ISSN: 2474-9206

Research Article

Journal of Anesthesia & Pain Medicine

A Comparative Study of Sevoflurane Versus Isoflurane as an Anaesthetic Agents

Girishkumar Modi*, Vijay Kumar and Nagaraju Munagala

Specialist Anesthesiologist, Tawam Hospital, UAE.

***Corresponding Author**
Girishkumar Modi, Specialist Anesthesiologist, Tawam Hospital, UAE.

Submitted: 2023, Jun 20 ; **Accepted:** 2023, July 10; **Published:** 2023, July 12

Citation: Modi, G., Kumar, V., Munagala, N. (2023). A Comparative Study of Sevoflurane Versus Isoflurane as an Anaesthetic Agents. *J Anesth Pain Med, 8*(4), 159-163.

Abstract

Background: *Inhalational anesthesia has come a long way since the day of open ether and chloroform, newer better inhalational agents continue to be introduced at regular intervals leading the earlier ones to obsolence.*

Objective: *To study recovery characteristics and compare the clinical cardiovascularparameters during maintenance of anesthesia and post-operative events resulting from Sevoflurane and Isoflurane anesthesia.*

Materials and Method: *Fifty adult patients of ASA grade - I and ASA grade - II between the ages of 18-55 years were selected for the study at municipality hospital during anesthesia residency program of author in India. Patients maintained on Sevoflurane were designated as Group - I and those on Isoflurane as Group - II. Inhalational agent was started and maintained with 50% Oxygen and 50% Nitrous Oxdie. Patients were maintained with controlled ventilation with Vecuronium bromide and Inhalational agent. Vital signs were recorded every 15 minutes. After completion of surgery inhalational agent was stopped. Post operatively, the patient's vital signs, muscle tone and power were checked and recorded.*

Result: *In group II, Heart rate increased in 96% as compared to Group I where heart rate increased in 88%. In group II, 92% of patients showed a decrease in MAP as compared to 76% in Group I. In Group I mean (average) time interval between loading dose and 1st maintenance dose of muscle relaxant was 38.48 + 2.40 min and in Group II it was 30.08 + 1.44 min. Recovery was fast in Group - I as compared to Group – II.*

Conclusion: *It was concluded that though hemodynamic disturbances are present with both the agents, Sevoflurane ensures more cardiovascular stability than Isoflurane. The recovery was faster with Sevoflurane than Isoflurane. The incidence of post-operative complications is slightly less with Sevoflurane than Isoflurane. In nutshell, Sevoflurane is a better volatile agent of choice as compared to Isoflurane.*

Keywords: Inhalational Anesthesia, Sevoflurane, Isoflurane, Volatile Agent.

Abbreviation

IPPV: Invasive Positive Pressure Ventilation, TOF: Train of Four, O2 Oxygen, N2O: Nitrous Oxide, MAP: Mean Arterial Pressure, ASA: American Society of Anesthesiology

1. Introduction

The evolution of modern volatile anesthetic agents has been dictated by increasing concern for safety and ease of use. Inhalational anesthesia has come a long way since the day of open ether and chloroform, newer better inhalational agents continue to be introduced at regular intervals leading the earlier ones to obsolence.

Ideal inhalational agent should have the following properties.

- Allows for pleasant, rapid induction and emergence.
- Minimum or negligible metabolism.
- Have the least interaction with body tissue.
- Compatible with materials of circuit and soda lime.
- Non-flammable and non-explosive
- Should not be teratogenic or carcinogenic.
- No significant hemodynamic action
- Provides good analgesia.
- Provides some degree of muscle relaxation.
- Sufficiently potent to allow high inspired oxygen concentra-

tion.

- Should not provide allergic reaction.

With giant stride in technology resulting in better means of delivery with accurate vaporizer it is possible to achieve the desired level of concentration.

Improved automated monitoring allows the monitoring of the required concentration. This place a great check on the morbidity and mortality due to inhalational anesthesia.

Introduction of Sevoflurane that produces rapid induction and emergence ensures better intra operative hemodynamic and cardiac status.

