ISSN 2466-488X (Online) doi: 10.5937/sjait2108147P

Original article

COMPARISON OF RECOVERY PROFILES OF PROPOFOL AND SEVOFLURANE ANESTHESIA WITH BISPECTRAL INDEX MONITORING IN GENERAL ANESTHESIA. RUNNING TITLE: RECOVERY PROFILES: PROPOFOL VS SEVOFLURANE

Parth Pandya[1], Gauri M. Panjabi[1], Jaimini Parmar[1], Binal Patel[1]

[1]Dept. Of Anesthesiology, Smt. SCL general hospital, Ahmedabad.

Submitted May 27, 2021, Revision received July 3, 2021, Accepted July 31, 2021

Summary

Introduction: *Introduction of more rapid and short-acting volatile anesthetics and intravenous anesthetics has allowed anesthesiologists to achieve a recovery profile that facilitates rapid emergence after general anesthesia. Both propofol and sevoflurane provide rapid induction and faster recovery by titrating the depth of anesthesia based on the BIS Index during maintenance. The objectives of the study were analysis of hemodynamic parameters, changes in the BIS Index, recovery characteristics, postoperative complications.* ***Methods:*** *Following IRB approval, an observational study was conducted in 60 patients of ASA grade I-II, aged 18–60 years undergoing surgical procedures under general anesthesia. Patients were randomly divided into two groups, with 30 patients each receiving propofol infusion (Group P) or sevoflurane (Group S) to maintain anesthesia. The requirement of anesthetic agents was titrated by BIS monitoring. BIS score was held between 40 to 60.* ***Results:*** *Hemodynamic parameters like heart rate and mean arterial pressure (MAP) were comparable in both groups. During recovery, the meantime to spontaneous ventilation, eye-opening, hand squeezing, following verbal command, extubation, stating the name, and mean time to achieve modified Aldrete's score of ≥ 9 from the cessation of the anesthetic drug was significantly shorter in Group S as compared to Group P. PONV was noted as a postoperative complication in the sevoflurane group.* ***Conclusion:*** *In our study, sevoflurane provided rapid emergence and faster recovery with stable hemodynamic. However, propofol appears to be an excellent alternative to sevoflurane for maintenance of anesthesia as it also provides fast recovery with a lower incidence of PONV.*

Key words: *BIS Monitoring; Faster recovery; Propofol infusion; Recovery characteristics; Sevoflurane*

Introduction

Expeditious recovery and shorter hospital stays are necessary for early ambulation andreduced health care costs. One of the significant factors that determine the speed of recovery from anesthesia is the choice of an anesthetic agent. Both propofol and sevoflurane have a smooth and rapid onset of action and provide fast recovery. Both can be used for general anesthesia maintenance with highly satisfying anestheticconditions[1].

Propofol is the most frequently used intravenous anesthetic. It has high lipid solubility,and its kinetic properties allow rapid induction of anesthesia, adequate maintenance, quick and clear-headed recovery, and minimum postoperative sickness (Nausea, vomiting, respiratory depression)[2]. Inhalational anesthesia technique remains themainstay for maintenance of anesthesia as it allows rapid emergence from anesthesia, probably because of easy titratability. Sevoflurane is a halogenated volatile anesthetic agent with a relatively low blood-gas partition coefficient of 0.69, which causes early-onset and rapid recovery with stable hemodynamic[3].

During the last decade, Bispectral index (BIS) monitoring has been designed to estimate the depth of anesthesia. Different studies have shown that BIS helps to assess the hypnotic component of anesthesia. Titrating anesthetic agent's delivery by BIS monitoring during General anesthesia allows the anesthetist to determine and administer the precise amount of drug to meet the needs of each patient, leading to an increase in patient's satisfaction and rapid recovery[4].

