Section: Anaesthesiology

Original Research Article

# COMPARISON OF EFFECTS OF PROPOFOL AND SEVOFLURANE ON POSTOPERATIVE COGNITIVE FUNCTIONS AND MEMORY

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ABSTRACT

In this study we compared the effect of propofol and sevoflurane on cognitive function and memory in the post-operative period and also the effect on postoperative recovery quality in patients undergoing general anaesthesia. Aim of the study is to compare the effects of propofol and sevoflurane on cognitive functions and memory in terms of psychometric test pre and post operatively. 90 patients of age group 18– 60 years and ASA grade I, II scheduled for elective open cholecystectomy under general anaesthesia were included the study. Patients were divided into two groups in induction and maintenance: group P: Inj. propofol and group S: sevoflurane. Assessment of cognitive function and memory of patients in both groups was done perioperatively by following Materials and Methods: MMSE score, CVLT, DST, RBMT and Recalling the names of surgeon and anaesthesiologist. Post operatively, patients were observed for recovery by alderate recovery score up to 60 minutes and assessed for pain by visual analogue scale up to 240 minutes postoperatively. Cognitive function and memory up to 240 minutes was assessed postoperatively. The recovery quality was better with sevoflurane than propofol up to 5 mins. Sevoflurane had less impact on cognitive function and memory as compared to propofol up to 30 mins postoperative. We concluded from the study that when rapid recovery of cognitive function and memory are desired, sevoflurane is more favourable than propofol.

**Keywords:** Propofol, Sevoflurane, POCD.

## INTRODUCTION

General anaesthesia can affect the cognition and memory, which can lead to postoperative cognitive decline, commonly known as postoperative cognitive dysfunction (POCD).

The International Study of Post-Operative Cognitive Dysfunction (ISPOCD) was undertaken in the late 1990s.[1] The ISPOCD group coined the term postoperative cognitive dysfunction (POCD), which reflected an objectively measured decline in cognitive function that typically persists beyond the period expected for normal recovery from the physiological and pharmacological effects of anaesthesia and surgery.[2]

The causes of prolonged recovery of cognition and memory after anaesthesia and surgery are multifactorial. Multiple risk factors for the development of postoperative Neuro Cognitive Dysfunctions are there such as advanced age, history of cognitive impairment, type of surgical procedure, prior history of delirium, frailty, psychotropic medications, ASA physical status, number of medications, and smoking.[3]

Agents such as propofol, sevoflurane, nitrous oxide (N2O), midazolam, and fentanyl act on various types of receptors in the brain and these in turn may lead to POCD.[4,5] Sevoflurane and propofol are two most commonly used anaesthetic agents in day care cases.

The present study was an attempt to compare the effects of sevoflurane with that of propofol in patients undergoing open cholecystectomy under

GA as regards POCD in the immediate post-operative period (up to 4 h after surgery).

**Aim and Objectives**

- To compare the effects of propofol and sevoflurane on cognitive functions and memory post operatively in patients undergoing general anaesthesia.
- To compare the quality of recovery from general anaesthesia between the two groups.

## MATERIALS AND METHODS

This observational study was conducted from february, 2023 to March, 2024 after obtaining approval of the Ethical Committee of the Institution. A total of 90 patients posted for elective open cholecystectomy to be performed under GA were included, after informed consent and divided into two groups of 45 patients each with the help of a computer generated randomisation list. The primary endpoint was to compare early post operative cognitive functions between the two groups. Haemodynamic parameters, post operative recovery quality and pain were also evaluated.

Propofol was used in Group P and sevoflurane in Group S for induction and maintenance. All patients underwent a thorough pre anaesthetic check up. Inclusion criteria comprised, American Society of Anaesthesiologists (ASA) I and II physical status, age group between 18 and 60 years, education till 10th class and pre operative mini mental state examination (MMSE) score >23. Exclusion criteria included, patients receiving treatment with any psychotropic medications, patients with known psychiatric illness, drug or alcohol abuse, pregnant and lactating women, patient refusal, patient's education level below 10th class and pre operative MMSE score <23, Patients with significant hypotension (MAP< 65mmhg) and hypoxia (SPO2 <92%).

