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Comparative Study Of High Dose Versus Incremental Doses Of Sevoflurane For Induction In Paediatric Patients.

Nandita Kad[1], Deepak[2], Kiranpreet[3], Jai prakash[4], Vineet Kumar[5]

[1]Professor, Department of Anaesthesia, PGIMS, Rohtak, Haryana, India.
[2]Junior Resident, Department of Anaesthesia, PGIMS, Rohtak, Haryana, India.
[3]Associate Professor, Department of Anaesthesia, PGIMS, Rohtak, Haryana, India.
[4]Assistant Professor, Department of Anaesthesia, PGIMS, Rohtak, Haryana, India.
[5]Senior Resident, Department of Anaesthesia, PGIMS, Rohtak, Haryana, India.

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ABSTRACT

Background: We compared high doses of sevoflurane with incremental doses of sevoflurane during induction in paediatric patients. **Methods:** The present prospective, randomized single blind study conducted in the Dept. of Anaesthesiology PGIMS, Rohtak. . A total of 80 patients of either sex and age (1-6 yrs) years presenting for elective surgery under general anesthesia were included in the study.Ethical clearance and written informed consent taken for study. . Patients were randomly divided in 2 groups (I and II) of 40 each.Group I patients) were induced with high dose (8%) sevoflurane whereas group II patients were induced with incremental dose of sevoflurane (1% to 8%). Study parameters (HR, BP, SpO2) were recorded just before starting induction (T0) and at 30 seconds (T1), 60 seconds (T2), loss of eyelash reflex (T3) and after insertion of PLMA (T4). **Results:** Our primary outcome, time required for induction of anaesthesia in Group I was found to be 60.225 ±4.932 secs and for the Group II it was found to be 84.9± 6.953secs.The difference was highly significant between the two groups (p value = 0.0001). **Conclusion:** This randomised,blind controlled study suggests that the time for induction of anesthesia could be significantly shortened using sevoflurane with a high concentration primed circuit as compared with incremental induction technique. The effect of both these techniques on haemodynamic parameters was statistically insignificant. Also both the techniques were safe and well tolerated in paediatric patients.

Keywords: Sevoflurane 8% vs incremental sevoflurane , paediatric , onset time for induction.

INTRODUCTION

Induction with inhalational agents is preferred in children because of difficult venous access and lack of cooperation. It will also save the paediatric patients from insertion of intravenous needle and discomfort caused by injection of intravenous anaesthetic agents. Inhalational induction may be desirable on those occasions when there is a danger of airway obstruction following rapid loss of consciousness.[1]

The introduction of fluorinated hydrocarbons into clinical practice provides one of the greatest landmarks in the development of anaesthesia. Fluorinated hydrocarbons are used very frequently in paediatric patients as inhalational agents for induction and in adults for day care anaesthesia.[2] Sevoflurane (1,1,1,3,3,3-hexafluoro-2-(fluoromethoxy) propane) derives its name from seven fluorine atoms in its substituent, alongside a standard suffix for such agents. Sevoflurane is a sweet smelling, non flammable, highly fluorinated methyl isopropyl ether used as an inhalational anaesthetic for induction and maintenance of general anaesthesia. Induction with sevoflurane is reported to be safe, reliable and well accepted. It has low blood: gas anaesthetic solubility which allows rapid induction and emergence from anaesthesia. It causes limited irritation to airways and minimal cardiovascular, respiratory and end organ side effects.[3-5]

The low initial concentration technique involves administering a low concentration of sevoflurane initially and then gradually increasing the concentration until patient is anaesthetised. The high initial concentration technique involves administering high concentrations of sevoflurane from the beginning, continuing until the patient is anaesthetised.[5]

We designed our study to compare high doses of sevoflurane with incremental doses of sevoflurane for induction of anaesthesia in paediatric patients.

Name & Address of Corresponding Author
Dr. Vineet Kumar
Senior Resident, Department of Anaesthesia,
PGIMS, Rohtak,
Haryana, India.

