Laryngospasm	0	40	40	>0.05
	1	-	-	
	2	-	-	
	3	-	-	
Vomiting	0	40	40	>0.05
	1	-	-	
	2	-	-	
	3	-	-	
Breath holding	0	33	37	<0.05
	1	6	3	
	2	1	-	
	3	-	-	
SPO2<90%	0	40	40	>0.05
	1	-	-	
	2	-	-	
	3	-	-	
Rigidity	0	39	38	>0.05
	1	1	2	
	2	-	-	
	3	-	-	

Movement	0	35	29	<0.05
	1	5	11	
	2	-	-	
	3	-	-	
Shivering	0	40	40	>0.05
	1	-	-	
	2	-	-	
	3	-	-	

Laryngospasm, vomiting, SPO2<90% and shivering were not observed in any patients in either group.

Patients in the halothane group had more incidence of coughing than in the sevoflurane group (8 patients in halothane vs 4 patients in sevoflurane). Involuntary movements during induction was observed in a significantly more number of patients in sevoflurane group than halothane group (sevoflurane 11 patients vs halothane 5 patients). Also, Breath holding during induction was observed in a significantly more number of patients in halothane group than sevoflurane group (halothane 7 patients vs sevoflurane 3 patients). When these data were submitted for comparison by chi-square test, the result is p<0.05, indicating the difference between halothane and sevoflurane induction characteristics (i.e. for coughing, involuntary movements and breath holding) was statistically significant.

The other characteristics of intolerance, salivation and rigidity that occurred in the two groups were comparable and there was no statistically significant difference in their occurrence between the two groups after applying chi-square test. These induction related side-effects were minimal and transient and did not come in the way of smooth induction in all the patients in both the groups.

Intubation time

It is the time interval between the placements of facemask to centrally placed mid-dilated pupils.

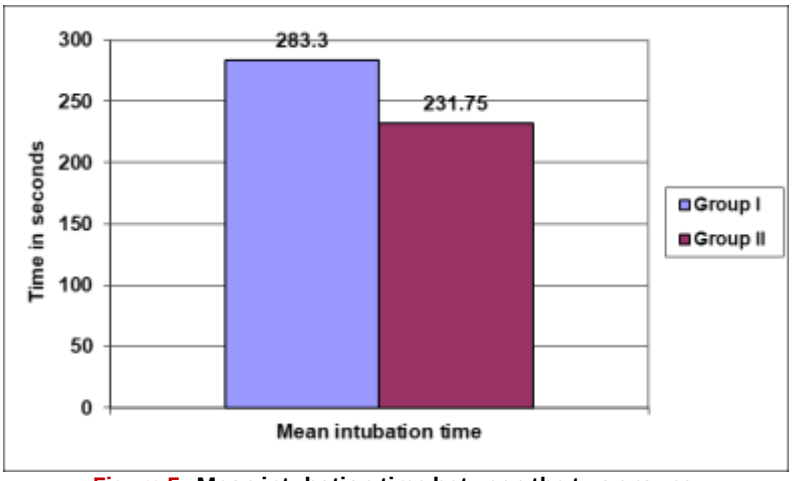

Figure 5: Mean intubation time between the two groups.

Mean intubation time with halothane was 283.3 secs (SD 34.7) and that with sevoflurane 231.7 secs (SD 48.5). When these data was submitted for comparison by unpaired 't' test the result is p<0.05, indicating the difference between the halothane and sevoflurane intubation time was statistically significant. We noted a significantly shorter intubation time with sevoflurane than with halothane.

Intubation characteristics

A number of characteristics were studied during the intubation with the two agents and each character was graded on a scale 1-4, as detailed in the Materials and Methods. The result obtained is as shown below.