Corresponding author: Dr. Jaimini B. Parmar3 2nd year Resident Doctor Anesthesia Department, Address: Block No: 72/3 'J' type sector-21 Gandhinagar-382021., Telephone: 8156032370, E-mail: jaiminiparmar442@yahoo.com

The present study was designed to compare recovery profiles of propofol and sevoflurane anesthesia recovery with BIS monitoring in patients undergoing various elective surgical procedures under General anesthesia. The objectives of our study were analysis of hemodynamic parameters, intra-operative complications, recovery characteristics, and postoperative complications.

Methods

After Hospital's Institutional Review Board's3 (IRB) approval, the present observational study was conducted on 60 patients of ASA grade I/II, aged 18-60 years of either sex, undergoing various elective surgeries under general anesthesia. Patients who have known allergy from study drugs, uncontrolled diabetes mellitus and hypertension, obesity (BMI > 30), cardiovascular and respiratory diseases were excluded from the study. The objectives of the study were analysis of hemodynamic parameters, recovery characteristics, and postoperative complications.

A thorough preoperative check-up, general and systemic examination, airway assessment, and routine investigations were done. All the patients were kept nil orally for at least 6 hours pre-operatively. Written informed consent was taken. Standard monitoring, including non-invasive blood pressure, pulse oximetry, capnograph, and ECG, was attached to the patient in the operating room. After establishing peripheral intravenous access using an 18/20 G cannula, Ringer lactate was started. The skin of the forehead was cleaned and a BIS electrode (BISQUARTO Sensor strips, developed by Aspect medical system, Newton, MA) was placed on the forehead.

All the patients were premedicated with intravenous glycopyrrolate (0.004 mg/kg),ondansetron (0.08 mg/kg), midazolam (0.1 mg/kg), and fentanyl (100 μg) in operating room. Patients were pre -oxygenated with 100% oxygen for 3 minutes, and Induction was done with intravenous propofol (2–2.5 mg/kg) followed by succinylcholine (2 mg/kg). Intubation was done with the appropriate size of the cuffed endotracheal tube. Bilateral air entry was checked, and the cuff was inflated.The patients were randomly divided into two groups (n = 30), each to receive propofolinfusion (Group P) or sevoflurane (Group S) for maintenance of anesthesia. Group P had propofol infusion (3–12 milligram/kilogram/hour), and a combination of O_2:N_2O [50:50] and Group S had sevoflurane (0.5–2.5%) with O_2:N_2O (50:50). Atracurium 0.5 mg/kg was given intravenously, followed by 0.1 mg/kg when required. During maintenance, the propofol infusion rate and concentrations of sevoflurane were adjusted to maintain a BIS score between 40–60. Ifthe BIS score rose over 60, the propofol infusion rate and concentration of sevofluranewere gradually increased, and if it falls under 40, both were decreased accordingly.

Heart rate, non-invasive blood pressure, oxygen saturation (SpO_2), and end-tidal carbon dioxide ($EtCO_2$) were recorded in predefined time points: pre-operative, before induction, after induction, after intubation at 1, 3, 5, 10, 15 minutes, and after that every 15 minutes throughout the surgery, Post-extubation and 10 minutes after extubation.

About fifteen minutes before the end of the surgery, propofol and sevoflurane were gradually reduced to facilitate rapid emergence from anesthesia. At the end of the surgery, reversal was done by i.v. injection of glycopyrrolate 0.008 mg/kg and neostigmine 0.05 mg/kg. Proper suctioning was done, and after complete neuromuscular recovery, patients were extubated. During recovery, time to spontaneous ventilation, eye-opening, hand squeezing, following verbal command (movement of limbs, elevate head), extubation, stating name and time to achieve modified Aldrete's score of ≥ 9 (recovery time) were recorded from the cessation of anesthetic drugs.

Statistical analysis of continuous numerical variables was done by unpaired t-Test. All the continuous variables were recorded as Mean ± SD. Data were analyzed using Graphpad software (Developed by Dr. Harvey Motulsky, San Diego, CA). P-value of < 0.05 was considered statistically significant, whereas a P-value of < 0.001 was taken as highly significant.

Results

There was no significant difference between the two groups concerningdemographic data and ASA grading (Table 1). The mean duration of surgery was

126.43 3.56 min in group P and 124.43 3.80 min in group S (Table 2).

