Comparative evaluation of recovery after desflurane or sevoflurane anaesthesia

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Abstract

Introduction and Aims: Early recovery is seen while using sevoflurane and desflurane for anaesthesia as inhalation agents. Main aim of the study was to compare and analyze desflurane and sevoflurane inhalation agents in terms of emergence from anaesthesia and recovery of cognitive functions using short Orientation-Memory-Concentration Test (SOMCT) and digital symbol substitution test (DSST) in patients undergoing laparoscopic surgeries.

Materials and Methods: A prospective randomized controlled study was conducted over 60 ASA I-III patients posted for laparoscopic surgeries. The day when patient was posted for surgery, SOMCT and DSST were done and baseline score was noted. Patients were pre-medicated and induced and were maintained on inhalation agents according to the group allocated. Inhalation agent was stopped after the surgery was completed and reversal agent for neuromuscular agent was being given. Total anaesthetic time, Time to extubaton, Time to eye-opening, Time to follow verbal commands, Time to achieve aldrete score 9 were noted. Then, patient was asked to perform SOMCT and DSST. Time required to reach the baseline level was compared.

Results: The mean time to extubation was comparable in both groups. The mean time to follow verbal command after stopping study drug was statistically significantly less in desflurane group D ($p < 0.05$). The mean time to achieve aldrete score 9 was statistically highly significantly lesser in group D. The mean time to achieve baseline SOMCT score was statistically significantly less in group D ($p<0.05$) while it was comparable in DSST score.

Conclusion: Desflurane when compared with sevoflurane during laparoscopic surgery produces faster emergence from anaesthesia but time to achieve baseline cognitive function is similar in both.

Keywords: DSST, SOMCT, Sevoflurane, Desflurane.

Introduction

Introduction of general anaesthesia and its safe usage around 150 years ago, is one of the major milestones in the evolution of medical practise, as it not only facilitated development and expansion of modern surgery but also lead to various other anaesthesia specialities.[1]

General anaesthesia can broadly be defined as a drug induced suppression of consciousness due to reversible depressing central nervous system resulting in the loss of response to and perception of all external stimuli. General anaesthesia is very frequently used in day-to-day ambulatory surgeries. Faster recovery and early discharge from hospitals are necessary to improve efficiency of a day-care facility and reduce burden of health care expenses. Advantages of laparoscopic surgery are early mobilization and reduced hospital stay, but the associated capnoperitoneum may lead to intraoperative cardiovascular instability. An ideal anaesthetic agent for laparoscopic procedures should provide both intraoperative haemodynamic stability and rapid recovery. The choice of inhalation anaesthetic agent is one of the factors which determines the expeditious recovery from the effects of general anaesthesia. With availability of newer faster and shorter acting drugs anaesthesia has become quite safe and easily reversible.

Inhalation anaesthetics are the most common drugs used for the provision of general anaesthesia. Only a fraction of inhalation anaesthetic agents is added to flow of fresh gas along with other anaesthetic adjuvant agents such as benzodiazepines, opoiods and others to decrease each others requirement and leading to a balanced anaesthesia giving analgesia, amnesia, hypnosis. They are especially popular in ambulatory surgery because of their ease of administration and the ability to reliably monitor their effects with both clinical signs and end tidal concentrations with predictable recovery.[1] With the easy access and availability of inhalation agents with lower blood solubility such as sevoflurane and desflurane, they are better suited for out patient surgeries and are replacing the traditional volatile agents due to their faster emergence and recovery from general anaesthesia.[2,3] In this study more robust tests to check cognitive functions were employed to analyze and compare the difference in recovery of cognitive functions between two inhalation anaesthetic agents using short orientation memory concentration test (SOMCT) and digital symbol substitution test (DSST) tests.

The purpose of this study was to evaluate desflurane and compare it with sevoflurane in terms of emergence from anaesthesia and recovery of cognitive function during laparoscopic surgeries.

Materials and Methods

A prospective randomized controlled study was conducted over 60 ASA I-III patients aged 18 to 60 years posted for laparoscopic surgeries under general anaesthesia.

Patients were randomly and equally allotted to either group D and group S by computer based randomised system.

Group D: Patients were maintained on O_2 + N_2O + Desflurane (3% to 6%).

Group S: Patient were maintained on O_2 + N_2O + Sevoflurane (0.6% to 2%).

Pre-anaesthetic check up was done a day before surgery and written informed consent was taken. Patients with cardiopulmonary risk, hepatic or renal dysfunction, neurological or psychiatric disorders, those with allergies to study drug or drug abuse, pregnant females, obese patients with BMI > 30, known difficult airway, cervical spine disease patient and patients who will not give consent to be part of study were not included in the study.

