IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)
e-ISSN: 2279-0853, p-ISSN: 2279-0861.Volume 16, Issue 8 Ver. IV(Aug. 2017), PP 73-77
www.iosrjournals.org

Comparison of Intraoperative Haemodynamic Parameters And Cost Effectiveness Between Sevoflurane (Inhaltional) Anaesthesia And Propofol (Tiva) Based Anaesthesia.

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Abstract
Background: *Intravenous Propofol as Total Intravenous Anaesthesia (TIVA) is being widely used for the induction and maintenance of anaesthesia. Sevoflurane is a relatively newer anaesthetic agent which is expensive, but has the advantage of rapid induction and recovery characteristics.*
Materials and Methods*: Sixty patients ASA Grade I and II aged 18-65 yrs were randomly divided into two groups. Group A received Sevoflurane inhalational induction via a vital capacity rapid inhalational induction (VCRII) technique using 8% Sevoflurane from a closed circuit primed for 1 minute. Maintenance was done with 1.5-2% Sevoflurane. Group B patients were induced with Propofol i.v 2-2.5mg/kg. Intraoperative maintenance was done with multistep Propofol infusion (8mg/kg/hr -3mg/kg/hr) via infusion pump.*
Results: *Induction time was faster in Sevoflurane group as compared to Propofol group (p<0.001), which was highly significant. The intraoperative haemodynamics were comparable between the two groups with no statistically significant difference. The recovery profile was significantly (p<0.001) better with Sevoflurane group as regards the spontaneous eye opening, verbal communication and mental orientation. Although the total volume of each agent used was almost similar in both groups, but the cost incurred in Sevoflurane anaesthesia is still higher than the Propofol based anaesthesia.*
Conclusion: *Sevoflurane is a good alternative for Propofol as an induction and maintenance agent with better recovery profile, but has cost limitations.*
Keywords: *Propofol, Sevoflurane, Total Intravenous Anaesthesia.*

Date of Submission: 22 -07-2017 Date of acceptance: 18-08-2017

I. Introduction

Intravenous agents are commonly used for the induction of anaesthesia followed by inhalational agents for the maintenance. A problem with this technique is the transition phase from the induction to maintenance. The rapid redistribution of intravenous agent could lead to the lightning of anaesthesia before an adequate depth is attained with the inhalational agent. This problem has prompted the rediscovery of "single agent" anaesthesia which avoids the problems associated with the transition phase. Total intravenous anaesthesia (TIVA) is a technique of anaesthesia which involves use of intravenous drugs to anaesthetize the patient without the use of inhalational agents. The popularity of Propofol as a main component of TIVA has been attributed to its pharmacokinetic and pharmacodynamic properties. Its shorter onset of action, rapid metabolism and no significant accumulation on prolonged use makes it an ideal choice. With the advent of advanced computer drug predictable. It allows the administration system, the i.v infusion of Propofol has become much safer and anaesthesiologist to vary the depth of anaesthesia by just controlling the rate of infusion of the drug. The TIVA concept is simple, less toxic than inhalational agents, less risk of malignant hyperthermia with no risk of any environmental pollution[14.]

Sevoflurane is a relatively newer inhalational anaesthetic agent & was first synthesized by Regan at Travenol laboratories in 1968, but was introduced in clinical practice in Japan in 1990. When compared to other inhalational agents, it has better properties. Its insoluble nature, low blood gas partition coefficient, no pungency and rapid wash in and rapid wash out makes it an ideal choice for the volatile induction and maintenance of anaesthesia. Its good haemodynamic profile and non irritating nature also adds to its increased acceptance amongst the anaesthesiologists. Use of Sevoflurane for the induction and maintenance of anaesthesia produces a reduction in costs, predominantly through less drug wastage[12]. Since the introduction of small 50 ml Sevoflurane bottles in our country and the cost also cutting down, we wanted to compare its haemodynamics and the cost factor with the Propofol based anaesthesia.

II. Aim & Objectives

The aim was to compare the intraoperative haemodynamics recovery profile and cost effectiveness of Sevoflurane and Propofol based anaesthesia.

