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Comparison of hemodynamic alterations and post-operative profile of sevoflurane and propofol during laparoscopic cholecystectomies

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ABSTRACT

Background: Modern laparoscopic surgeries with insufflation of gas into peritoneal cavity are gold standard treatment for cholelithiasis. Propofol, a GABA receptor positive allosteric modulator and Sevoflurane, an inhalational anesthetic are used for maintenance of general anesthesia. In laparoscopy, significant hemodynamic changes occur. Searching in field of anesthesia is going on for anesthetic agent for better recovery. **Aims and Objectives:** Objective of the study is to compare sevoflurane with propofol for intraoperative hemodynamic changes and post-operative recovery profile of patient's undergone laparoscopic cholecystectomies under general anesthesia. Secondary objective is to compare post-operative complications. **Materials and Methods:** A prospective, randomized, single-blinded, and comparative study done after permission from the institutional ethical committee and informed consent from patients. Total 84 patients of 20–50 years age of either sex were scheduled for laparoscopic cholecystectomy, divided in two equal groups – Group P, induced with propofol and anesthesia was maintained with propofol (100–120 µg/kg/min), nitrous oxide and oxygen and Group S induced with propofol and anesthesia was maintained using sevoflurane (1–2%), nitrous oxide, and oxygen. **Results:** We found that time for eye opening was 9 ± 1.21 min in Group P and 8 ± 1.34 min in Group S. Time for following verbal command was 10 ± 1.20 min in Group P and 9 ± 1.32 min in Group S. Time for speaking name by patient was 11 ± 1.20 min in Group P and 10 ± 1.34 min in Group S. Difference between two groups regarding eye opening, following verbal command, and time to speak own name are highly significant with $P < 0.001$ which proves that eye opening, following verbal command and time for speaking name by patient were significantly shorter in sevoflurane group. Time to achieve modified aldrete score > 8 was 14 ± 1.30 min in Group P and 13 ± 1.37 min in Group S. Difference between two groups is also highly significant with $P < 0.001$ which proves that time to achieve modified aldrete score > 8 were significantly shorter in sevoflurane group. **Conclusion:** From our study, maintenance of general anesthesia with sevoflurane is associated with faster recovery from anesthesia.

Keywords: Laparoscopic cholecystectomy; Propofol; Sevoflurane; Hemodynamics; Recovery

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INTRODUCTION

Laparoscopic surgeries are modern surgical techniques involving insufflation of gas (usually CO_2) into the peritoneal cavity, under pressure, to separate the organs from the abdominal cavity. Laparoscopic cholecystectomy has now become the gold standard for treatment of cholelithiasis. Despite many benefits, all laparoscopic

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surgeries are challenging from an anesthetist's perspective, mainly due to significant alteration of hemodynamics resulting from the effects of pneumoperitoneum, patient position, and hypercapnia from absorbed CO_2.[1]

Most elective laparoscopic cholecystectomy surgeries are performed under general anesthesia. For maintenance of anesthesia multiple agents are used like propofol, dexmedetomedine, isoflurane, and sevoflurane. Propofol (2,6-di-isopropylphenol) with elimination half-life of 2–24 h, acting as a GABA receptor positive allosteric modulator.[2] It is an intravenous anesthetic characterized by rapid metabolic clearance. Its specific pharmacodynamic characteristics, for example, decrease in heart rate and blood pressure, are particularly useful for physiological changes of pneumoperitoneum like tachycardia and hypertension. Sevoflurane is a sweet-smelling, non-flammable, and highly fluorinated methyl isopropyl ether used as an inhalational anesthetic for induction and maintenance of general anesthesia. It has lower blood gas solubility, pleasant to inhale, offers good hemodynamic stability, and also provides both rapid induction and recovery time.[3] Sevoflurane has been successfully used as an alternative to propofol in various daycare procedures.[4]

The purpose of the study was to compare newer, less soluble, and volatile anesthetics sevoflurane with propofol for maintenance of anesthesia in laparoscopic surgeries.

Aims and objectives

To compare intraoperative haemodynamic changes and post operative recovery profile between Sevoflurane and Propofol. Secondary - To compare Post operative complications.

MATERIALS AND METHODS

A prospective, randomized, single-blinded, and comparative study was done after permission of the Institutional Ethics committee. Randomization was done by lottery method. Patients attending a tertiary care hospital and medical college, scheduled to undergo elective laparoscopic cholecystectomy under general anesthesia were evaluated for eligibility into the study, based on inclusion and exclusion criteria.