Thorough pre-anaesthetic evaluation was carried out. Patient was kept nil by oral for 6hours. Tab. Pantoprazole 40 mg HS was given day before surgery. Assessment of cognitive function and memory was done preoperatively by: MMSE Score, CVLT, DST, RBMT, Recall names of surgeon and anaesthesiologist. CVLT (California Verbal Learning Test): It measures episodic verbal learning and memory. Patient were asked the names of any 5 fruits preoperatively and asked to remember same names of 5 fruits postoperatively. (Grapes, Pineapple, Banana, Apple, Mango). DST (Digit Span Test): Measures the numerical memory. Patients were asked their vehicle no (4digit number) and pin code (6digit number) preoperatively and asked same questions postoperatively. RBMT (Rivermed behavioural memory test): Semantic memory assessed. Patient were shown picture of animal, to identify that animal and the place from where they came and their own birth date preoperatively. Patients were asked again to identify the same postoperatively. Recall names of surgeons and anaesthesiologist: Patient were told the names of surgeon and anaesthesiologist preoperatively and told to remember it and asked the same postoperatively. MMSE Score: It assesses the severity and progression of cognitive impairment. Categories are checking orientation to time (total score of 5), attention and calculation (total score 5), orientation to place (total score 5), registration (score 3), Recall (score 3), Language (score 2), repetition (score 1), complex commands (score 6). Total score is 30 (>23 no cognitive disablement, 18 - 23 mild cognitive disablement, 0 - 17 severe cognitive disablement). Premedication was given Inj. Glycopyrrolate 10 µg/kg IV, Inj. Palanosetrone 75 µg IV and Inj. Fentanyl 2 µg/kg IV, just before induction in patients of both groups. Pre oxygenation was done with 100% Oxygen for 3 min. The patient's baseline measurements of SPO2, MAP, HR, SBP, and DBP were noted.

Induction as well as maintenance of anaesthesia done with propofol 2.5mg/kg IV in Group P and sevoflurane up to 8 vol% in Group S. Endotracheal intubation was facilitated with inj. atracurium 0.5mg/kg. Endotracheal tube placement was confirmed, controlled ventilation was maintained with 1.2 to 1.5 volume% sevoflurane, 50% O2, 50% N2O. Inj. atracurium maintenance doses given. Maintenance fluid was given.

Intraoperatively pulse, SPO2 and ETCO2 monitored continuously and blood pressure monitored every 3 mins interval till extubation. At the end of surgery when the last suture was inserted, N2O and anaesthetic agents were stopped and O2 was administered at flow rate of 6 L/min. Reversal was done by using Inj. Glycopyrrolate 0.01mg/kg IV + Inj. Neostigmine 0.05 mg/kg IV at the end of the surgery. Duration of surgery was recorded. After extubation, Patients were observed for recovery by alderate recovery score at 0 min, 3 min, 5 min, 10 min, 15 min, 30 min and 60 min. Assessment of cognitive function and memory of patients in both groups was done by same method: MMSE Score, CVLT, DST, RBMT, and recall names surgeons and anaesthesiologist at 5 minutes, 30 minutes and then every hourly up to 4 hours postoperatively. SBP, DBP, MAP, SPO2 were monitored at 0min, 5min, 30min, 60min, 120min, 180 min and 240min after extubation. Intensity of pain assessed by VAS score at 0min, 5min, 30min, 60min, 120min, 180 min and 240min after extubation.