III. Material & Methods

After informed consent, sixty ASA I and II patients, aged 18-65 yrs of either sex undergoing surgery under general anaesthesia were randomly divided into two groups of 30 each. Patients with ASA III or above, patients with significant cardiovascular, renal or pulmonary disease, history of malignant hyperthermia, any documented allergy to the study drug, H/O any mental illness or use of sedative drugs.

Group A: Sevoflurane group.

Group B: Propofol group.

All the patients were kept fasting overnight and were premedicated with Inj. Ranitidine 50 mg i.v in the pre operative room. On arrival in the operation room, i.v line was secured and baseline parameters were recorded i.e, HR, NIBP and SpO_2. Inj. Fentanyl 1 mcg/kg was given to all patients. In group A, patients were induced with vital capacity rapid inhalational induction (VCRII) technique using 8% Sevoflurane with N_2O in O_2 (3L each) from a closed circuit which was primed for 1 minute. Patients were trained to perform vital capacity breathing before the induction. The induction time was noted i.e, from the start of anaesthesia till loss of eyelash reflex. For muscle relaxation, Inj. Rocuronium 0.6 mg/kg was given as loading dose and thereafter 1/3 as its maintenance dose for all patients in both groups. In the group B, patients were induced with Inj. Propofol 2-2.5 mg/kg till the loss of eyelash reflex. Intraoperatively, Inj. Propofol infusion was started with 8mg/kg/hr for 1st ten min, 6 mg/kg/hr next ten min and 3 mg/kg/hr thereafter till end of surgery. Also, Inj. Fentanyl was used as infusion of 1 mcg/kg/hr till the end of surgery. Inj. Ondensetron 0.1 mg/kg was given to all the patients for PONV. Both the Sevoflurane and Propofol infusion were stopped at the end of surgery when the skin sutures were being applied. The reversal, consisting of Inj. Neostigmine (50 mcg/kg) and Inj. Glycopyrolate (10 mcg/kg) was given and patients were extubated after proper suctioning and on return of spontaneous respiration.

IV. Observation And Results

There was no statistical difference between the two groups with respect to age, weight, gender, ASA and duration of surgery. Induction time (sec) was faster in Sevoflurane group (48.4±5.04) as compared to Propofol group (60.2±6.53) with a ($p<0.001$), which is highly significant. Also, the intraoperative haemodynamic parameters consisting of heart rate and blood pressure were comparable between the two groups with no statistically significant difference.

Table showing induction time (seconds) among studied groups

Induction time (Seconds)	Mean	SD	Range	P-value	Remarks
Group A [n=30]	48.4	5.04	41-56	<0.001*	H S
Group B [n=30]	60.2	6.53	50-59		