The day, patient was posted for surgery, before giving pre-medication, SOMCT and DSST were done and baseline score was noted. Best tests evaluate cognitive function by which we can check memory, orientation and concentration. The SOMCT is patient based test designed to assess cognitive function in terms of memory, concentration, orientation. The SOMCT requires subjects to recall the current year and month and one sentence, and address of our institute and repeat them at last. SOMCT yields score ranging from 0 to 24, with higher score indicating better cognitive function.

DSST is a sensitive neuropsychological test that is used to analyze brain damage, age, dementia, and depression. It consists of pairs of digit symbol each followed by a list of digits. Under each digit patient is asked to write down the symbol corresponding to the digit as fast as possible. The number of correctly written symbols within the allowed time of 90 seconds is noted down.

Patients were pre-medicated with injection midazolam 1-2mg i.v., inj glycopyrolate 0.2mg i.v., inj tramadol 75 mg i.v. and inj. emset 4mg i.v. In operation theatre basal haemodynamic readings were taken. Patients were induced with inj propofol 1 to 2.5 mg/kg i.v. and inj. succinylscoline 1 to 1.5mg/kg. Patients were maintained on inj. vecuronium and inhalation agent according to the group allocated.

Inhalation agent was stopped after the surgery was completed and before the reversal agent for neuromuscular agent was being given. Patients were reversed with inj. neostigmine 0.05mg/kg i.v. and inj. glycopyrolate 0.008 mg/kg i.v.

Total anaesthetic time (from injecting induction agents till the volatile anaesthetic agent is stopped), total surgery duration (from placing incision over skin till the last suture is placed), time of discontinuation of study inhalation agent (just before administration of the neuromuscular blockage reversal), time to extubaton (from stopping of volatile inhalation agent till the patient is extubated), time to eye opening (time till patient opens eyes after stopping inhalation agent), time to follow verbal commands (from discontinuation of maintenance agent to squeeze fingers) were noted down. After extubation, aldrete score was checked every 5 minutes till patient achieved an aldrete score of 9. Time taken for achieving aldrete score 9 was noted down. After that, patient was asked to perform SOMCT and DSST. Cognitive functions of the patient were analyzed and noted before surgery (baseline) and post operatively after every 15 minutes till the time patient achieves baseline value. Time required by patient to regain the baseline level of cognition was compared in patients of both the groups.

Observations and Results

All data were presented as mean and standard deviation (SD), except where specified. Data were analyzed using computer statistical software system open epi (open source epidemiological statistics for public health). The unpaired t-test and chi-square test were used for intergroup and intra-group comparisons. Probability values $p>0.05$ were considered not significant, $p < 0.05$ were considered significant and $p < 0.001$ were considered highly significant.

Demographic profile and duration of anaesthesia as well as surgery was found to be comparable in both groups. The mean age of patients in group D was 34.70 ±11.80 years while it was 35.20 ±13.40 years in group S ($p>0.05$). The mean weight of patients in desflurane group was 56.83 ±3.55kgs while it was 58.30 ± 4.24kgs in group sevoflurane ($p>0.05$). The male: female ratio was found to be same in both groups of 24: 6. Thus, both the groups were comparable with respect to age, weight and sex ratio. The mean duration of anaesthesia observed was 137.71 ± 41.30 minutes in desflurane group and 144.40 ± 54.20 minutes in group sevolfurane ($p>0.05$).

The mean time to extubation after discontinuation of volatile anaesthetic agents was comparable in both the groups ($p>0.05$). It was 2.41 ± 1.41 minutes in group D while it was 3.06 ± 1.41 minutes in group S). While, the mean time to eye opening after discontinuation of inhalation agent was statistically significantly less in group D as compared to group S ($p<0.05$). It was measured as 2.9 ± 2.21 minutes in group D while it was 4.23 ± 1.41 minutes in group S. The mean time for patients to follow verbal command after the study drug was stopped was 3.3 ± 2.12 minutes in group D while it was 6.1 ± 2.21 minutes in group S. It was significantly less in group D as compared to group S statistically ($p <0.05$). The mean time to achieve aldrete score of 9 was statistically highly significantly ($p<0.001$) less in desflurane group (1.5 ± 3.53 minutes) while it was 7.66 ± 10.6 minutes in sevoflurane group.

Table 1: Recovery parameters

Recovery parameters (minutes)	Group D	Group S	P Value
Time to extubation	2.41 ±1.41	3.06 ±1.41	P > 0.05
Time to eye-opening	2.9 ±2.21	4.23 ±1.41	P < 0.05
Time to follow verbal commands	3.3 ±2.12	6.1 ±2.12	P < 0.05
Time to achieve aldrete score of 9	1.5 ±3.53	7.6 ±10.6	P < 0.001

The mean time to achieve baseline SOMCT score was 18.5 ± 0 minutes in group D vs 22.33 ± 7.07 minutes in group S. The difference was statistically significantly less in group D when compared to group S ($p<0.05$). The mean time till the baseline DSST score was achieved was analyzed. It was 27.5 ± 21.21 minutes in group S and 20.5 ± 10.06 minutes in group D. It was comparable in both the groups ($p>0.05$).