**Statistical Analysis**

Data was analyzed using SPSS version 20.0 and Microsoft Excel 2010. The mean ± standard deviation is used to present the results of continuous measurements, and the student t test was used for contrasting the intergroup and intragroup data. Fischer's exact test and the Chi square test are used to analyze discrete data, which are expressed as numbers (%) in cases where the cell count is zero or less than five. The statistical significance was set at the 5% level for each analysis (p value <0.05).

## RESULTS

The demographic parameters for this study were comparable between the two study groups. The age, gender, weight and the ASA status differences were not significant statistically (p value > 0.05) in the" groups. Since the dose of fentanyl calculated according to weight of the patient (2µg/kg), it was also comparable among the study groups. In this study the mean age in Group P and Group S group was 37.24±9.34 years and 37.76±8.59 years respectively. Female patients predominated in this study (64.44 % in Group P and 60.00 % in Group S), this may be because cholelithiasis happen more in females than males. The duration of surgery was also comparable between the Group P and Group S with p value >0.05. In our study HR, SBP, DBP, MAP and SPO2 in both the groups were comparable throughout the perioperative period. The difference between the two groups was statistically insignificant (p value >0.05).

We found out that MMSE score was significantly high in group S (24.07±1.19, 27.00±1.00) as compared to group P (22.20±1.36, 25.36±0.96) at 5 min and 30 min after extubation respectively with p value <0.001.

We found that the mean no. of words recalled by the patients (CVLT) was significantly high in Group S as compared to Group P with p value <0.001 at 5 min. and 30 min. after extubation. The mean no. of words recalled by patients at 5 min. after extubation was 3.13±0.66 in Group S and 1.93±0.81 in Group P. At 30 min. after extubation the mean no. of words recalled by patients was 4.11±0.75 in Group S and 3.18±0.81 in Group P.

The DST results showed that mean no. of numbers recalled by patients was significantly high in Group S as compared to Group P with p value <0.001 at 5 min. and 30 min. after extubation. The mean no. of numbers recalled by patients at 5 min. after extubation was 0.96±0.56 in Group S and 0.62±0.58 in Group P. At 30 min. after extubation the mean no. of numbers recalled by patients was 1.84±0.37 in Group S and 1.24±0.48 in Group P.

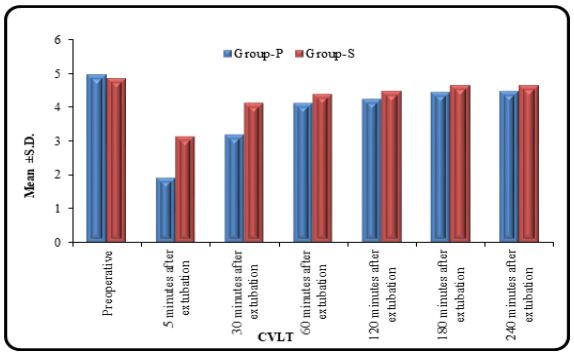
By doing RBMT we found out that mean no. of tasks done by patients was significantly high in Group S in comparison to Group P with p value <0.05 at 5 min. and 30 min. after extubation. The mean no. of tasks done by patients at 5 min. after extubation was 0.67±0.60 in Group S and 0.40±0.50 in Group P. At 30 min. after extubation the mean no. of tasks done by patients was 1.42±0.54 in Group S and 1.18±0.49 in Group P.

We assessed the no. of names (Recalling the names of surgeon and anaesthesiologist) recalled by patients and found out that the results were significantly high in Group S in comparison to Group P with p value <0.05 at 5min. and 30min. after extubation. The mean no. of names recalled by patients at 5min. after extubation was 0.62±0.65 in Group S and 0.31±0.51 in Group P. At 30min. after extubation the mean no. of names recalled by patients was 1.62±0.53 in Group S and 1.27±0.54 in Group P.