NS : Non – Significant

HS : Highly Significant

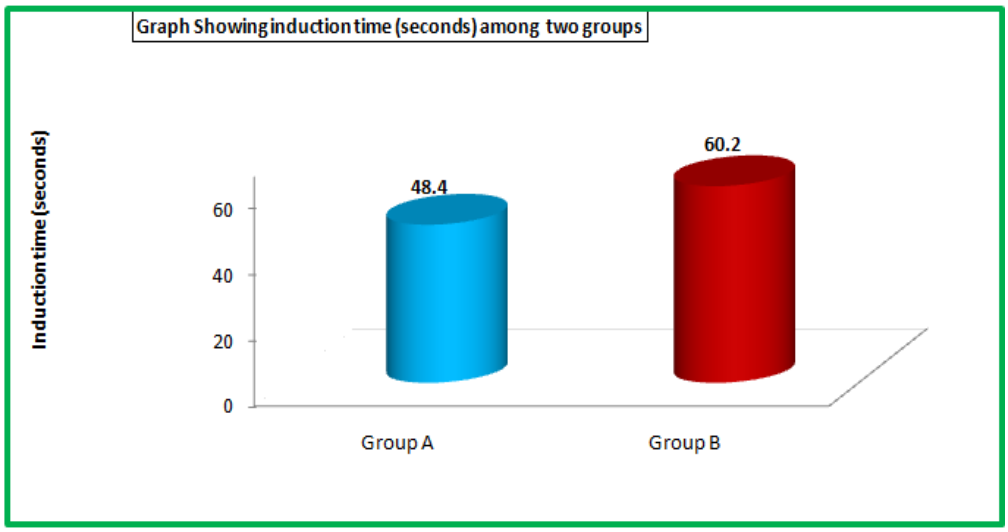
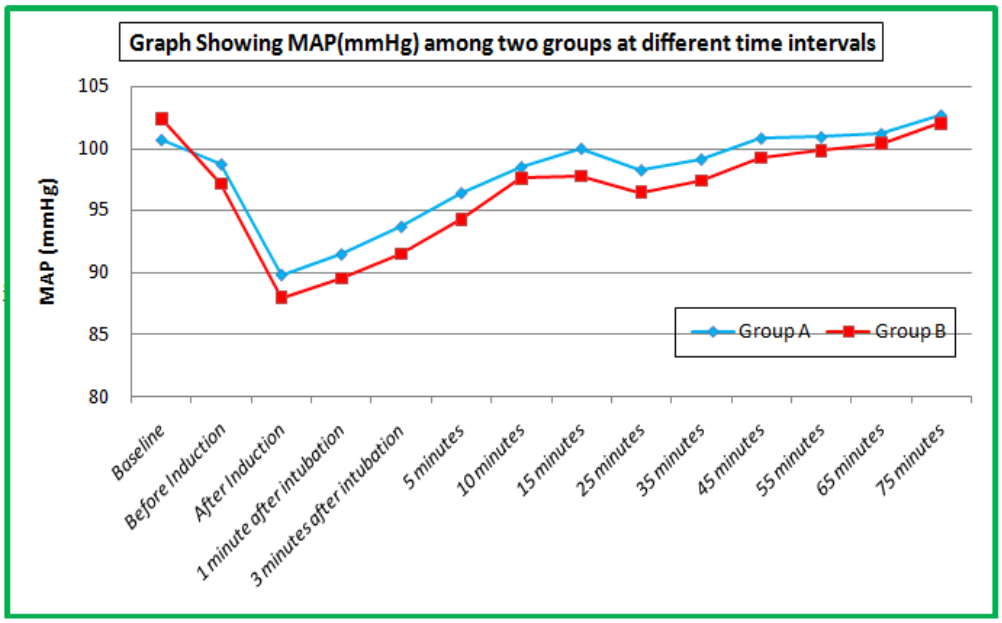


Table showing comparison based on MAP (mmHg) among two groups at different time intervals						
Time Interval	**Group A [n=30]**		**Group B [n=30]**		**P-value**	**Remarks**
	Mean	**SD**	**Mean**	**SD**		
Baseline	100.7	5.56	102.4	6.29	0.260	NS
Before Induction	98.7	6.00	97.2	7.17	0.377	NS
After Induction	89.8	6.45	88.0	7.52	0.311	NS
1 minute after intubation	91.5	6.33	89.5	6.98	0.263	NS
3 minutes after intubation	93.7	6.73	91.5	6.41	0.199	NS
5 minutes	96.4	6.07	94.3	6.38	0.192	NS
10 minutes	98.5	6.21	97.6	6.21	0.582	NS
15 minutes	100.0	6.09	97.8	5.96	0.163	NS
25 minutes	98.3	5.93	96.5	6.34	0.269	NS
35 minutes	99.1	7.00	97.4	7.25	0.355	NS
45 minutes	100.8	6.47	99.3	6.17	0.352	NS
55 minutes	100.9	3.92	99.8	5.34	0.443	NS
65 minutes	101.2	3.90	100.4	4.42	0.659	NS
75 minutes	102.7	5.25	102.0	5.65	0.785	NS