Table 1: Demographic data

Patient data	**Group P**	**Group S**
Number of patients	30	30
Age (years)	34.06 ± 12.73	36.67 ± 15.07
Weight (kg)	55.10 ± 5.25	56.63 ± 4.86
Sex (M/F)	15/15	10/20
ASA Grade (I/II)	14/16	16/14

M – male; F – female; ASA – American Society of Anesthesiologists score

Table 2: Type of surgery

Department	**Type of surgery**	**Number of patients**	
		Group P	**Group S**
Orthopedic surgery	Upper Limb surgery	9	11
	Lower Limb surgery	6	4
Ear, nose, and throatsurgery	Tonsillectomy	5	5
	Ear surgery	4	3
	Septoplasty	1	2
General surgery	Open Appendicectomy	2	3
	Open Cholecystectomy	1	1
	Breast Lumpectomy / MRM	2	1
Total		30	30

MRM (Modified Radical Mastectomy)

Heart rate was comparable at various intervals in both groups (Figure 1). Mean heart rate increases after intubation and post-extubation period because of sympathetic stimulation in both groups. There was no incidence of bradycardia that needed treatment in any groups.

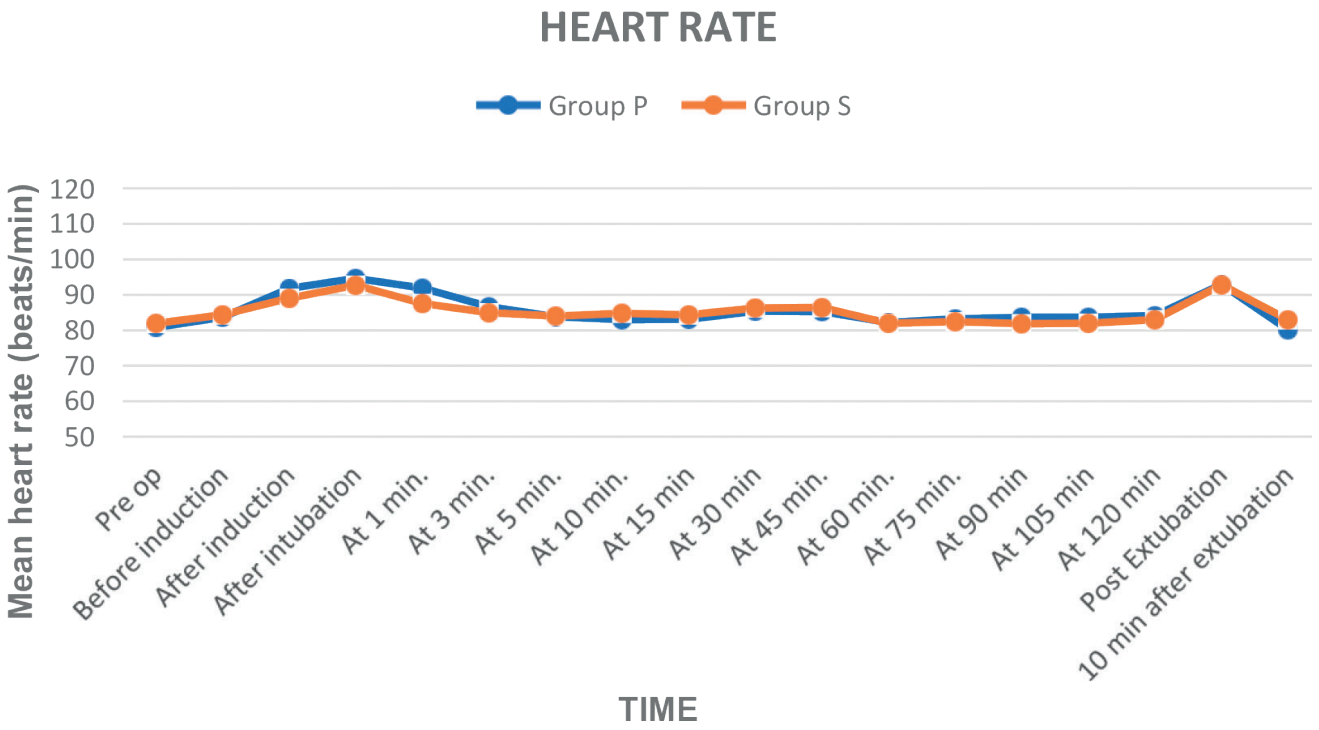

Figure 1: Intraoperative mean heart rate

MAP was comparable at various intervals in both groups (Figure 2), but no statistical difference was found. Two patients in the propofol group developed hypotension treated appropriately compared to none in the sevoflurane group.

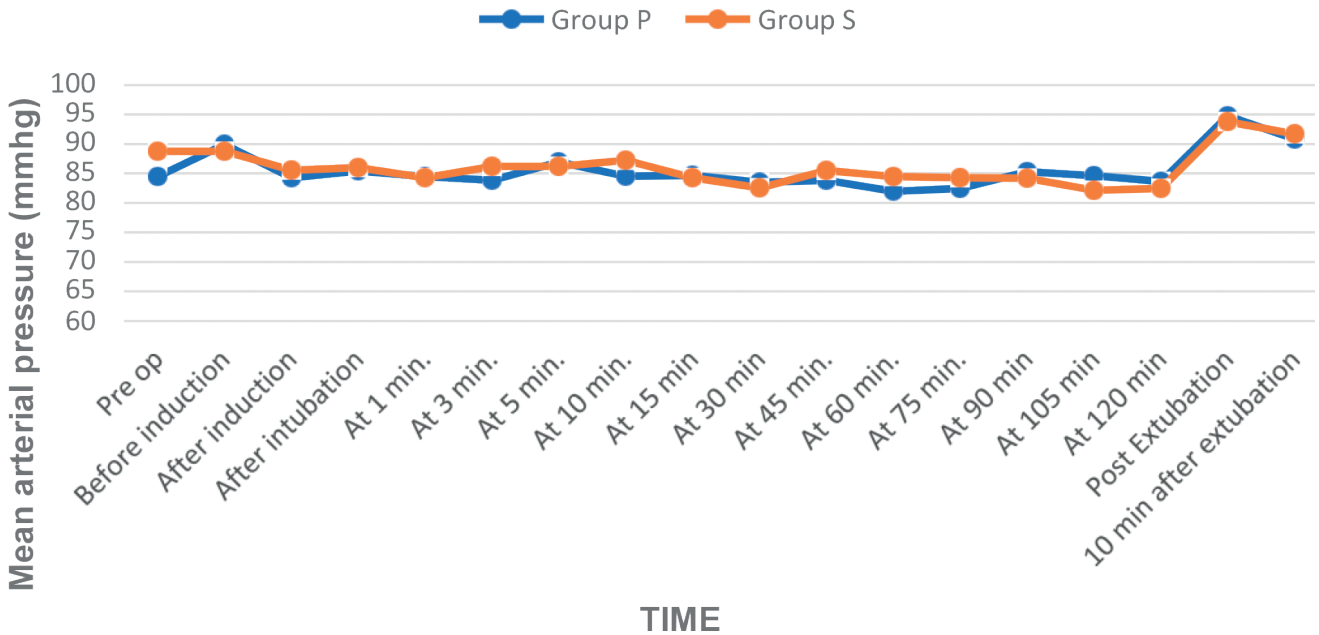

Figure 2: Mean arterial pressure

Time to achieve all the recovery criteria from the cessation of the anesthetic drug was significantly shorter in the sevoflurane group compared to the statistically significant propofol group ($P < 0.0001$) (Table 1).

Table 3. Patients' recovery characteristics. Data are presented as mean±SD.