Isoflurane, besides producing rapid induction and outcome also provides more cardiovascular stability and it is potent respiratory depressant. It has no toxic effect on Liver and kidney.

2. Materials and Method

Fifty adult patients of ASA grade - I and ASA grade- II between ages of 18-55 Years of average 50 kg weight were selected for the study. Twenty-five each were maintained with Sevoflurane (0.5 - 2.0 %) and Isoflurane (0.5 - 1.5 %). Patients maintained on Sevoflurane were designated as Group –I and those on Isoflurane as Group - II.

All patients were sent to the operation theatre and ECG, SPO2, NIBP monitors were attached. Patient's pre-operative pulse, B.P., Respiratory rate and SPO2 were recorded, i.v. line was secured. All patients were premedicated with Inj. glycopyrrolate 0.2 mg i.v. Inj. ondansetron 4 mg i.v, Inj. midazolam 1 mg i.v. and lnj. diclofenac 75 mg diluted in 10 cc saline i.v slowly, along with Inj. Ringer lactate was started. Peripheral nerve stimulator was kept ready.

Patients were preoxygenated with 100% 02 for 5 minutes. 5 mg/kg of sodium thiopentone was used to induce the patients. Loss of consciousness was confirmed by loss of eyelash reflex and Inj. Succinyl choline was given at the dose of 2 mg/kg.

I.P.P.V. was given with I00% 02, followed by laryngoscopy and intubation with appropriately sized cuffed endotracheal tube was accomplished. Bilateral air entry checked. Patients were connected to the anesthesia machine through Bain's circuit. Inhalational agent was started and maintained with 50% 0_2 and 50% N_20. Sevoflurane in Group I and Isoflurane in Group II were used with appropriate vaporizers.

Patients were maintained with controlled ventilation with Vecuronium bromide and Inhalational agent. Concentration of inhalational agents was changed according to hemodynamics. Vital signs were recorded every 15 minutes. Vecuronium's dose was repeated with use of TOF mode with peripheral nerve stimulator, when two twitches were recorded.

After completion of surgery inhalational agent was stopped and reversal was done after TOF mode > 3 twitches after stoppage of muscle relaxant with Inj. Glycopyrrolate 0.01 mg/kg i.v. and Inj. Neostigmine 0.05 mg/kg i.v. Extubation was done after establishment of adequate spontaneous respiration, reflexes, muscle tone and power.

Post operatively, the patient's vital signs, muscle tone and power were checked and recorded. Immediate post-operative complications were looked for and recorded if any.

The patient was shifted to the recovery room and monitored for vital signs and post -operative complications for up to 2 hr.

3. Result

Two groups of patients were studied for comparison of Sevoflurane (0.5 -2%) and Isoflurane (0.5 - 1.5%). In Group - I, 60% of patients were of ASA Grade I and in group - II they were 56%.

There were 14 males in Group I (56%) and 13 males in Group II (52%) and allocation to groups were done randomly.

The maximum number of patients were between 18 to 35 years of age. In group I, 60% of patients were between the age range of 18 - 35 years and 40% were between 36 - 55 years while in case of Group II, they were 60% and 40% respectively.

Average pre-operative (basal) heart rate, mean arterial pressure, SPO2 in Group I and Group II is mentioned in Table 1.

	Group-I	Group-II
Average (Mean) Heart rate (beats/min)	78.32 ± 7.13	80.12 ± 7.34
Average (Mean) MAP (mmHg)	83.68 ± 9.74	88.48 ± 8.27
Average (Mean) SPO_2 (0/o)	98.24 ± 0.97	98.44 ± 0.96

Table 1: Pre-Operative (Basal) Haemodynamics Monitor

In group II, the Heart rate increased in 96% as compared to Group I where heart rate increased in 88%. In group II, 92% of patients showed a decrease in MAP as compared to 76% in Group I.

MAP remained steady at 24% in Group I and 8% in Group II.

The mean time interval between loading dose and 1st maintenance dose of muscle relaxant in Group I it was 38.48 + 2.40 min and in Group II it was 30.08 + 1.44 min.