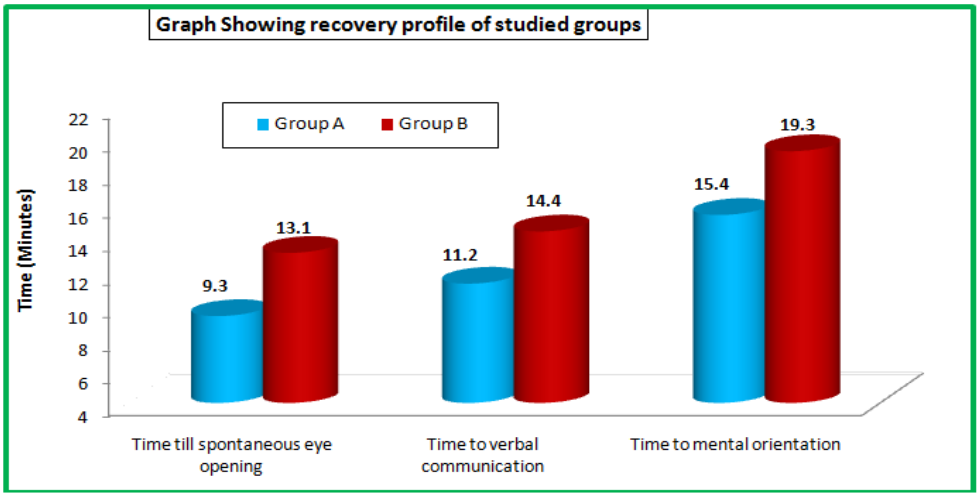
NS : Non – Significant.
S : Significant.



The recovery profile showed a significant difference as regards spontaneous eye opening (9.3±1.8 min in Sevo gp and 13.1±1.67 min in Propofol gp), verbal communication (11.2±1.41 min Sevo gp and 14.4±1.33 The recovery profile showed a significant difference as regards spontaneous eye opening (9.3±1.8 min Propofol gp) & mentalorientation (15.4±1.25 min Sevo gp and 19.3±1.23 min Propofol gp) after the agents were stopped at the end of surgery (p<0.001), with Sevoflurane showing the better recovery profile.

Table showing recovery profile of studied groups						
Recovery Profile		**Mean**	**SD**	**Range**	**P-value**	**Remarks**
Time till spontaneous eye opening (Minutes)	Group A [n=30]	9.3	1.80	7-12	<0.001*	HS
	Group B [n=30]	13.1	1.67	10-16		
Time to verbal communication (Minutes)	Group A [n=30]	11.2	1.41	9-14	<0.001*	HS
	Group B [n=30]	14.4	1.33	12-17		
Time to mental orientation (Minutes)	Group A [n=30]	15.4	1.25	14-18	<0.001*	HS
	Group B [n=30]	19.3	1.23	17-22		

NS : Non – Significant HS : Highly Significant.



The total volume of Propofol used for the induction and the maintenance was noted. The amount of Sevoflurane consumed was calculated using the Dion formula. Amount of Sevoflurane used = PTFM/2,412 d (P= Vaporizer dial conc, F= Fresh gas flow l/m, T= time for which the conc was set in minutes, M= Mol. Mass of Sevoflurane, D= Density of liquid Sevoflurane in milliliters). After substitution of the fixed variables, the equation could be rewritten as Amount of Sevoflurane used = 0.00546 X Sevoflurane conc. X Time (sec). The total Sevoflurane consumed was calculated by adding the amount used for priming, for induction and that used for the maintenance of anaesthesia. The total volume of each agent used was comparable (42.5 ml in Sevoflurane gp and 40.6 ml in Propofol gp), but in terms of cost comparison, the Sevoflurane still costs more than the Propofol. The actual cost of Sevoflurane 50 ml bottle was about 750 rupees while the cost of same volume of Propofol was around 500 rupees.

V. Discussion

Modern practice of medical science demands high quality anaesthesia, minimum side effects and rapid recovery. The characteristics of the ideal anaesthetic technique are that the induction should be rapid and swift, maintenance should be physiologically stable with readily adjustable anaesthetic depth and recovery be rapid and complete allowing early return to normal activities. Generally both Propofol and Sevoflurane meet these criteria. Propofol is a common i.v agent used a main component of TIVA. Sevoflurane used in high concentration is suitable for induction and maintenance of anaesthesia because of low blood gas solubility and non irritant property.We did not find any statistical difference between the two groups with respect to age, weight, gender, ASA and duration of surgery. In our study, the mean time taken for induction in Sevoflurane group was 48.4 seconds, whereas in Propofol group it was 60.2 seconds ($p<0.001$).The vital capacity breath technique using 8 % Sevoflurane has been seen to cause faster induction as compared to the conventional incremental dose technique. Lim KY et al[1] found a shorter induction time with Sevoflurane VCRII technique as compared to the i.v Propofol induction. EL - Radiadeh and El – Ghazo[2] also reported a faster loss of consciousness with Sevoflurane vital capacity breath technique than with Propofol. Sevoflurane has attributes that facilitates rapid, smooth inhalational induction i.e, low blood gas solubility, relative absence of pungency and a vaporizer with high over pressure capability. The vital capacity breath of Sevoflurane provides rapid induction especially when used with N_2O 50 % in oxygen. Besides, this technique has been seen to have better patient acceptability. Induction characteristics of Sevoflurane comparing the vital capacity induction technique with the tidal breathing technique has shown better patients acceptability and shorter induction time in the VCRII technique.

