COMPARISON OF SEVOFLURANE WITH HALOTHANE FOR ENDOTRACHEAL INTUBATION IN PAEDIATRIC PATIENTS

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ABSTRACT

In paediatric patients, smooth induction with rapid endotracheal intubation without morbidity and mortality is of prime importance. Many of the inhalational anaesthetic agents have been tried for this purpose. In the present study, Sevoflurane due to its high potency, rapid induction, excellent intubating conditions with haemodynamic stability was compared with Halothane in paediatric patients. In the present study, 60 paediatric patients of ASA grade I and II of either sex were divided into 2 equal groups of 30 each according to inhalational anaesthetic agent used for induction of anaesthesia. In group S, Sevoflurane 8% and group H Halothane 3% were used for induction of anaesthesia with Nitrous oxide/oxygen mixture on Boyles' anaesthesia machine. All patients received Inj. Glycopyrrolate 5-8 µgm/kg and inj. Midazolam 0.25 µgm/kg as premedication 10 minutes prior to the induction of anaesthesia. It was observed that mean induction time in group S was 210±17 secs. and in Group H was 262±21 secs. Sevoflurane has low blood/gas co-efficient of 0.69 as compared to Halothane 2.5, so quicker induction time with Sevoflurane as compared to Halothane. In group S, 90% of patients had excellent intubating conditions, 7% good, and 3% had fair while in group H 84% had excellent intubating conditions, 13% had good, and 3% had fair intubating conditions. During intubation, mean pulse rate decreased significantly in both groups and increased after intubation. The decrease in pulse rate was comparatively less in group S than group H and also there was significant increase in pulse rate after intubation in both groups. Similar changes were observed with mean systolic blood pressure and mean arterial pressure in both groups. Thus, Sevoflurane provided better cardiovascular stability during and after intubation as compared to Halothane. We observe that, Sevoflurane due to its cardiovascular stability, smooth induction, and excellent intubating conditions maybe preferred over Halothane in paediatric patients for endotracheal intubation.

KEYWORDS

Sevoflurane, Halothane, Smooth Induction, Rapid Intubation, Paediatric Patients.

HOW TO CITE THIS ARTICLE: Deshmukh UU, Manikrao AS, Satish GD. Comparison of sevoflurane with halothane for endotracheal intubation in paediatric patients. J. Evolution Med. Dent. Sci. 2016;5(69):5025-5029, DOI: 10.14260/jemds/2016/1141

INTRODUCTION

Introduction of newer anaesthetic agents and inhalation agents have refined and improved the anaesthetic practice. Endotracheal intubation is mandatory for providing safe protected airway and IPPV during general anaesthesia for operative procedures. Smooth endotracheal intubation is necessary to avoid bucking and coughing during laryngoscopy and endotracheal intubations and related complications of aspiration of gastric contents resulting morbidity and mortality.

In paediatric patients for smooth induction and rapid endotracheal intubation, halogenated hydrocarbon inhalational anaesthetic agents are being tried by so many practicing anaesthesiologists. Halothane was synthesised in 1951 and was introduced for clinical use in 1956. Halothane has tendency to enhance the dysrhythmogenic effects of epinephrine, which led to search of new inhalational agents. In this series, Methoxyflurane, Enflurane, Isoflurane were tried, but were not so popular. Then, Sevoflurane was introduced.

Halothane has been used worldwide for many years as it provides smooth induction and good intubating conditions with some drawbacks of myocardial depression and arrhythmias. Sevoflurane is non-pungent and with rapid increase in alveolar concentration makes it an excellent choice for rapid and smooth induction in paediatric patients. It has rapid onset of action within 1-3 minutes in 4-8% concentration with more rapid emergence.

In view of these properties, the present study was undertaken to evaluate the efficacy of Sevoflurane for smooth induction and rapid endotracheal intubation with haemodynamic stability as compared to Halothane in paediatric patients.