Recovery criteria	Group P	Group S S	P-value
Time to spontaneous ventilation [min]	6.77 ± 0.95	4.27 ± 0.48	< 0.0001
Time to eye opening [emergence time] [min]	9.88 ± 0.94	5.65 ± 0.65	< 0.0001
Time to hand squeezing [min]	10.20 ± 0.94	7.68 ± 0.64	< 0.0001
Time to fo verbal commands [min]	12.40 ± 1.03	8.58 ± 0.62	< 0.0001
Time to extubation [min]	12.97 ± 1.08	10.69 ± 0.69	< 0.0001
Time to stating name [min]	14.09 ± 1.02	11.60 ± 0.75	< 0.0001
Time to achieve Modified Aldrete Score ≥ 9 (recovery time) [min]	15.39 ± 0.70	13.82 ± 1.34	< 0.0001

PONV was noted in three patients (10%) of Group S while none in Group P. Two patients (6.7%) in the sevoflurane group developed sore throat compared to none in the propofol group. Also, one patient (3.3%) from both groups developed hoarseness (Table 4).

Table 4. Postoperative complications presented as number (n)

Complication	GroupP	GroupS
Laryngospasm/Bronchospasm	0	0
PONV	0	3
Agitation	0	0
Headache	0	0
Sore throat	0	2
Hoarseness	1	1

PONV – postoperative nausea and vomiting

Discussion

Rapid emergence from anesthesia and postoperative recovery of cognitive function and hemodynamic stability are important requirements of modern anesthesia. Generally, both propofol and sevoflurane meet these criteria due to their smooth and rapid onset of action with a shorter recovery period[6]. The recovery characteristics of propofol are comparable with many newer inhalation anesthetic agents like sevoflurane, desflurane[2]. The depth of anesthesia is usually assessed by monitoring the clinical parameters during anesthesia. These clinical parameters are unreliable in terms of the exact titration of anesthetic agents[13].

BIS index offers a direct and accurate method for continuous brain status monitoring, provides a measurement of the hypnotic effect of anesthetic agents, andenables the anesthesiologist to titrate the delivery of anesthetic agent according to adepth of anaesthesia, And thereby reducing the amount of drug administered and shortening recovery times[8]. BIS monitoring decreased consumption of both propofol and sevoflurane and facilitate immediate recovery after anesthesia[7].

In 2015, Somvanshi et al. compared recovery profiles of propofol and sevoflurane anesthesia with BIS monitoring in general anesthesia. They concluded that recovery times were significantly shorter in the sevoflurane compared to the propofol group,while the occurrence of PONV was significantly higher in the sevoflurane group[9].

In 2013, Zeynep Nur Orhon et al., compared recovery profiles of propofol and sevoflurane with BIS monitoring in percutaneous nephrolithotomy and found that hemodynamic parameters, SpO2, EtCO2, and BIS values were clinically insignificant in both groups[8]. Recovery time after sevoflurane was significantly shorter than propofol except for Aldrete recovery scores. The incidence of PONV was significantly higher in the sevoflurane group. Propofol has a known anti-emeticproperty which is responsible for less incidence of PONV in this study[8].

The results of our study were comparable with the previous surveys[7-9]. Both propofol andsevoflurane provide rapid titration with BIS monitoring and fast recovery when maintaining general anesthesia in various elective surgeries[9]. Mean heart rate and blood pressure remained relatively low in the propofol group compared to the sevoflurane group due to inhibition of sympathetic activity and was treated appropriately. However, no patient had bradycardia in any groups. Two patients hadhypotension in any groups. These results were comparable with the previous study[5].

In our study, the time to achieve various recovery criteria was significantly shorter in the sevoflurane group than in the propofol group. These results were comparablewith the previous research[8] There was a significantly lower incidence of PONV inthe propofol group, which may be related to its intrinsic anti-emetic properties and often prolong the hospital stay. [12] Two patients in the sevoflurane group developedsore throat as compared to none in the propofol group. These results were comparable with the previous studies[9,11,14]. As observed in our study, and many other studies, recovery is faster with sevoflurane[7-11].

Both propofol and sevoflurane have similar recovery profiles with BIS monitoring when used for maintenance of general anesthesia. Sevoflurane provides rapidemergence and faster recovery with stable hemodynamic. However, propofol appears to be a good alternative to sevoflurane for maintenance of anesthesia as it also offers fast and clearheaded recovery with a lower incidence of PONV.