Group I	38.48 + 2.40 min
Group II	30.08 + 1.44 min

Table 2: Mean (Average) time interval from loading dose to first maintenance dose (min.)

TOF mode 3 twitches after stoppage of muscle relaxant were more rapid in Group - I (Sevoflurane) 9.16 + 1.27min as compared to Group -II (Isoflurane) 12.08 + 1.25 min.

Time when TOF mode > 3 after last dose of M.R. (min.)	Group I		Group II	
	No. of Patients	Percentage	No. of patients	Percentage
5 -10	22	88%	4	16
10 - 15	3	12%	21	84%
Mean	9.16 ± 1.27 min		12.08 + 1.25 min	

Table 3: Time when Tof mode ≥ 3 twitches after stopping muscle relaxant

Average post-operative Heart rate: Mean Arterial pressure and SP02 in Group I and Group II is mentioned in Table 4.

	Group-I	Group-II
Average (Mean) Heart Rate (BPM)	82.96 + 7.10	85.64 + 6.99
Average (Mean) MAP (mm of Hg)	90.08 + 7.63	92 + 7.83
Average (Mean) SPO_2 (%)	98.32 + 0.98	98.44 + 0.92

Table 4: Post-operative vital data

The average recovery time in Group - I (Sevoflurane) was 9.20 + 2.15min as compared to Group - II (Isoflurane) 12.08 + l .20min. So, recovery was fast in Group - I as compared to Group – II.

Recovery (minutes)	Group I		Group II	
	No. of Patients	Percentage	No. of Patients	Percentage
5-10	23	92%	4	16%
> IO min.	2	8%	21	84%
Mean time	9.20 + 2.15 min.		12.08 + 1.20 min	

Table 5: Recovery time of patients

Nausea was the most common post-operative complication in both groups. (Table 6)

Complications	Group I		Group II	
	No. of Patients	Percentage	No. of Patients	Percentage
Nausea	7	28	8	32
Vomiting	4	16	4	16
Coughing	3	12	4	16
Somnolence	5	20	5	20
Dizziness	2	8	3	12
Chills	3	12	4	16
Agitation	0	0	0	0

Table 6: Post-operative complications

4. Discussion

Fifty patients ASA grade I and II were taken up for surgical procedures. 25 of them were designated as belonging to Group I (Sevoflurane) (0.5 - 2%) and the remaining 25 - belonging to Group II (Isoflurane) (0.5 - 1.5%).

There were 14 males in Group I (56%) and 13 males in Group II (52%) and allocation to groups were done randomly. All subjects were between the ages of 18 - 55 years.

During the study of twenty-five patients, in the case of Group I patients' heart rate increased in 88% patients and remained steady in 12% patients, while in case of Group II heart rate increased in 96% and remained steady in 4% patients. Mean heart rate change was + 5.87%in the case of Group I while in Group II it was+ 9.78%. Thus, tachycardia was more common in Group II. Isoflurane depresses parasympathetic and sympathetic system. Parasympathetic depression is greater.

W.J Levy has discussed the behavior of heart rate with Isoflurane in his study for population a slight increase in heart rate was observed [1]. Patients having less basal rate tended to show more increase than those with higher basal rates for both the agents. In the maintenance phase of human anesthesia, Tomoki Nishiyama examined the hemodynamic and catecholamine reactions to a sudden rise in isoflurane or sevoflurane concentration [2]. Only in the Isoflurane group did the heart rate noticeably increase after the anesthetic concentration was increased.

Makoto Kato observed spectral analysis of heart rate variability during Isoflurane anesthesia [3].

In Group I (Sevoflurane) MAP decreased in nineteen patients and in six patients it remained steady. Thus in 76% cases it decreased while in Group II (Isoflurane) MAP decreased in twenty-three patients and in two patients it remained steady. Thus in 92% cases it decreases. So, in group II - 8.26% changes was seen in MAP as compared to Group I - 3.06 change was seen. Hypotension was less in Group I (Sevoflurane) as compared to Group II (Isoflurane).