Inclusion criteria

Inclusion criteria were as follows-patients aged between 20 and 50 years of either sex, patients belonging to ASA Grade I, II, patients scheduled for elective laparoscopic cholecystectomy under general anesthesia.

Exclusion criteria

Exclusion criteria were as follows:- Patient refusal, heavy smoker (more than 20 cigarettes per day), patients having hemorrhagic disorders or patients with anticoagulant therapy, other systemic disorders, on MAO-inhibitors, antidepressants and β-blockers, patient had general anesthesia within the past 2 weeks, positive pregnancy test or were breast feeding at the time of surgery, patients with history of allergy or sensitivity to volatile anesthetics or to propofol, and patients with body mass index more than 1.5 times normal.

Written informed consent was taken from the willing participants after proper explanation of study procedure and expected outcome in their own vernacular language. Total 84 patients of 20–50 years age of either sex were scheduled for laparoscopic cholecystectomy, divided in two equal groups: Group P and Group S with 42 cases in each group by matching patient's age, sex and ASA grading (I or II).

Tab. Alprazolam (0.25 mg) at bedtime before day of surgery and on the day of surgery Tab. Pantoprazole (40 mg) and Tab. Domperidone (10 mg) were given. In operation room, standard monitors were attached. The patient was premedicated with injection Glycopyrrolate 4 mcg/kg; injection Midazolam 0.025 mg/kg and injection Fentanyl 2 mcg/kg intravenously. After adequate pre-oxygenation anesthesia was induced with inj.Propofol 2 mg/kg administered slowly intravenously till the loss of response to verbal commands and intubation facilitated with injection Atracurium 0.5 mg/kg intravenously. After confirming the position of the tube, patient was ventilated with gas mixture of 33% oxygen and 66% nitrous oxide with a tidal volume of 8–10 mL/kg and a rate of 12–15 breaths/min to maintain End Tidal CO_2 ($EtCO_2$) in range of 35–40 mm of Hg. In Group-S, anesthesia was maintained using Sevoflurane (1–2%), nitrous oxide, and oxygen with intermittent injection of Atracurium (0.1mg/kg). In Group-P, anesthesia was maintained with Propofol (100–120 μg/kg/min), nitrous oxide, and oxygen with injection of Atracurium (0.1 mg/kg) intermittently. Patient-s hemodynamics were monitored. CO_2 was insufflated into the peritoneal cavity @ 2 L/min to create pneumoperitoneum. Intra-abdominal pressure was maintained at 12–14 mm of Hg throughout the laparoscopic procedure. Hemodynamics and SpO_2 were measured baseline; after intubation; before pneumoperitoneum; immediately after pneumoperitoneum; and thereafter at 10, 20, 30, and 40 min and after extubation. At the end of the surgery, in both groups, Sevoflurane and Propofol were discontinued, especially when deflation of pneumoperitoneum and closure started. Residual neuromuscular block was reversed by giving Neostigmine (0.05 mg/kg) and Glycopyrrolate (0.01 mg/kg). When patient's respiration becomes spontaneous and regular

and they are able to obey simple commands, suctioning and extubation were done. Time of extubation and the times at which patients were able to say their name were recorded. Before discharging the patient from post-operative recovery room, any adverse effect such as sedation, hypotension, bradycardia, nausea, vomiting, and dryness of mouth, if observed, was recorded. Hypotension was treated with inj.Phenylephrine 50 mcg iv bolus, bradycardia with inj.Atropine 0.6 mg, Nausea/vomiting with inj.Ondansetron 4 mg iv.

The parameters studied were intra operative hemodynamic parameters, namely, heart rate, systolic blood pressure, diastolic blood pressure, mean arterial blood pressure, SpO_2, $EtCO_2$, and post-operative recovery profile (eye opening time, response to verbal command, Time for speaking name by patient, and time taken to achieve modified aldrete score >8).

All the data were collected and placed in Microsoft Excel sheet. Data analysis was done by SPSS version 2.0. Quantitative data were compared using Student's unpaired t test while Qualitative data were compared using Chi-square test. $P<0.05$ was considered significant. Microsoft Excel and Microsoft Word were used to generate graphs and Tables 1-5.

RESULTS

The two groups were comparable in terms of patients demographic characteristics. Mean age between groups is comparable (Group P – 40.02±7.71, Group S – 41.69±6.62). There were 17 male (40%) and 25 female (60%) in Group P and 17 male (40%) and 25 females (60%) in Group S.

Table 1: Comparison of demographic characteristics between groups

	Group P	Group S	P-value
Age	40.02±7.71	41.69±6.62	0.303833
Sex	M: F=17:25	M: F=17:25	1
Weight (kg)	64.12±8.41	63.60±8.27	0.783663

Two groups were comparable in terms of mean heart rate.