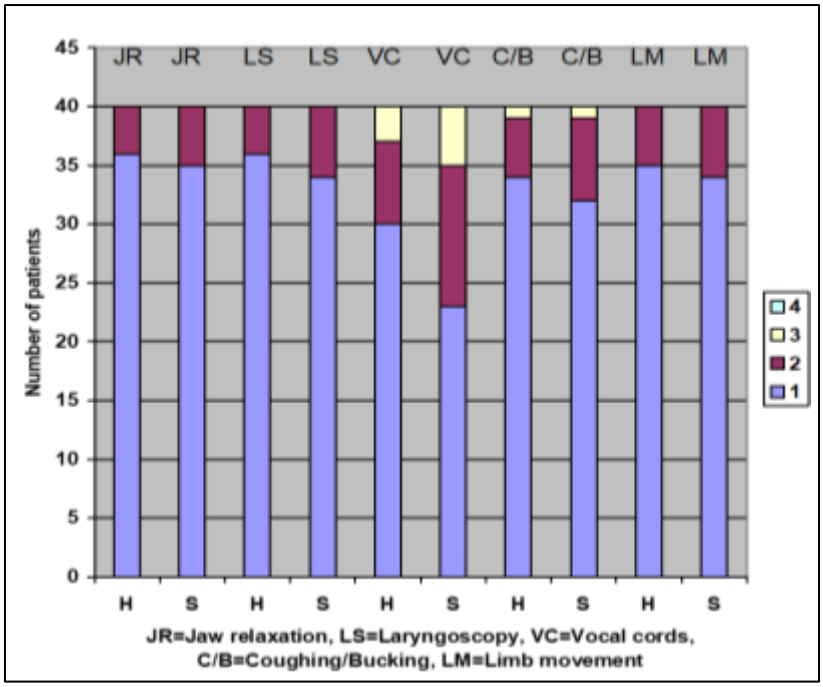

Figure 6: Intubation characteristics of both the agents in the study group.
H - Halothane, S - Sevoflurane.

Thus 90% patients in halothane group and 85% patients in sevoflurane group had excellent intubating conditions. 4 patients in group I and 6 patients in the group II had a score of 3 in any one category and hence intubating condition was considered difficult in these patients, as per the scale used for assessing intubating conditions. However, we were able to intubate in all the patients in both groups in the first attempt.

Also, significantly more number of patients had the vocal cords moving or closing in the sevoflurane group compared to halothane group. When these data was submitted for comparison by Chi-square test the result is $p<0.05$, indicating the difference between the halothane and sevoflurane intubating characteristics was statistically significant.