MATERIAL AND METHODS

The present study was undertaken in 60 paediatric patients of age range 3 months-3 years of ASA grade I and II. The weight range was 3-12 kg. Sampling method used was double-blind randomised study. The paediatric patients with severe systemic diseases of renal, cardiovascular, respiratory, hepatic, and central nervous system were excluded from the study. All patients were preanaesthetically evaluated for fitness of anaesthesia and informed valid consent was obtained from parents. These patients were divided into 2 equal groups of 30 patients each according to inhalational induction agent used for endotracheal intubation. Sevoflurane group was labelled as Group S and Halothane group as Group H.

Preoperatively, baseline pulse rate, blood pressure, and O_2 saturation were noted. All patients were premedicated with Inj. Glycopyrrolate 5-8 µgm/kg and inj. Midazolam 0.25 µgm/kg IV 10 minutes prior to induction. Induction of anaesthesia was performed with N_2O/Oxygen and either Halothane or Sevoflurane on mask with Boyles' anaesthesia

Financial or Other, Competing Interest: None.
Submission 07-05-2016, Peer Review 13-08-2016,
Acceptance 20-08-2016, Published 29-08-2016.
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DOI: 10.14260/jemds/2016/1141

machine. Endotracheal intubation was performed under 6-8% Sevoflurane or 2-3% Halothane slowly incremental inhalation.

The quality of endotracheal intubation was assessed as ease of laryngoscopy, vocal cord position, coughing, or bucking on laryngoscopy and intubation, jaw relaxation, and response of body movements. The scoring system was used as devised by Helbo-Hausen and Trap-Anderson (1998)[1] and revised by Steyn et al (1998).[2]

Anaesthesia was continued and maintained with N_2O, Oxygen, Halothane, or Sevoflurane on controlled ventilation. All patients were monitored for changes in pulse rate, blood pressure (systolic, diastolic, and mean pressure) intraoperatively, after premedication, during intubation, after intubation and 1, 2, 3 minutes after intubation. At the end of operative procedure, inhalational anaesthetic agent was tapered and extubation was done after complete recovery. These patients were also observed in recovery room for any related complications.

Statistical Analysis

The chi-square test was used for non-parametric data and students 't' test for parametric data.

Scoring System for Intubating Conditions:

Criteria	Score			
	1	2	3	4
Laryngoscopy	Easy	Fair	Difficult	Impossible
Vocal cords	Open	Moving	Closing	Closed
Coughing	None	Slight	Moderate	Severe
Jaw relaxation	Complete	Slight	Stiff	Rigid
Limb movement	None	Slight	Moderate	Severe

Helbo-Hansen[1]

Criteria	Score			
	0	1	2	3
Jaw relaxation	Poor	Minimal	Moderate	Good
Vocal cord position	Closed	Closing	Moving	Open
Reaction to intubation	Severe Coughing	Mild Coughing	Slight Movements	none

Cooper

Intubating Condition	Total Score
Excellent	8-9
Good	6-7
Fair	3-5
Poor	0-2

RESULTS

Age in Months	Sevoflurane Group S		Halothane Group G	
	No. of Patients	%	No. of Patients	%
3-6	1	3	4	13
7-12	9	30	8	27
13-18	4	13	4	13
19-24	7	24	4	13
25-30	3	10	8	27
31-36	6	20	2	8
Total	**30**		**30**	

Table I: Showing Age Distribution

Gender	Group S		Group H	
	No. of Patients	%	No. of Patients	%
Male	20	67	23	77
Female	10	33	07	23
Total	**30**		**30**	

Table II: Showing Sex Distribution

Weight Range in Kg	Sevoflurane Group S		Halothane Group G	
	No. of Patients	%	No. of Patients	%
1-3	1	3	1	3
4-6	9	30	12	40
7-10	16	54	14	47
11-14	4	13	3	10
25-30	3	10	8	27
31-36	6	20	2	8
Total	**30**		**30**	
Mean	7.68±2.57		7.30±2.64	