References

1 Joshi GP. Recent developments in regional anesthesia for ambulatory surgery. Curr Opin Anaesth 1999; 12:643–7.

2. Anil Gupta, Tracey Stieres, Rhonda Zuckerman, Neal Sakima, Stephen D Parker. Comparison of recovery profile after ambulatory anaesthesia with propofol, isoflurane, sevoflurane, and desflurane. A systemic review. Anesth Analg 2004; 98:632–41.

3. Beverly K. Philip, Surinder K. Kallar, Martin S. Bobetz, Mark S. Scheller, Bernard V. Wetcher, and the Sevoflurane Multicenter Ambulatory Group. Amulticenter comparison of maintenance and recovery with sevoflurance or isoflurance for adult ambulatory anaesthesia. Anesthetist. 1996; 83:314–9.

4. Liu SS. Effect of Bispectral Index Monitoring on ambulatory anaesthesia, AMeta-analysis of randomized controlled trials and cost analysis. Anaesthesiology. 2004; 101:311–5.

5. Robinson BJ, Ebert TJ, O'Brien TJ, Colinco MD, Muzi M: Mechanisms whereby propofol mediates peripheral vasodilation in humans: Sympathoinhibition or direct vascular relaxation? Anesthesiology. 1997; 86:64–72.

6. Ibraheim O, Alshaer A, Mazen K, El-Dawlaty A, Turkistani A, Alkathery K, Al-Zahrani T, Al-Dohayan A, Bukha-

ri A. Effect of bispectral index (BIS)monitoring on postoperative recovery and sevoflurane consumption amongmorbidly obese patients undergoing laparoscopic gastric banding. Middle East J Anaesthsiol. 2008; 19:819–30.

7. Yli Hankala A, Vakkuri A, Annila P, Kortilla K: EEG bispectral index monitoring sevoflurane or propofol anaesthesia: analysis of direct costs and immediate recovery. Acta Anaesthesiol Scand 1999; 43:545–549.

8. Zeynep Nur Orhon, Sibel Devrim, MelekCelik, Yekbun Dogan, Asif Yildirim and KaanBasok; Comparison of recovery profiles of Propofol and Sevoflurane anaesthesia with bispectral index monitoring in percutaneous nephrolithotomy. Korean J Anaesthesiol 2013; 64:223–8.

9. Somvanshi M, Agrawal D, Tripathi A. Comparison of recoveryprofile of propofol and sevoflurane with BIS monitoring in generalanaesthesia. Natl J Med Sci 2015; 5:52–56.

10. Khushali R. Tilvawala, Parul R. Panchotiya. A randomized, comparative study of propofol infusion and sevoflurane as the sole maintenance agent in laparoscopic surgery; Anaesth Pain & Intensive Care. 2017:154–8.

11. Wandel C, Neff S, Böhrer H, Browne A, Motsch J, Martin E. Recoverycharacteristics following anaesthesia with sevoflurane or propofol in adults undergoing out-patient surgery. Eur J Clin Pharmacol 1995; 48:185–8.

12. Rhonda Zuckerman, Neal Sakima, Anil Gupta, Stephen D. Parker. Comparisonof recovery profile after ambulatory Anaesthesia with propofol, isoflurane, sevoflurane and desflurane. A systemic review. Anaesth Analg 2004; 98:632–41.

13. Weber F, Seidl M, Bein T. Impact of AEP – Monitor/2-derived composite auditory-evoked potential index on propofol consumption and emergence times during total intravenous anesthesia with propofol and remifentanil in children. Acta Anaesthesiol Scand. 2005; 49:277–83.

14. Shiv Kumar Singh, Amit Kumar, Reena Mahajan, Surabhi Katyaland Sfurti Mann; Comparison of recovery profile for propofol and sevoflurane anaesthesiain cases of open cholecystectomy. Anesth Essays Res. 2013 Sep – Dec; 7(3):386–389.