MATERIALS AND METHODS

The present prospective and randomized study was conducted in the Department of Anaesthesiology and Critical Care, Pt. B. D. Sharma, PGIMS, Rohtak. Eighty patients of American Society of Anesthesiologists (ASA) physical status I or II of either sex, aged 1-6 years presenting for elective surgery under general anesthesia were included in the study.

Exclusion Criteria

- Anticipated difficult airway (MPG-III and IV).
- Orofacial abnormality like cleft lip, cleft palate, etc.
- Asthma, pneumonia and bronchoplastic lung disease.
- Congenital heart disease and neuromuscular defects.
- History of seizures.
- Family history of malignant hyperthermia.
- Weighing > 20 kgs.

Clinical Examination

In this study all the children were examined during the preoperative visit a day prior to surgery. A full explanation of general anaesthesia and about the study, including risks and benefits was given to the guardians and informed written consent was obtained from them. Patients were subjected to detailed clinical history, complete general physical and systemic examination. Routine investigations like haemoglobin (Hb), bleeding time (BT), clotting time (CT), urine complete examination and any other investigations needed were done.

Preparation of Patients

The patients were kept fasting for 6 hours prior to the scheduled time of surgery. They were premedicated with syrup promethazine 0.5mgkg-1 orally 2 hours before surgery. On arrival in the operating room monitoring of HR, BP, ECG and SpO2 was done using Phillips Intellivue MP50 monitor. Baseline readings of vital parameters were recorded.

Allocation of Groups

Eighty patients aged between 1 to 6 years belonging to ASA grade I, II were randomly divided into two groups of 40 each by computer generated random number as follows:

Group I (n=40) were induced with high dose (8%) sevoflurane.

Group II (n=40) were induced with incremental dose of sevoflurane (1% to 8%).

Technique and Maintenance of anaesthesia

Group I- After priming the circuit with 8% sevoflurane in 100% oxygen, at a flow of 6Lmin-1, inhalation induction was initiated. After loss of eyelash reflex (eyelash reflex was checked every 3 secs), sevoflurane concentration was reduced to 4%.

Group II- The sevoflurane vaporizer dial was initially set at 1%, in 100% oxygen at a flow rate of 6 Lmin-1. The sevoflurane concentration was incrementally increased by 1% every 10 sec. This was done until the concentration reached 8% or loss of eyelash reflex (whichever occured early).

In both the groups an intravenous access was secured. Adequate analgesia and anaesthesia was given according to requirement of each patient. Optimal size PLMA was inserted. Total induction time was noted in seconds. After induction, sevoflurane concentration was adjusted to maintain MAC 1-1.2%. Study parameters (HR, BP, SpO2) were recorded just before starting induction (T0) and at 30 seconds (T1), 60 seconds (T2), loss of eyelash reflex (T3) and after insertion of PLMA (T4). Thereafter, anaesthesia was continued with nitrous oxide, oxygen, sevoflurane and analgesics administered based on the requirement. Intraoperative vitals were monitored at 1 min, 5 mins and 10 mins. Intraoperatively patients were observed for bradycardia, apnoea, desaturation (SpO2), nausea, vomiting and any other complications.

Haemodynamic responses were compared in between groups by measuring

- Heart rate (HR)
- Systolic Blood Pressure (SBP)
- Diastolic Blood Pressure(DBP)
- SpO2
- Complications, if any.

Induction characteristics were measured as

1. Quality of mask acceptance: good (defined as cooperative child breathing smoothly in face mask); acceptable (defined as a child requiring firm face mask application); or poor (defined as reluctant child requiring active restraint).
2. Degree of airway obstruction (judged by need for an oropharyngeal airway to maintain airway patency).
3. Quality of insertion of device (related to jaw relaxation and number of attempts required for insertion of device).

The speed of induction of anaesthesia was judged clinically by loss of eyelash reflex. Eyelash reflex was checked every 3 secs in each patient until it was lost. All patients were monitored for any adverse reactions intraoperatively and postoperatively.