Table III: Showing Weight Range in Kg

Induction Time In Sec.	Group S		Group H	
	No. of Patients	%	No. of Patients	%
180-210	16	53	--	--
210-240	14	47	4	12
240-270	--	--	13	39
270-300	--	--	13	39
Total	**30**		**30**	
Mean time	210±17 secs		262±21 secs	

Table IV: Showing Distribution According to Induction Time

Intubating Conditions	Group S		Group H	
	No. of Patients	%	No. of Patients	%
Excellent	27	90	25	84
Good	2	7	4	13
Fair	1	3	1	3
Poor	--	--	--	--
Total	**30**	**--**	**30**	**--**

Table V: Showing Intubating Conditions

Time Interval	Group S	Group H
After Premedication	127. 63±9.91	129.86±9.81
During Intubation	118.96±9.86	113.13±9.56
After Intubation	133.86±10.74	126.06±8.28
1 minute after intubation	130.86±9.66	127.06±8.71
2 minutes after intubation	128.86±10.97	127.56±9.46
3 minutes after intubation	129.53±11.53	127.73±10.50

Table VI: Showing Changes in Mean Pulse Rate

Time Interval	Mean Systolic Blood Pressure in mm of Hg	
	Group S	Group H
After Premedication	90.73±8.19	90.08±7.94
During Intubation	86.36±7.98	80.66±6.65
After Intubation	99.80±7.66	96.0±6.38
1 minute after Intubation	94.76±7.19	92.6±5.99
2 minutes after Intubation	93.73±7.14	92.4±5.97
3 minutes after Intubation	93.13±6.78	91.86±5.27

Table VII: Showing Changes in Mean Systolic Blood Pressure

Time Interval	Mean Arterial Blood Pressure in mm of Hg	
	Group S	Group H
After Premedication	56.7±4.41	60.93±4.77
During Intubation	56.42±4.13	57.99±3.98
After Intubation	66.58±5.52	63.46±3.72
1 minute after intubation	61.58±4.90	61.21±3.35
2 minutes after intubation	60.70±4.50	61.15±3.15
3 minutes after intubation	60.01±4.50	60.57±2.71

Table VIII: Showing Mean Arterial Blood Pressure

OBSERVATIONS

These 60 paediatric patients were divided into 2 groups. The age distribution was as shown in Table No. I.

Mean age range in group S was 21±9 months and group H was 18±9 months. There was no significant difference as far as age range was concerned in both groups (p-value=0.22). Distribution of patients according to sex was as shown in Table No. II.

There were 67% male in group S and 77% in group H while there were 33% female in group S and 23% in group H.

The weight range in both groups was as shown in Table No. III.

Mean weight range was 7.68±2.57 in group S and 7.30±2.64 in group H. There was no statistical significant difference in weight of both groups (p-value=0.87).

The distribution of patients according to induction time in seconds was as noted in Table No. IV.

The induction time was within 180-210 seconds in 53% of patients and 210-240 secs in 47% in Sevoflurane group. In Halothane group, induction time was 210-240 secs in 12%, 240-270 secs and 270-300 secs in 39% of patients each. The mean induction time was 210±17 secs. in Sevoflurane group and 262±21 secs in Halothane group. Thus, induction time was significantly less in Sevoflurane group as compared to Halothane group (p-value=0.02). Sevoflurane offered quicker induction than Halothane in paediatric patients.

The distribution of patients according to intubating conditions observed were as shown in Table No. V.

In Sevoflurane group, 90% of patients had excellent intubating conditions while in Halothane group 84% of patients had excellent intubating conditions. Good intubating conditions were noted in 7% of patients in group S and 13% patients in group H. Only one patient in each group had fair intubating conditions. So, the intubating conditions between two groups were not statistically significant (p-value=0.99). Thus, intubating conditions were excellent in more number of patients of Sevoflurane group as compared to Halothane group.