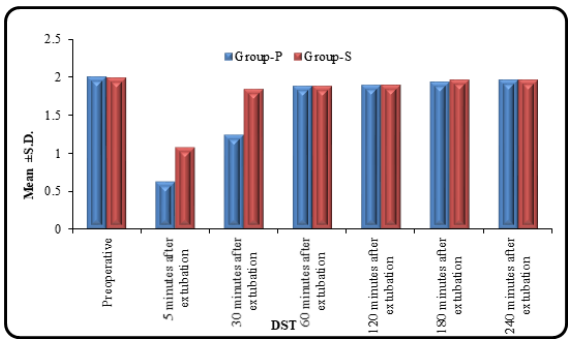
From 30mins after extubation onwards there was no significant difference in MMSE, CVLT, DST, RBMT" scores, Recalling the names of surgeon and anaesthesiologist done by the patients in both the groups.

Post operatively we used VAS score to evaluate the intensity of pain at 0 min, 5 min, 30 min, 1 hour, 2 hours, 3 hours, 4 hours after extubation. At all the time points the difference in VAS score between Group P and Group S was not significant with p value >0.05.

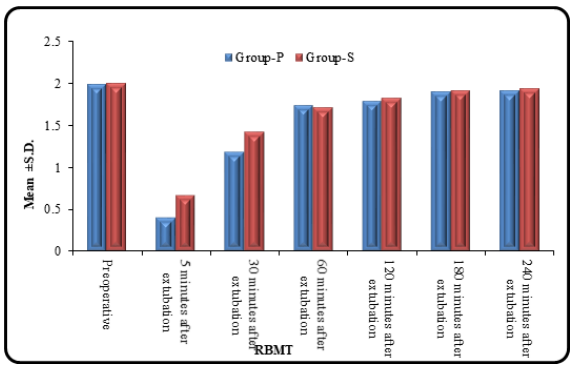
We found out that the Aldrete recovery score were significantly high in Group S in comparison to Group P at 0 min., 3 min. and 5 min. after extubation with p value < 0.001. The difference between the groups ceased to be significant at 5 min. after extubation onwards.



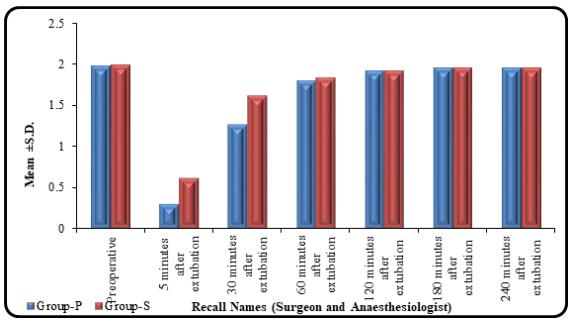

**Graph 1: Showing Perioperative CVLT**



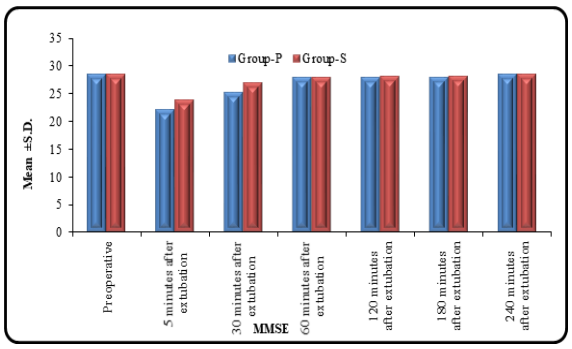

**Graph 2: Showing Perioperative DST**




**Graph 3: Showing Perioperative RBMT**




**Graph 4: Showing Peripherative Recall Names (Surgeon and Anaesthesiologist)**




**Graph 5: Showing Perioperative MMSE**

**Table 1: Distribution of age, gender, weight and ASA between the groups**

| | Group P | Group S | P value |
|---|---|---|---|
| Age | 37.24±9.34 | 37.76±8.59 | 0.996 |
| Gender (Male:Female) | 16:29 | 18:27 | 0.664 |
| Weight | 63.60±10.27 | 64.24±9.91 | 0.994 |
| ASA I:II | 27:18 | 28:17 | 0.829 |