RESULTS

The patients' demographic profile including age, sex, height, weight, BMI, ASA physical status between the two groups were comparable with each other.

Time For Induction Of Anaesthesia (In Seconds)

Table 1: shows the comparison of time to loss of eyelash reflex between the two studied groups.

Group	Group I		Group II		p value
	Mean ± SD	Min – Max	Mean ± SD	Min – Max	
Time to loss of eyelash reflex (secs)	60.225 ±4.932	50-72	84.9± 6.953	69-101	0.0001

The mean time for loss of eyelash reflex in Group I was found to be 60.225 ±4.932 secs and for the Group II it was found to be 84.9± 6.953secs [Figure 1]. We found statistically highly significant difference between the two groups (p value = 0.0001).

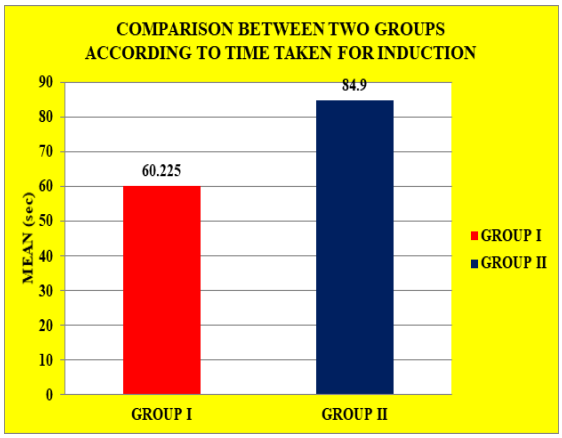

Figure 1:

Heart Rate (Per Minute)

Table 2: Shows intergroup comparison of HR between the two studied groups [Figure 2].

HR	Group I(n=40)		Group II(n=40)		p value
	Mean ± SD	Min – Max	Mean ± SD	Min – Max	
T0	120.625±19.8464	88-162	122.5±16.6394	92-158	0.854
T1	123.575±19.5236	93-166	124.825±16.5775	95-158	0.627
T2	125.325±18.3238	96-164	126.475±18.3008	88-162	0.242
T3	128.5±18.1136	98-166	130.225±16.9667	96-165	0.440
T4	123.475±18.6382	90-162	126.45±16.4300	94-158	0.266
1 MIN	121.525±19.8816	89-163	123.75±16.4702	93-157	0.0799
5 MIN	120.6±19.8349	88-161	122.65±16.7570	92-157	0.468
10 MIN	120.025 ±19.890	89-161	122.025 ±16.869	91-156	0.585

Heart rate was measured at baseline, 30 secs after starting, 60 secs after starting, at time of induction, at time of device insertion, 1 min, 5 mins and 10 mins after insertion of device. The HR at different points of time during the process in two studied group are comparable. Also, there was no significant difference in the HR in both the groups (p value >0.05).

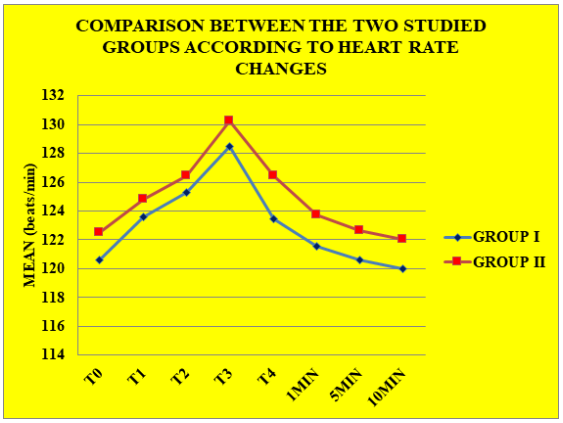

Figure 2:

Comparison Between Two Studied Groups According To Attempts Taken For Device Insertion

Table 3: Shows the comparison between two studied groups in terms of attempts taken for device insertion [Figure 3].