The changes in mean pulse rate at various time intervals were noted as shown in Table No. VI.

After premedication, mean pulse rate was 127.63±9.91 in group S and 129.86±9.81 in group H. During intubation, mean pulse rate was 118.96 in group S and 113.13±9.56 in group H. It was observed that mean pulse rate was significantly less in both groups during intubation as compared to premedication readings (p-value=0.03). The mean pulse rate increased insignificantly in both groups after intubation and 1,2,3 minutes time intervals in both groups as compared to post premedication. The mean pulse rate remained low during intubation in both groups.

The changes in mean systolic blood pressure at various time intervals in both groups were as shown in Table No. VII.

After premedication, mean systolic blood pressure were 90.73±8.19 mm of Hg in group S and 90.08±7.94 mm of Hg in group H. There was significant fall in mean systolic blood pressure during intubation in both groups as compared to premedication readings (p-value=0.007). After intubation and at 1,2,3 minutes intervals, again there was insignificant increase in mean systolic blood pressure in both groups as compared to during intubation readings and also during premedication readings. Thus, during intubation, mean systolic blood pressure was significantly less as compared to premedication and after intubation readings in both groups.

The changes in mean arterial pressure were noted as shown in Table No. VIII.

After premedication, mean arterial blood pressure was 56.7±4.41 mm of Hg in group S and 60.93±4.77 mm of Hg in group H. There was insignificant decrease in mean arterial pressure during intubation readings in both groups (p-value=0.11). There was no significant difference in mean arterial pressure amongst two groups at various time intervals.

DISCUSSION

Since introduction of newer inhalational anaesthetic agents, it has become safe to practise anaesthesia. These contribute for advanced medical and healthcare for human population. General anaesthesia constitutes smooth induction, rapid endotracheal intubation, uneventful intra and postoperative outcome after operative procedures. Aspiration of gastric contents during laryngoscopy and intubation is a major contributing factor for anaesthetic morbidity and mortality. So, smooth induction and rapid endotracheal intubation is mandatory particularly in paediatric patients to avoid these complications.

Inhalational anaesthetic agents with potent action and smooth induction simplified technique of general anaesthesia. Halothane due to its high potency and smooth induction, easy passage into deep levels of anaesthesia by increasing concentration, sweet smell, and easy acceptance by paediatric patients remained agent of choice for many years. There is tendency for alkaline derivatives of Halothane to enhance dysrhythmogenic effects of epinephrine, which led to search of new inhalational agents particularly derived from esters. The introduction of fluorinated methyl isopropyl ester Sevoflurane having low solubility in blood facilitates rapid and smooth induction and smooth recovery.

Meretoja O A et al (1996),[3] Paris S T et al (1997),[4] Brain K O et al (1998),[5] Sigston P E et al (1997),[6] Black A et al (1996),[7] and Vernoque et al (1994)[8] have used Sevoflurane and Halothane in paediatric patients for endotracheal intubation. In the present study, the age range was 3 months to 3 years and the age range of above authors was corresponding to our study. Mean weight range was 7.68±2.64 kg in Group S and 7.30±2.64 in group H. There was no statistical difference in both groups.

Induction Time

Meretoja O A et al (1996),[3] Paris S T et al (1997),[4] Brien K O et al (1998),[5] Massakki et al (1993),[9] Veronique et al (1994),[8] Matsuyki et al (1993),[10] Joel B et al (1995),[11] Sigston et al (1997),[6] Bkack A et al (1996),[7] and many others have used various inhalational anaesthetic agents such as Sevoflurane, Halothane, Enflurane, or Isoflurane for induction of anaesthesia in their paediatric patients. Many of them have noted that, induction time within 120-160 seconds for Sevoflurane and 180-240 secs for Halothane. In the present study, mean induction time was 210±8 secs for Sevoflurane and 262±21 secs for Halothane. Induction time was significantly less with Sevoflurane as compared to Halothane. The induction time was comparatively prolonged in the present study as the inspired concentration was low during the starting of induction in both groups as compared to other studies. Most of above authors have observed quicker induction time with Sevoflurane as compared to Halothane in their studies. Our observations coincides with above observations.