**Table 2: Showing perioperative CVLT**

| CVLT | Group-P | | Group-S | | p value |
|---|---|---|---|---|---|
| | Mean | ±S.D. | Mean | ±S.D. | |
| Preoperative | 4.96 | 0.21 | 4.84 | 0.37 | 0.081 |
| 5 minutes after extubation | 1.93 | 0.81 | 3.13 | 0.66 | <0.001 |
| 30 minutes after extubation | 3.18 | 0.81 | 4.11 | 0.75 | <0.001 |
| 60 minutes after extubation | 4.11 | 0.80 | 4.38 | 0.49 | 0.061 |
| 120 minutes after extubation | 4.22 | 0.67 | 4.47 | 0.50 | 0.054 |
| 180 minutes after extubation | 4.44 | 0.59 | 4.64 | 0.48 | 0.081 |
| 240 minutes after extubation | 4.47 | 0.50 | 4.64 | 0.48 | 0.090 |

**Table 3: Showing Perioperative DST**

| DST | Group-P | | Group-S | | p value |
|---|---|---|---|---|---|
| | Mean | ±S.D. | Mean | ±S.D. | |
| Preoperative | 2 | 0 | 1.98 | 0.15 | 0.32 |
| 5 minutes after extubation | 0.62 | 0.58 | 0.96 | 0.56 | <0.001 |
| 30 minutes after extubation | 1.24 | 0.48 | 1.84 | 0.37 | <0.001 |
| 60 minutes after extubation | 1.87 | 0.34 | 1.87 | 0.34 | 1 |
| 120 minutes after extubation | 1.89 | 0.32 | 1.89 | 0.32 | 1 |
| 180 minutes after extubation | 1.93 | 0.25 | 1.96 | 0.21 | 0.65 |
| 240 minutes after extubation | 1.96 | 0.21 | 1.96 | 0.21 | 1 |

**Table 4: Showing perioperative recall names (Surgeon and Anaesthesiologist)**

| Recall Names | Group-P | | Group-S | | p value |
|---|---|---|---|---|---|
| (Surgeon and Anaesthesiologist) | Mean | ±S.D. | Mean | ±S.D. | |
| Preoperative | 1.98 | 0.15 | 2 | 0 | 0.32 |
| 5 minutes after extubation | 0.31 | 0.51 | 0.62 | 0.65 | 0.014 |
| 30 minutes after extubation | 1.27 | 0.54 | 1.62 | 0.53 | 0.002 |
| 60 minutes after extubation | 1.8 | 0.4 | 1.84 | 0.37 | 0.586 |
| 120 minutes after extubation | 1.93 | 0.25 | 1.93 | 0.25 | 1 |
| 180 minutes after extubation | 1.96 | 0.21 | 1.96 | 0.21 | 1 |
| 240 minutes after extubation | 1.96 | 0.21 | 1.96 | 0.21 | 1 |

**Table 5: Showing perioperative RBMT**

| RBMT | Group-P | | Group-S | | p value |
|---|---|---|---|---|---|
| | Mean | ±S.D. | Mean | ±S.D. | |
| Preoperative | 1.98 | 0.15 | 2 | 0 | 0.32 |
| 5 minutes after extubation | 0.4 | 0.5 | 0.67 | 0.6 | 0.024 |
| 30 minutes after extubation | 1.18 | 0.49 | 1.42 | 0.54 | 0.028 |
| 60 minutes after extubation | 1.73 | 0.45 | 1.71 | 0.46 | 0.816 |
| 120 minutes after extubation | 1.78 | 0.42 | 1.82 | 0.39 | 0.603 |
| 180 minutes after extubation | 1.89 | 0.32 | 1.91 | 0.29 | 0.729 |
| 240 minutes after extubation | 1.91 | 0.29 | 1.93 | 0.25 | 0.7 |