J. Tarnow observed hemodynamic changes with Isoflurane and concluded that with Isoflurane there is decrease in arterial pressure and myocardial oxygen consumption [4]. Edward J. Frink observed comparison of Sevoflurane and Isoflurane and concluded that baseline systolic arterial pressure value for Sevoflurane was greater than those for the Isoflurane [5].

W.J. Levy observed that range of arterial pressure recorded during maintenance with Isoflurane correlated with base line value [1]. Sebastin Reiz studied the coronary hemodynamic effects of Isoflurane [6]. As studied in both groups, in group-I the average time interval from loading dose to 1st maintenance dose was 38.48 + 2.40 min. while with group II it was 30.8 + 1.44 min. So, it suggests, that the dose requirement of muscle relaxant was decreased more with Sevoflurane as compared to Isoflurane.

Sudhakar S observed the effect of Sevoflurane on Vecuronium bromide induced neuromuscular blockade and concluded that Sevoflurane enhances and prolongs Vecuronium induced blockade in predictable manner and lesser dose of Vecuronium bromide provide adequate relaxation [7]. Shigeki Yamuguchi, Hintoshi Egawa high concentration of Sevoflurane induction of anesthesia accelerates onset of action and prolongs the neuromuscular blockade [8]. Average time of return of TOF mode > 3 twitches after stopping muscle relaxant, in group I (Sevoflurane) it was 9.16 + 1.27 minute as compared to Group II (isoflurane) 12.04 + 1.25 minute. So TOF mode 3 twitches were more rapid in Group I as compared to Group II.

Average time of return to awake state with Sevoflurane anesthesia was 20 + 2.15 minutes as compared to Isoflurane anesthesia 12.08 + 1.20 minute. Anesthesia with Sevoflurane produced qualitatively better recovery and better psychological and mental function than Isoflurane. It was comparable to the following references. Beverly K. Philip observed the recovery with Sevoflurane and Isoflurane for adult ambulatory anesthesia and concluded that emergence and recovery time were less, with Sevoflurane as compared to Isoflurane anesthesia [9].

B.J. Robinson observed the recovery with Sevoflurane and Isoflurane anesthesia and concluded that emergence from Sevoflurane anesthesia, response to commands and orientation occurred average 3 - 4 minutes earlier than in patients anaesthetized with Isoflurane and extubation averaged 1-5 min faster with Sevoflurane than the Isoflurane anesthesia [10].

Anil Gupta observed recovery profile after anesthesia with Sevoflurane and Isoflurane and concluded that emergence and response to commands and orientation was faster with Sevoflurane than Isoflurane anesthesia [11]. Post-operative complications were compared between two groups and observed that complications with Sevoflurane (Group-I) anesthesia were less with Isoflurane (Group-II) anesthesia. Our study was comparable with the following studies.

Christiana Campbell observed the effect of Sevoflurane and Isoflurane in post-operative events and concluded that less nausea, chills and dizziness and coughing in Sevoflurane as compared to Isoflurane [12].

Edward J. Frink observed post operative events with sevoflurane and isoflurane anesthesia and concluded that incidence of nausea and emesis in first 24-hour,34% and 2% with Sevoflurane as compared to 44% and 8% with Isoflurane anesthesia [5].

M.F. Terriet observed Pungetancy between Sevoflurane and Isoflurane and concluded that Sevoflurane is significantly less irritable and pungent than Isoflurane [13].

5. Conclusion

Following are the conclusions from this study:

Tachycardia is less with Sevoflurane than Isoflurane with equipotent concentration. With equipotent concentrations, fall in MAP is greater in Isoflurane than Sevoflurane. Though hemodynamic disturbances are present with both the agents, Sevoflurane ensures more cardiovascular stability than Isoflurane. The dose requirement

of Vecuronium bromide is less with Sevoflurane comparable to Isoflurane. The emergence and recovery are faster with Sevoflurane than Isoflurane. The incidence of post-operative complications - nausea, coughing, dizziness, chills are slightly less with Sevoflurane than Isoflurane. In nutshell, Sevoflurane is a better volatile agent of choice as compared to Isoflurane.