Device Attempts	Group I(n=40)		Group II(n=40)		p value
	No. of cases	Percentage	No. of cases	Percentage	
First	38	95%	37	92.5%	0.644
Second	2	5%	3	7.5%	
Total	40	100%	40	100%	

In Group I PLMA was placed in single attempt in 38 out of 40 cases, and two remaining cases achieved proper insertion in second attempt. On the other hand the in Group II PLMA was inserted in a single attempt in 37 out of 40 cases and remaining three cases achieved proper insertion in second attempt. This difference was statistically insignificant when two groups were compared (p value= 0.644).

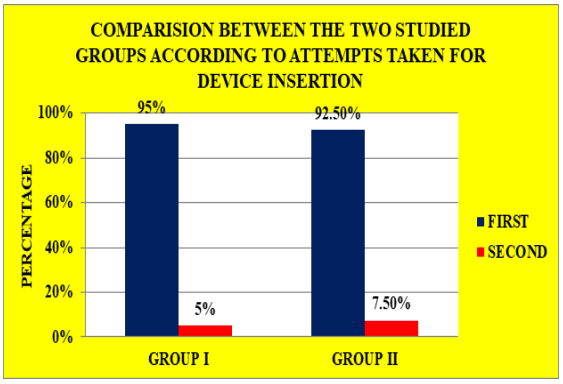

Figure 3:

Comparison Between Two Studied Groups In Terms Of Jaw Relaxation

Table 4: Shows the comparison between two studied groups in terms of jaw relaxation [Figure 4].

	Group I(n=40)		Group II(n=40)		
	No. of cases	Percentage	No. of cases	Percentage	p value
Adequate	38	95%	36	90%	0.6752
Inadequate	2	5%	4	10%	
Total	40	100%	40	100%	

In Group I, 38 cases out of 40 (95%) jaw relaxation was adequate. In Group II, jaw relaxation was adequate in 36 out of 40 cases (90%). This difference was statistically insignificant when two studied groups were compared (p value= 0.6752).

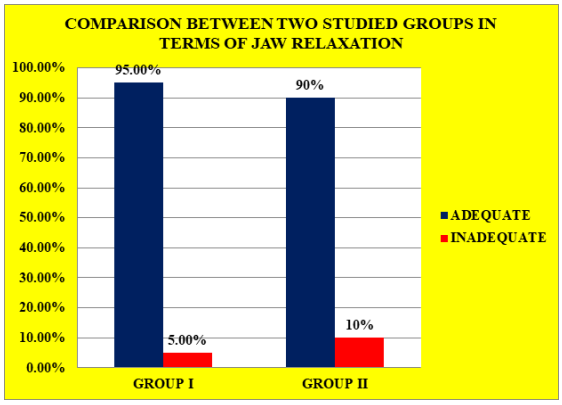

Figure 4:

DISCUSSION

The present prospective, randomized study was conducted in 80 patients of either sex belonging to ASA physical status class I or II, between ages 1 to 6 years, weighing less than 20 kgs, scheduled to undergo elective surgery under general anaesthesia. Patients were divided into two groups of 40 each. All the patients were anaesthetized using an anaesthesia workstation using sevoflurane vaporizer. Patients were randomly allocated to one of the two groups using a computer generated sequence of random numbers.

In Group I, after priming the circuit with 8% sevoflurane in 100% oxygen, at a flow of 6Lmin-1, inhalation induction was initiated. After loss of eyelash reflex (eyelash reflex was checked every 3 secs), sevoflurane concentration was reduced to 4%.

In Group II the sevoflurane vaporizer dial was initially set at 1%, in 100% oxygen at a flow rate of 6 Lmin-1. The sevoflurane concentration was incrementally increased by 1% every 10 sec. This was done until the concentration reached 8% or loss of eyelash reflex (whichever occured early).

The mean time for loss of eyelash reflex in Group I was found to be 60.225 ±4.932 secs and for the Group II it was found to be 84.9± 6.953secs. We found statistically significant difference between the two groups (p value = 0.0001).