All two groups maintained heart rate within 15% of basal value.

Two groups were comparable in terms of systolic blood pressure, diastolic blood pressure, and mean blood pressure. All two groups maintained systolic BP, diastolic BP, and MAP within 15% of basal value.

Recovery profile is significantly better in Group S compared to Group P.

Two groups were comparable in terms of post-operative nausea vomiting (PONV). Five patients (11.9%) of Group S had PONV while only one patient (2.4%) of Group P had PONV within 10 min of extubation but the difference of PONV incidence between two groups were statistically not significant ($P>0.05$).

DISCUSSION

Laparoscopic procedures are rapidly increasing nowadays because of shorter hospital stay and reduced health cost. For this reason, use of anesthetics that provide fast and smooth induction, allow early recovery, and have no postoperative side effects is suggested. Propofol is preferred intravenous ultra-short acting agent in day care surgeries and have smooth induction and rapid recovery of consciousness with some antiemetic properties. Fast induction and early recovery based on low blood/gas partition coefficient is expected from newer inhalation agents. In our study, sevoflurane compared with traditional agents like propofol. Although there are many comparative studies with propofol and inhalation agents, for the effects of PONV, and on recovery criteria; there are not that many in peripheral based medical college. In this study, the effects of sevoflurane and propofol, on hemodynamics and recovery in patient

Table 2: Comparison of mean heart rate between two groups

Time of assessment (min)	Group P	Group S	P-value	Statistical significance
Baseline	77.55±8.18	78.07±7.12	0.740822	NS
After intubation	82.05±6.71	80.00±7.19	0.219128	NS
Before pneumoperitonium	81.62±6.99	81.86±6.41	0.857775	NS
After pneumoperitonium	81.57±5.58	80.57±5.32	0.433645	NS
10 min	82.43±6.33	81.52±7.22	0.574888	NS
20 min	79.05±6.09	79.48±5.78	0.721773	NS
30 min	82.90±5.54	83.71±4.52	0.481127	NS
40 min	81.71±5.56	81.86±4.72	0.895892	NS
50 min	84.24±4.05	83.81±3.92	0.632728	NS
60 min	83.90±5.94	85.52±8.15	0.318902	NS
After extubation	83.52±7.66	84.90±7.87	0.428715	NS

Table 3: Comparison of systolic blood pressure, diastolic blood pressure, and mean blood pressure between two groups.

Time of assessment (min)	Group P	Group S	P-value	Statistical significance
Systolic blood pressure (mm of hg)				
Baseline	95±9.74	96±9.18	0.487911	NS
After intubation	86±7.62	86±7.86	0.724596	NS
Before pneumoperitonium	88±9.90	91±9.51	0.265630	NS
After pneumoperitonium	90±9.66	90±8.39	0.817318	NS
10 min	92±9.21	92±9.66	0.774534	NS
20 min	92±10.94	93±9.99	0.618523	NS
30 min	95±6.81	96±7.17	0.347332	NS
40 min	94±7.62	94±8.03	0.934125	NS
50 min	96±9.59	96±7.55	0.859713	NS
60 min	97±11.13	100±11.67	0.277163	NS
After Extubation	97±7.79	98±8.15	0.401413	NS
Diastolic blood pressures (mm of hg)				
Baseline	95±9.74	96±9.18	0.487911	NS
After intubation	86±7.62	86±7.86	0.724596	NS
Before pneumoperitonium	88±9.90	91±9.51	0.265630	NS
After pneumoperitonium	90±9.66	90±8.39	0.817318	NS
10 min	92±9.21	92±9.66	0.774534	NS
20 min	92±10.94	93±9.99	0.618523	NS
30 min	95±6.81	96±7.17	0.347332	NS
40 min	94±7.62	94±8.03	0.934125	NS
50 min	96±9.59	96±7.55	0.859713	NS
60 min	97±11.13	100±11.67	0.277163	NS
After extubation	97±7.79	98±8.15	0.401413	NS
Mean arterial blood pressure (MAP) (mm of hg)				
Baseline	95±9.74	96±9.18	0.487911	NS
After intubation	86±7.62	86±7.86	0.724596	NS
Before pneumoperitonium	88±9.90	91±9.51	0.265630	NS
After pneumoperitonium	90±9.66	90±8.39	0.817318	NS
10 min	92±9.21	92±9.66	0.774534	NS
20 min	92±10.94	93±9.99	0.618523	NS
30 min	95±6.81	96±7.17	0.347332	NS
40 min	94±7.62	94±8.03	0.934125	NS
50 min	96±9.59	96±7.55	0.859713	NS
60 min	97±11.13	100±11.67	0.277163	NS
After extubation	97±7.79	98±8.15	0.401413	NS