Conflict of Interest: None

Funding: None

Acknowledgment

This study was mandatory thesis topic of author during anesthesia residency program. I am sincerely thankful to my PG teacher Dr Parul for support and guidance for this study.

References

1. Levy, W. J. (1984). Clinical Anesthesia with Isoflurane. BJA (56), 1105-1109.
2. Nishiyama, T. (2005). Hemodynamic and catecholamine response to a rapid increase in isoflurane or sevoflurane concentration during a maintenance phase of anesthesia in humans. Journal of anesthesia, 19, 213-217.
3. Kato, M., Komatsu, T., Kimura, T., Sugiyama, F., Nakashima, K., & Shimada, Y. (1992). Spectral analysis of heart rate variability during isoflurane anesthesia. Anesthesiology, 77(4), 669-674.
4. Tarnow, J., Brückner, J. B., Eberlein, H. J., Hess, W., & Patschke, D. (1976). Haemodynamics and myocardial oxygen consumption during isoflurane (Forane) anaesthesia in geriatric patients. British Journal of Anaesthesia, 48(7), 669-675.
5. Frink Jr, E. J., Malan, P. T., Atlas, M., Dominguez, L. M., DiNardo, J. A., & Brown Jr, B. R. (1992). Clinical comparison of sevoflurane and isoflurane in healthy patients. Anesthesia & Analgesia, 74(2), 241-245.
6. Reiz, S., Bålfors, E., SØRENSEN, M., ARIOLA JR, S., Friedman, A., Truedsson, H., & Tinker, J. H. (1984). Isoflurane—A Powerful Coronary Vasodilator in Patients with Coronary Artery Disease. Survey of Anesthesiology, 28(3), 198.
7. Sudhakar, S., Hemavathi, B., & Ravishankar, M. (2007). Effect of sevoflurane on vecuronium induced neuromuscular blockade. Journal of Anaesthesiology Clinical Pharmacology, 23(1), 59-64.
8. Yamaguchi, S., Egawa, H., Okuda, K., Mishio, M., Okuda, Y., & Kitajima, T. (2001). High concentration sevoflurane induction of anesthesia accelerates onset of vecuronium neuromuscular blockade. Canadian journal of anaesthesia, 48, 34-37.
9. Philip, B. K., Kallar, S. K., Bogetz, M. S., Scheller, M. S., & Wetchler, B. V. (1996). A multicenter comparison of maintenance and recovery with sevoflurane or isoflurane for adult ambulatory anesthesia. Anesthesia & Analgesia, 83(2), 314-319.
10. Robinson, B. J., Uhrich, T. D., & Ebert, T. J. (1999). A review of recovery from sevoflurane anaesthesia: comparisons with isoflurane and propofol includingmeta-analysis. Acta anaesthesiologica scandinavica, 43(2), 185-190.
11. Gupta, A., Stierer, T., Zuckerman, R., Sakima, N., Parker, S. D., & Fleisher, L. A. (2004). Comparison of recovery profile after ambulatory anesthesia with propofol, isoflurane, sevoflurane and desflurane: a systematic review. Anesthesia & Analgesia, 98(3), 632-641.
12. Campbell, C., Andreen, M., Battito, M. F., Camporesi, E. M., Goldberg, M. E., Grounds, R. M., ... & Coriat, P. (1996). A phase III, multicenter, open-label, randomized, comparative study evaluating the effect of sevoflurane versus isoflurane on the maintenance of anesthesia in adult ASA class I, II, and III inpatients. Journal of Clinical Anesthesia, 8(7), 557-563.
13. TerRiet, M. F., DeSouza, G. J. A., Jacobs, J. S., Young, D., Lewis, M. C., Herrington, C., & Gold, M. I. (2000). Which is most pungent: isoflurane, sevoflurane or desflurane?. British journal of anaesthesia, 85(2), 305-307.