Baum et al conducted a study comparing the efficacy and tolerance of paediatric induction with 8% sevoflurane in 70% nitrous oxide in oxygen or with gradual sevoflurane or incremental halothane in 70% nitrous oxide in oxygen. They concluded that immediate 8% sevoflurane results in significantly faster induction than with graded sevoflurane or halothane. Time to loss of consciousness was 37±10s in high sevoflurane, 70±18s in graded sevoflurane group and 81±34s in halothane group (p value<0.001). We also found similar results in our study regarding induction time between immediate 8% and incremental sevoflurane. The induction time in our study was more than their study, this difference could be because of use of nitrous oxide in their study. They also concluded that 8% sevoflurane was well tolerated in ASA I and II patients, we also found similar results in terms of tolerance of 8% sevoflurane.[6]

Dubois et al compared the three techniques for induction of anesthesia with sevoflurane in children. They studied 65 patients, 23 patients were induced using incremental induction of sevoflurane in 100 % oxygen, 22 patients were induced using high concentration of sevoflurane in 100 % oxygen and 20 patients were induced with high concentration of sevoflurane in a mixture of oxygen and nitrous oxide (1:1). Induction was well accepted and well tolerated in most children, Similarly in our study also induction was well accepted and well tolerated in patients. Induction time was 85±16 secs in incremental concentration group and was 61±12 secs in high concentration group with 100 % oxygen. In our study the mean time for loss of eyelash reflex using high concentration was found to be 60.225 ±4.932 secs and using incremental concentration was found to be 84.9± 6.953secs, which is comparable with the above study. All three techniques were well tolerated in children.[7]

In our study we found no significant change from baseline in HR, SBP and DBP in both the groups. The heart rate showed an increasing trend from baseline in both the groups which was maximum just before induction and returned to baseline after insertion of PLMA. This difference was statistically insignificant (p value >0.05). Similar changes in heart rate were also noted in study conducted by Dubois et al.[7]

We also observed a slight decrease in SBP and DBP in both the groups which was not statistically significant. The SBP reached its lowest point just before induction and returned to baseline 5 mins after insertion of PLMA. In group I, from 102±6.421 mm Hg at baseline to 96.15±6.347 mm Hg at the time of induction and returned to near baseline 5 minutes after insertion of PLMA. In group II, from 102.35±6.241 mm Hg at baseline to 97.675±6.111 mm Hg at the time of induction and returned to near

baseline 5 minutes after insertion of PLMA. The lowest reading of DBP in group I was 49.75±3.807 mm Hg, which was seen at the time of induction, whereas the baseline was 54.1±4.505 mm Hg. The lowest reading of DBP in group II was 50.15±4.566 mm Hg, which was seen at the time of induction, whereas the baseline was 54.2±4.456 mm Hg. Epstein et al in 1998 also did not find any statistically significant decrease in systolic and diastolic blood pressure using sevoflurane for induction, this was similar to our study results.[8]

The saturation of oxygen (SpO2) in both the groups, as measured by pulse oximetry probe, did not change significantly in any group at any point of time. There was no episode of desaturation in any of the patient. Similar results were obtained in other included studies.

In Group I bradycardia was seen in 2 out of 40 cases, which is 5% whereas in group II bradycardia was seen in only 1 case out of 40. Bradycardia was resolved by just decreasing the concentration of sevoflurane, we did not require any medical treatment to overcome this. Apnoea was seen in 2 cases out of 40 in group I and in 1 case out of 40 in group II. This breath holding resolved spontaneously. Cough was seen in 5 cases out of 40 in group I and in 3 cases out of 40 in group II. The results were statistically insignificant (p value > 0.05). No incidence of arrhythmia or bradycardia requiring atropine was noted in both the groups. Similar results were seen in study conducted by Dubois et al.[7]

CONCLUSION

From our study we concluded that high concentration primed circuit technique is a quick and safe method and is not associated with clinically significant haemodynamic response or complications. Induction with this technique has advantage of smooth and rapid loss of consciousness as compared to the incremental technique. So, high concentration technique can be very useful in uncooperative and anxious child, as this technique causes faster induction of anesthesia.

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