Table 4: Comparison of time in minutes for eye opening, following verbal command, speaking name by patient, and achieve modified aldrete score >8 between two groups

Time of assessment (min)	Group P	Group S	P-value	Statistical significance
Eye opening	9±1.21	8±1.34	0.000083	HS
Time for following verbal command	10±1.20	9±1.32	0.000004	HS
Time for speaking name by patient	11±1.20	10±1.34	0.000012	HS
Time to achieve Modified Aldrete Score >8	14±1.30	13±1.37	0.000016	HS

HS: Highly significant

Table 5: Comparison of incidence of post-operative nausea and vomiting between two groups

Incidence of PONV	Group P (n=42)	Group S (n=42)	P-value	Statistical significance
Yes	1	5	0.0901	NS
No	41	37		

PONV: Post-operative nausea vomiting

undergoing laparoscopic cholecystectomy had been comparatively studied.

There was no significant difference between two groups with regard to mean age and weight (P>0.05). Both the groups were comparable in terms of gender distribution although majority of patients were females. This could be due to inclusion of cholecystectomy which is a more common procedure in females. For assessing hemodynamic status – pulse rate, systolic and diastolic

blood pressure, mean arterial pressure, SpO_2, and $EtCO_2$ were recorded before induction (baseline), after intubation, before pneumoperitoneum, immediately after pneumoperitoneum, throughout intraoperative period and after extubation.

In our study, hemodynamic variables (heart rate, systolic BP, diastolic BP, and MAP), SpO_2 and $EtCO_2$ were maintained within ±15% of baseline values in all the two study groups by adjusting the maintenance anesthetic concentration and found no statistically significant (P>0.05) difference between two groups.

These findings are similar to a study by Khushali et al.,[5] they also did not find any significant difference in hemodynamic parameters between propofol and sevoflurane groups in patients undergoing laparoscopic surgeries. Samantaray et al.,[6] observed that the intraoperative hemodynamic parameters such as heart rate and blood pressure were within acceptable range in both the groups during his study on spine surgery, although both the drugs effectively counteracted transient hypertensive response. However, Juckenhofel et al.,[7] and Yao et al.,[8] observed a significant decrease in mean heart rate during maintenance of anesthesia with propofol, (P<0.05), but not with sevoflurane.

In our study, we found that the time for eye opening was 9±1.21 min in Group P and 8±1.34 min in Group S. This difference between the two groups is highly significant with P<0.001 which proves that time for eye opening were significantly shorter in Sevoflurane group. The time for following verbal command was 10±1.20 min in Group P and 9±1.32 min in Group S. This difference between the two groups is highly significant with P<0.001 which proves that time for following verbal command were significantly shorter in Sevoflurane group. The time for speaking name by patient was 11±1.20 min in Group P and 10±1.34 min in Group S. This difference between the two groups is highly significant with P<0.001 which proves that time for speaking name by patient were significantly shorter in Sevoflurane group. The time to achieve modified aldrete score >8 was 14±1.30 min in Group P and 13±1.37 min in Group S. This difference between the two groups is highly significant with P<0.001 which proves that time to achieve modified aldrete score >8 were significantly shorter in Sevoflurane group. This findings suggest that recovery profile is significantly better in sevoflurane group than propofol group.

Singh et al.,[9] observed that sevoflurane group had better recovery profile with better cognitive function as compared to propofol group, the percentage of patients judged fast-track eligible on arrival in the PACU was significantly higher in the sevoflurane group (75% vs. 26%). Gupta et al.,[10] reported that no time difference was found in eye opening time between sevoflurane and propofol in their systematic review, but the time period to obey commands was faster in the sevoflurane group. Modified Aldrete score was lower in min after surgery in the propofol group. Similarly Goswami et al.,[11] found significant difference till 5 min postoperatively. Bharti et al.,[3] found that recovery time to achieve the aldrete score of 9 was same among groups.

Li et al.,[12] found that propofol group perceived a better post-operative sleep efficiency and less post-operative pain and adverse effects compared with patients in sevoflurane group which is contrasting our study. Another supporting study done by Orhan et al.,[13] evaluated the comparative effects of propofol infusion versus sevoflurane for maintenance of anesthesia with respect to recovery characteristics in patients undergoing percutaneous nephrolithotomy. Early recovery times (spontaneous respiration [P=0.002], eye opening [P=0.006], extubation [P=0.013], obey commands [P<0.05], and hand squeezing [P=0.005]) were significantly longer in propofol group and they concluded that maintenance of anesthesia with sevoflurane is associated with faster recovery than anesthesia with propofol, which is similar to the findings of the present study. Incidence of PONV less among patients received propofol infusion probably due to the intrinsic anti emetic property of propofol though the difference is statistically not significant (P>0.05).