**Table 6: Showing Perioperative MMSE**

| MMSE | Group-P | | Group-S | | p value |
|---|---|---|---|---|---|
| | Mean | ±S.D. | Mean | ±S.D. | |
| Preoperative | 28.71 | 1.01 | 28.62 | 1.07 | 0.687 |
| 5 minutes after extubation | 22.2 | 1.36 | 24.07 | 1.19 | <0.001 |
| 30 minutes after extubation | 25.36 | 0.96 | 27 | 1 | <0.001 |
| 60 minutes after extubation | 28.02 | 0.72 | 28.02 | 0.69 | 1 |
| 120 minutes after extubation | 28.09 | 0.63 | 28.22 | 0.77 | 0.37 |
| 180 minutes after extubation | 28.07 | 3.17 | 28.33 | 0.8 | 0.585 |
| 240 minutes after extubation | 28.62 | 0.94 | 28.53 | 0.97 | 0.66 |

## DISCUSSION

POCD is a transient disturbance that can affect patients of any age but is more common in older people. Its diagnosis requires both pre and postoperative psychometric testing. Its manifestations are subtle and manifold, depending on the particular cognitive domains that are affected. The most commonly seen problems are memory impairment and impaired performance on intellectual tasks.

The new nomenclature recommends "perioperative neurocognitive disorders" (PND) as an overarching term for cognitive impairment or change, including delirium, identified in the perioperative period. Most forms of PND, including POD, are the result of the surgery itself, combined with preexisting vulnerabilities rather than type of anaesthesia (considering the fact that regional anaesthesia is often accompanied by sedation at levels comparable with general anaesthesia based on processed EEG monitoring).[6]

Intraoperative blood pressure variability, administration of vassopressors and postoperative hypertension were associated with the development of PND.[7-10] Both postoperative pain and opioid usage have been associated with development of POD. Other analgesic techniques such as regional analgesia, gabapentinoids, alpha 2 agonists, acetaminophen and COX2 inhibitors have been suggested as multimodal pain management strategy to reduce POD.

Effective strategies to reduce PND in older patients are nonpharmacologic – Assuring good sleep and nutritional hygiene, rapid mobilization, early orientation to familiar aspects of their environment, such as family members.

Post operative delirium in elderly patients is one of the most under diagnosed clinical entities in anaesthesiology practice, which increases the morbidity and mortality on this population.[11]

In the present study, short term POCD is evaluated. Similar studies,[12-14] have showed that sevoflurane affects the implicit memory and cognition of patients under general anaesthesia less than propofol. There was no added benefit of using total IV anaesthesia with propofol and opioid over the conventional balanced volatile anaesthesia technique in terms of postoperative recovery and cognitive functions.[15] Emergence and return of cognitive function were significantly faster after propofol compared with sevoflurane when assessed 60 min post operatively in another study.[16,17] Thus, the inferences of different studies have been different. In our study, propofol has been shown to affect explicit memory and other cognitive functions more than sevoflurane in the immediate post operative period. Sevoflurane, an inhalational anaesthetic with low solubility in blood and tissue is characterised by rapid induction and recovery and has been found to have less cognitive impairment than propofol.[13] Sevoflurane, therefore, be a better drug as far as short term preservation of cognitive functions are concerned and hence a better option in day care surgeries. But cost of sevoflurane can be a major challenge in many centers.

The limitation of this study was that it was not possible for us to follow up the patients beyond 240 minutes post operatively. Therefore we planned a short duration comparison between the two groups.

## CONCLUSION

Propofol was found to have a significant impact on cognitive functions and memory in comparison to sevoflurane in the immediate post operative period (up to 30 minutes). Beyond 30 minutes postoperatively, the values were not significantly different between sevoflurane and propofol group. The recovery in postoperative period was better in patients received sevoflurane anaesthesia when compared to propofol. Therefore, sevoflurane anaesthesia might be a better option in day care surgeries when postoperative cognition and memory are major concerns.

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