Haemodynamic characteristics

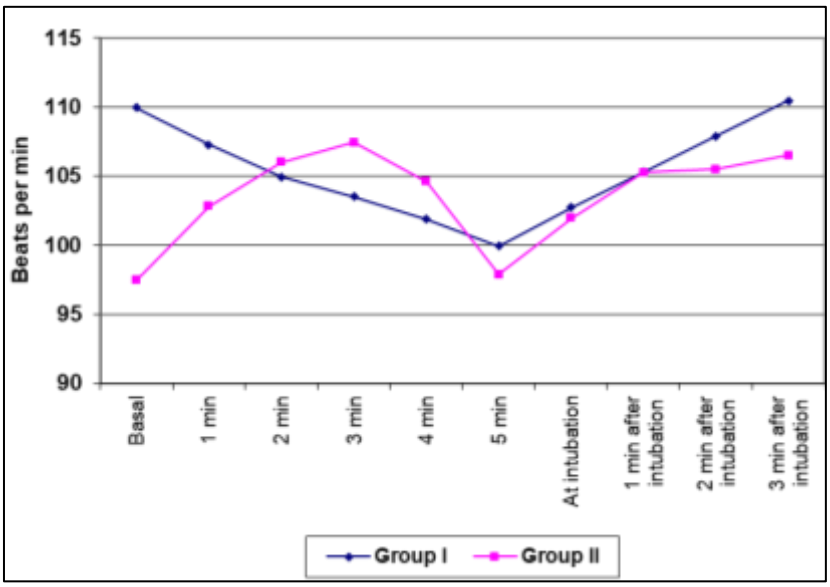

Figure 7: Mean Heart Rates changes during induction and intubation

Basal heart rate was 109.95 bpm in halothane group and 97.45bpm in the sevoflurane group. With induction of anaesthesia the heart rate decreased progressively in the halothane group from 109.95 bpm to 99.95 bpm, at 5 min. Whereas, in the sevoflurane group there was no significant change in the heart rate compared to basal value at 5 min. After intubation an increase in heart rate was observed in both the groups. Heart rate increased from 102.75 bpm at intubation to 110.45 bpm 3 min after intubation in the

halothane group and from 101.95 bpm at intubation to 106.5 bpm 3 min after intubation in the sevoflurane group.

Mean arterial pressure (MAP)

Basal MAP was 92.75 mmHg in halothane group and 88.75 mmHg in the sevoflurane group. With induction of anaesthesia there was a progressive decrease in the MAP in both the groups. MAP decreased from 92.75 mmHg to 82.85 mmHg at 5 min in halothane group and from 88.75 mmHg to 81.65 mmHg at 5 min in the sevoflurane group.

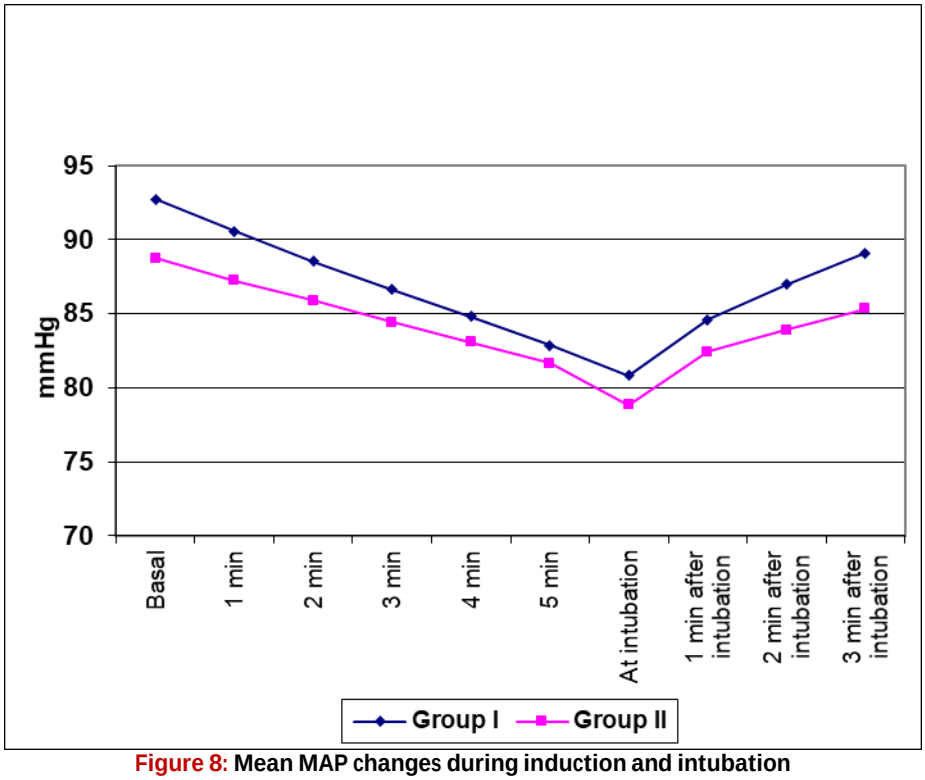

Figure 8: Mean MAP changes during induction and intubation

After intubation an increase in MAP was observed in both the groups. MAP increased from 80.83 mmHg at intubation to 89.13 mmHg 3min after intubation in the halothane group and from 78.83 mmHg at intubation to 85.33 mmHg 3 min after intubation in the sevoflurane group. The occurrence of cardiac arrhythmias and ventilatory depression (SPO2) were not observed in any patient in the either group, during maintenance.