The slow induction of anaesthesia is mainly due to its high blood/gas coefficient (Krien K O et al, 1998).[5] The induction of anaesthesia with inhalational anaesthetic agents depend on alveolar ventilation, cardiac output, and regional distribution as tissue/blood and blood/gas solubility coefficient (Veronique et al 1994).[8] Sevoflurane has a low blood/gas solubility than Halothane, hence rapid induction, rapid recovery. Thus, sevoflurane is more potent than Halothane, hence induction is quicker with sevoflurane as compared to Halothane and our observations can be explained on above grounds.

Intubating Conditions

Brien K O et al (1998)[5] used Helbo-Henson, Ralvo, and Trap Anderson.[1] Scoring system to assess the intubating conditions in their study. In the present study, we have also assessed the intubating conditions with above system in our study. We have observed equivalent intubating conditions either with Sevoflurane and Halothane. We have noted 27 (90%) out of 30 in Group S and 25 (84%) out of 30 in group H had excellent intubating conditions. Masaki et al (1993),[12] P E Sigston et al (1998),[6] Black J E et al (1996),[7] R C Agnor et al (1998)[12] have also observed excellent intubating conditions in more number of patients with Sevoflurane as compared to Halothane induction. Sevoflurane has less airway irritation, more pleasant smell than Halothane, so more acceptance with rapid induction and deep level of anaesthesia than Halothane. So, more number of patients had excellent intubating conditions with Sevoflurane than Halothane.

Heart Rate

O A Meretoja et al (1996)[3] observed cardiac arrhythmias more common in Halothane induction as compared to Sevoflurane anaesthesia. In our study, mean pulse rate decreased in Group S during intubation and increased after intubation. In Group H, mean pulse rate was more decreased during intubation and increased after intubation. We observed Sevoflurane to be more cardio stable as compared to Halothane as far as mean pulse rate was concerned. Paris S T et al (1993),[4] Brien K O, et al (1998),[5] Friesen R H et al (1982),[13] Veronique et al (1994),[8] and Sorner J B et al (1995)[11] have also noted Sevoflurane to be cardio stable during intubation than Halothane. Our observations correlate with these authors. Cardio stability offered with Sevoflurane might be due to its non-myocardial depressant action, which is there with Halothane.

Mean Arterial Pressure

Friesen R H et al (1982),[13] Epstein R H et al (1995),[14] Sarner J B et al (1995),[11] Shin Kawana et al (1995),[15] Black A et al (1996),[7] Brien K O et al (1998),[5] and H Vitanen (1999)[16] have studied mean arterial pressure during induction and after intubation under Sevoflurane and Halothane anaesthesia. In the present study, in group H, mean systolic blood pressure and mean arterial pressure decreased during intubation by 10 mm of Hg and increased after intubation. There are many variations as far as mean systolic and mean arterial pressure is concerned in different studies. These might be due to differences in age group of patients, MAC values, and concentrations of Sevoflurane and Halothane used for induction of anaesthesia. Overall, Sevoflurane offers more cardio stability due to less myocardial depressant action as compared to Halothane in paediatric patients.

CONCLUSIONS

From the present study, it was concluded that inhalational anaesthetic agents Sevoflurane and Halothane can be used for smooth induction and rapid endotracheal intubation. Sevoflurane has sweet smell, less airway irritation, and greater acceptance particularly by paediatric patients, so it is preferred over Halothane. Sevoflurane is more potent than Halothane. It provides excellent intubating conditions with cardiovascular stability in paediatric patients as compared to Halothane. So, it is better choice in paediatric patients for endotracheal intubation than Halothane.

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