Our observations were also in consonance with Hall JE et al[3] who compared the single breath inhalational induction of Sevoflurane with an intravenous bolus of Propofol. They found that 8% Sevoflurane carried in N_2O and O_2 is rapid, reliable and safe method for the induction of anaesthesia and a good alternative to i.v Propofol. Konstantopoulos K, Markis A, Moustaka A et al[4] found that induction as well as maintenance characteristics of Sevoflurane and Propofol based anaesthesia were comparable in terms of haemodynamic stability, PONV and post operative sedation scores and orientation to places.Our observations with respect to the intraoperative haemodynamics did not show any significant difference between the two groups. There was a comparable reduction in both the heart rate and MAP during the induction of anaesthesia. A study by Bharti N et al[5] found that the intraoperative haemodynamics during induction and the maintenance were comparable in both the groups. Our results were also in accordance with a study done by Amingad B and Prashanth Gowtham Raj SK[6].The patient's orientation with respect to time and place provides a rough estimation of the recovery of

cognitive function. In our study, the recovery profile showed a statistically significant difference between the two groups, with faster recovery in the Sevoflurane group. Our results were similar to a study done by Orhon ZM et al[7] and Kumar A et al[8], who also found that recovery time after Sevoflurane anaesthesia was shorter than with Propofol based anaesthesia. Shah A and Adoraja RN[9] compared the emergence and post operative recovery profile between Sevoflurane and Propofol. They found that Sevoflurane has a better recovery profile than the intravenous Propofol. This effect of Sevoflurane has been attributed to its insoluble nature, rapid wash in and out and low blood: gas partition coefficient, all of which lead to the rapid emergence. Another study by Cattano D et al[10] compared the total intravenous anaesthesia using Propofol and inhalational anaesthesia with Sevoflurane for the post operative effects i.e, degree of pain, incidence of nausea and vomiting and duration of recovery post operatively. They did not find any statistically significant difference between the two agents in relation to the above effects. In our study we found that there was no significant difference between the two groups in terms of the total volume of each agent used. But in terms of cost comparison, we found that Sevoflurane based anaesthesia is still costlier than the Propofol based anaesthesia. Our results were supported by Tang Jun at al[11] who also saw that total cost was more with Sevoflurane as compared to Propofol based anaesthesia. Similarly, a multi centric study done by Smith I et al[12] found that the total intravenous anaesthesia with Propofol was more expensive than the use of Sevoflurane for the induction and maintenance of anaesthesia. Our results were not supported by Maratha V et al[13] who found that Sevoflurane based anaesthesia was more cost effective. The reason could be due to the amount of wastage caused by the unused medicine.

VI. Conclusion

We found that Sevoflurane is superior to Propofol in terms of faster induction and rapid recovery profiles. The intraoperative haemodynamics were comparable between the two groups with no statistically significant difference. The Sevoflurane based anaesthesia is however still costlier as compared to Propofol which if solved will serve as excellent option of anaesthesia in the developing countries. As a final recommendation, we believe that the cost effectiveness of Sevoflurane need to be further investigated as this drug has better induction, haemodynamic and recovery characteristics.

VII. Conflicts of intrest

There are no conflicts of interest.

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*Sahir Rasool. "Comparison of Intraoperative Haemodynamic Parameters And Cost Effectiveness Between Sevoflurane (Inhaltional) Anaesthesia And Propofol (Tiva) Based Anaesthesia." IOSR Journal of Dental and Medical Sciences (IOSR-JDMS) 16.8 (2017): 73-77