CONCLUSIONS

Halothane has been the inhalational induction agent most often used in pediatric cases and in the anticipated difficult airway cases in adult population as it provides smooth induction with good intubating conditions. However, it has disadvantages like myocardial depression and cardiac arrhythmias. In conclusion, sevoflurane produces comparatively rapid and fairly smooth induction than halothane and intubation time is achieved much faster with sevoflurane than halothane. Induction with both agents is associated with minimal and transient induction side-effects and excellent intubating conditions are obtained with both agents in majority of patients. Haemodynamic stability during induction, intubation and maintenance is better with sevoflurane compared to halothane. Emergence and recovery from anaesthesia was significantly faster with sevoflurane than halothane with minimal emergence side-effects. However, quicker recovery from sevoflurane anesthetic is associated with higher incidence of agitation, probably due to early requirement of postoperative analgesic. Therefore, besides paediatric and difficult airway cases, in other clinical situations where quicker induction, faster intubation with security of airway and rapid emergence from anaesthesia with early discharge from hospital is desired, sevoflurane use has a definite clinical advantage over halothane anaesthesia.

CONFLICT OF INTEREST

None

BIBLIOGRAPHY

1. Klock, P. Allan, et al. "The effect of sevoflurane and desflurane on upper airway reactivity." Anesthesiology: The Journal of the American Society of Anesthesiologists 94.6 (2001): 963-967.
2. Swadia, V. N., G. P. Mamta, and G. Patel. (2001): "Comparison of induction and intubation characteristics of sevoflurane and halothane in paediatric patients." Indian J Anaesth 45.4: 294-7.
3. Dedhia, Kajal N., and Amala Kudalkar. (2004): "Comparison of sevoflurane and halothane for induction of anesthesia and laryngeal mask airway insertion in pediatric patients." Indian J Anaesth 48.6 : 465-68.
4. Choudhary M., Kiran U., Saxena N. (2005): Is sevoflurane vital capacity inhalational induction

suitable for patients undergoing coronary artery bypass grafting surgery. A comparison with halothane. Indian J. Anaesth. 2005; 49(5):403-408.
5. Black, A., et al. "A comparison of the induction characteristics of sevoflurane and halothane in children." Anaesthesia 51.6 (1996): 539-542.
6. Naito, Y., et al. "Comparison between sevoflurane and halothane for paediatric ambulatory anaesthesia." BJA: British Journal of Anaesthesia 67.4 (1991): 387-389.
7. Lerman, Jerrold, et al. "Induction, Recovery, and Safety Characteristics of Sevoflurane in Children Undergoing Ambulatory SurgeryA Comparison with Halothane." Anesthesiology: The Journal of the American Society of Anesthesiologists 84.6 (1996): 1332-1340.
8. Piat, Veronique, et al. "Induction and recovery characteristics and hemodynamic responses to sevoflurane and halothane in children." Anesthesia and analgesia 79.5 (1994): 840-844.
9. Paris, S. T., et al. "Comparison of sevoflurane and halothane for outpatient dental anaesthesia in children." British journal of anaesthesia 79.3 (1997): 280-284.
10. Sarner, Joel B., et al. "Clinical characteristics of sevoflurane in children A comparison with halothane." Anesthesiology: The Journal of the American Society of Anesthesiologists 82.1 (1995): 38-46.
11. Taivainen, Tomi, et al. (1994): "Comparison of the effects of sevoflurane and halothane on the quality of anaesthesia and serum glutathione transferase alpha and fluoride in paediatric patients." BJA: British Journal of Anaesthesia 73.5 : 590-595.
12. Bithal, Parmod Kumar, et al. "Comparison of halothane with sevoflurane inhalation in children for tracheal intubation." Ind J Anaesth 44 (2000): 47-54.

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