Limitations of the study

1. As this is a single centre study with relatively small sample size may have bias. 2. In this study we have used only laparoscopic cholecystectomy patients so the findings cannot be generalized to other types of surgeries.

CONCLUSION

Our study showed that recovery profile was significantly better in patients after maintenance with sevoflurane inhalation as compared to propofol infusion. Thus, sevoflurane appears to be a better alternative to propofol for maintaining general anesthesia in laparoscopic cholecystectomies.

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REFERENCES

1. Sood J and Kumra VP. Anaesthesia for laparoscopic surgery. Indian J Surg. 2003;65:232-240.
2. Reves JG, Glass P, Lubarsky DA and McEvoy MD. Intravenous anesthesia. In: Miller RD, editor. Anesthesia. 7th ed. New York: Churchill Livingstone; 2010. p. 719-758.
3. Bharti N, Chari P and Kumar P. Effect of sevoflurane versus propofol-based anesthesia on the hemodynamic response and recovery characteristics in patients undergoing microlaryngeal surgery. Saudi J Anaesth. 2012;6(4):380-384.
   https://doi.org/10.4103/1658-354X.105876
4. Philip BK, Lombard LL, Roaf ER, Drager LR, Calalang I and Philip JH. Comparison of vital capacity induction with sevoflurane to intravenous induction with propofol for adult ambulatory anesthesia. Anesth Analg. 1999;89(3):623-627.
   https://doi.org/10.1097/00000539-199909000-00014
5. Tilvawala KR and Panchotiya PR. A randomized, comparative study of propofol infusion and sevoflurane as the sole maintenance agent in laparoscopic surgery. Anaesth Pain Intensive Care. 2017;21(2):154-158.
6. Samantaray A and Rao MH. Comparative effects of propofol infusion versus sevoflurane for maintenance of anesthesia for spine surgery. Int J Anaesth. 2007;11(2):23-25.
   https://doi.org/10.5580/14c7
7. Juckenhöfel S, Feisel C, Schmitt HJ and Biedler A. TIVA with propofol-remifentanil or balanced anesthesia with sevoflurane fentanyl in laporoscopic operations. Hemodynamics, awakening and adverse effects. Anaesthesist. 1999;48(11):807-812.
   https://doi.org/10.1007/s001010050789
8. Yao XH, Zhou P, Xiao ZK, Wang B, Chen CY, Qing ZH, et al. Comparison of target controlled propofol infusion and sevoflurane inhalational anesthesia in laparoscopic cholecystectomy. Nan Fang Yi Ke Da Xue Xue Bao. 2007;27(8):1280-1284.
9. Singh SK, Kumar A, Mahajan R, Katyal S and Mann S. Comparison of recovery profile for propofol and sevoflurane anesthesia in cases of open cholecystectomy. Anesth Essays Res. 2013;7(3):386-389.
   https://doi.org/10.4103/0259-1162.123259
10. Gupta A, Stieres T, Zuckerman R, Sakima N, Parker SD and Fleisher LA. Comparison of recovery profile after ambulatory anesthesia with propofol, isoflurane, sevoflurane and desflurane: A systemic review. Anesth Analg. 2004;98(3):632-641.
    https://doi.org/10.1213/01.ane.0000103187.70627.57
11. Goswami U, Babbar S and Tiwari S. Comparative evaluation of the effects of propofol and sevoflurane on cognitive function and memory in patients undergoing laparoscopic cholecystectomy: A randomised prospective study. Indian J Anaesth. 2015;59(3):150-155.
    https://doi.org/10.4103/0019-5049.153036
12. Li S, Song B, Li Y and Zhu J. Effects of Intravenous anesthetics vs inhaled anesthetics on early postoperative sleep quality and complications of patients after laparoscopic surgery under general anesthesia. Nat Sci Sleep. 2021;13:375-382.
    https://doi.org/10.2147/NSS.S300803
13. Orhon ZN, Devrim S, Celik M, Dogan Y, Yildirim A and Basok EK. Comparison of recovery profiles of propofol and sevoflurane anesthesia with bispectral index monitoring in percutaneous nephrolithotomy. Korean J Anesthesiol. 2013;64(3):223-228.
    https://doi.org/10.4097/kjae.2013.64.3.223

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