Table 2: Cognitive functions

Recovery Parameters	Group D	Group S	P value
Time to achieve SOMCT score	18.5 ±0	22.33 ±7.07	P < 0.05
Time to achieve DSST score	20.5 ±10.06	27.5 ±21.21	P > 0.05

Discussion

Over last 15 years, there has been an explosive growth in the trend to provide cost- effective care in the practice of medicine. Faster recovery and shorter stay in hospital are required to provide efficient day care facility at a reasonable economic cost. An ideal anaesthetic agent for expeditious recovery and discharge should provide both intraoperative stable haemodynamic parameters and faster emergence and recovery.

In this study, we have assumed desflurane to be associated with rapid emergence from anaesthesia when compared to sevoflurane so, we compared desflurane and sevoflurane with respect to their recovery characteristics of patients undergoing laparoscopic surgery under general anaesthesia.

Pharmacokinetic properties of desflurane and sevoflurane favour better intra-operative anaesthestic control and faster recovery post-operatively. Both blood gas partition coefficients and fat/blood partition coefficient of sevoflurane and desflurane are low (0.45 vs 0.05 for desflurane vs sevoflurane, 25 vs 48 for desflurane vs sevoflurane) which causes early elimination of desflurane from body leading to faster recovery from anaesthesia. A study was conducted on healthy male volunteers, comparing desflurane and sevoflurane. It was observed that recovery was faster after desflurane anaesthesia. They attributed the delayed recovery from sevoflurane to effects of degradation products after prolonged anaesthesia.[8]

In this study, we observed that the mean time to extubation after discontinuation of volatile anaesthetic agents was comparable in both the groups ($p>0.05$). It was 2.41 ± 1.41 minutes in group D while it was 3.06 ± 1.41 minutes in group S). While, the mean time to eye opening after discontinuation of inhalation agent was statistically significantly less in group D as compared to group S ($p<0.05$). It was measured as 2.9 ± 2.21 minutes in group D while it was 4.23 ± 1.41 minutes in group S. The mean time for patients to follow verbal command after the study drug was stopped was 3.3 ± 2.12 minutes in group D while it was 6.1 ± 2.21 minutes in group S. It was significantly less in group D as compared to group S statistically ($p <0.05$). The mean time to achieve aldrete score of 9 was statistically highly significantly ($p<0.001$) less in desflurane group (1.5 ± 3.53 minutes) while it was 7.66 ± 10.6 minutes in sevoflurane group. Various studies have been conducted comparing recovery profile by sevoflurane and desflurane. Most of the studies having result almost similar with our study are discussed further. Fedricobilotta et al[6] (2009) conducted a study where it was seen that time for eye opening and time required for extubation was more with sevoflurane than desflurane ($p <0.05$). Also, aldrete score of ≥ 9 was achieved faster with desflurane group ($p <0.05$). Jindal Ravi[7] et al (2015) conducted a study where they noted that time taken since administering of reversal agent to achieve response to a painful stimulus, time taken to achieve eye opening, time taken to follow verbal commands, and time taken to achieve modified aldrete score of 9 were significantly faster with desflurane as compared to sevoflurane ($p<0.05$). Mayur Patel, Neelam Parmar[8] et al (2015) conducted study in which they observed that the time required since administration of reversing agents to achieve response to a painful stimuli to time taken for eye opening , to follow verbal commands, and to squeeze fingers were significantly less in desflurane group as compared to sevoflurane group ($p<0.05$). Joseph G, Werner[9] et al (2015) conducted study where they observed the median time required for eye opening and for achieving modified aldrete score of 9 was shorter with desflurane compared to sevoflurane. Akkeneni Lokesh[10] et al (2015) conducted study where they observed that the time to achieve recovery parameters like obtaining reaction to a painful stimuli, obeying of verbal commands and time to achieve spontaneous eye opening in minutes were achieved significantly earlier in patients in desflurane group v as compared to sevoflurane group ($p<0.001$). Vairavarajan chandrasekaran[1] et al (2016) conducted study in which they observed that the time to spontaneous motion, time to extubation, response to pain, time to hand grip were less with desflurane than sevofluranr ($p<0.05$).

Conclusion

Thus, it can be concluded that desflurane when compared with sevoflurane as a maintenance agent during laparoscopic surgery produces faster emergence from anaesthesia but time to achieve baseline cognitive function is similar with both the groups.

Conflict of Interest: None.

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