



## Clinical evaluation of Desflurane versus Sevoflurane in laparoscopic surgery

Authors

**Dr Vrishali Ankalwar<sup>1\*</sup>, Dr Anuja Dharmale<sup>2</sup>, Dr Vijay Patil<sup>3</sup>, Dr Naresh Tirpude<sup>4</sup>**

<sup>1</sup>Associate Profesoor, <sup>2</sup>Junior Resident, <sup>3</sup>Assistant Professor, <sup>4</sup>Professor

Department of Anesthesia, Government Medical College, Nagpur, Maharashtra, India- 440001

Corresponding Author

**Dr Vrishali Ankalwar**

Associate Professor, Dept. of Anesthesiology, GMCH, Nagpur

Address -403, C05, Pioneer Regency, Utkarsh Nagar, Katoal Road, Nagpur ,440013

Email: [vriankalwar@yahoo.com](mailto:vriankalwar@yahoo.com), Ph No. - 09881113317

### Abstract

**Aims and Objectives:** *The present study was undertaken to evaluate desflurane in terms of hemodynamic stability, recovery profile and perioperative complications and compare results of desflurane with routinely used sevoflurane for laparoscopic surgery.*

**Methods:** *Eighty patients of either sex, scheduled for laparoscopic surgeries under general anaesthesia were randomly allocated into two groups i.e. Group D and Group S. Patients of Group D received desflurane and of Group S received sevoflurane as an inhalational anesthetic. The intraoperative haemodynamic parameters, recovery characteristics and postoperative complications were observed and compared between two groups.*

**Results:** *Intraoperative MAP and HR did not differ between the two groups ( $P > 0.05$ ). Desflurane led to faster early recovery but the intermediate recovery was similar in both the groups. The incidence of postoperative complications was comparable in both the groups but incidence of coughing was more in desflurane group which was self limiting.*

**Conclusion:** *Desflurane can be used as an effective alternative to sevoflurane for maintenance of anaesthesia in laparoscopic procedures.*

**Keywords:** *Desflurane, Sevoflurane, Laparoscopic surgery, Early recovery, Modified Aldrete Score.*

### Introduction

Laparoscopic techniques offer major benefits to the patient such as minimized incision size and trauma with reduced postoperative discomfort, early recovery rates, and a lower incidence of postoperative wound infections. All these factors contribute to shorter in-patient stay and reduced perioperative morbidity <sup>(1)</sup>. Many laparoscopic surgeries are being increasingly performed on day care basis. So, while providing a standardized

balanced anaesthesia for laparoscopic surgery, management of hemodynamic stability and rapid early recovery from anaesthesia is desired <sup>(2)</sup>.

Both sevoflurane and desflurane have shorter emergence times compared to isoflurane based anaesthesia techniques and traditional inhalational anaesthetics <sup>(3)</sup>. Desflurane has lower solubility in blood and body tissues (blood: gas partition coefficient of 0.42 and fat: blood solubility 27 at 37°C) that leads to rapid induction and rapid early

and intermediate recovery compared with sevoflurane<sup>(4,5)</sup>. Although, faster recovery is a benefit, sympathetic stimulation induced by desflurane can result in transient hypertension and tachycardia<sup>(6,7)</sup> and also because of greater pungency and airway irritant properties, its use is associated with a high incidence of airway irritability<sup>(8)</sup>. But, the results of different studies have been conflicting. So, we have undertaken a study to clinically evaluate desflurane in terms of intraoperative hemodynamic stability, recovery profile and postoperative complications in patients posted for laparoscopic surgery and further to compare these results with that of routinely used inhalational anesthetic sevoflurane.

### Materials and Methods

After obtaining institutional ethics committee approval and written informed consent from all patients, this prospective randomized controlled study was conducted in department of Anaesthesiology at tertiary care hospital GMCH, Nagpur. Sample size of 80(each group 40) with power of 80% and alpha error=0.05 was calculated. So, 80 patients of either sex, aged 20–50 years, ASA grade I or II and who were scheduled for elective laparoscopic cholecystectomy or appendectomy surgery under general anaesthesia were included in present study and randomly allocated into one of the two groups using sealed envelope method; Group D received desflurane and Group S received sevoflurane as inhalational anesthetic with oxygen and nitrous oxide. The patients having history of any significant cardiopulmonary disease or any other significant systemic disease, smokers were excluded from the study. Thorough preanesthetic evaluation was carried out for all patients.

In the operation theatre, multipara monitor was applied to the patient and baseline parameters like mean BP (MAP), heart rate (HR) and SPO<sub>2</sub> were recorded. All the patients were premedicated with intravenous glycopyrrolate 0.01mg/kg, midazolam 0.03 mg/kg and fentanyl 2ug/kg. After

preoxygenation with 100% O<sub>2</sub> for 3 minutes, patients were induced with intravenous propofol 2mg/kg in both groups; intubation was facilitated with injection vecuronium 0.1 mg/kg. Airway was secured with portex cuffed endotracheal tube of adequate size and then connected to ventilator with flow of 3 liter/min of 50% O<sub>2</sub>+ 50% N<sub>2</sub>O+ either desflurane 3% or sevoflurane 1% to start with as per the group. Then dial concentration was adjusted to achieve 1 minimum alveolar concentration (MAC) before incision. The MAP and HR were targeted to maintain within  $\pm 20\%$  of the baseline values throughout intraoperative period. While maintaining anaesthesia, if the hemodynamic values of patients varied more than 20 % from baseline values, anaesthetic concentrations were adjusted within 3-6 % for desflurane and 1-3 % for sevoflurane to keep them within  $\pm 20\%$  range. If MAP and HR remained increased even after 5 minutes, rescue bolus doses of fentanyl 0.5ug/kg were given to control acute hemodynamic changes.

Hypotension i.e. MAP< 20% of baseline value was treated with bolus doses of 200ml Ringer Lactate and intravenous mephentermine 6 mg. In case of persistent hypotension, inhalational anesthetic was planned to reduce accordingly. Muscle relaxation was maintained by top up doses of injection vecuronium guided by train of four (TOF). Intra abdominal pressure was maintained between 12-14 mm Hg. EtCO<sub>2</sub>( end tidal carbon dioxide) was maintained between 30-40mm Hg. Parameters observed were MAP, HR, SPO<sub>2</sub>, ETCO<sub>2</sub> and MAC. After last skin suture, inhalational anesthetic and N<sub>2</sub>O were discontinued and patient was ventilated with 8 lit of 100% O<sub>2</sub> on bair circuit till ET (end tidal) volatile anesthetic was <1%. Time of total discontinuation of anesthetic agent was taken as time zero for all measures of recovery profile. Intravenous ondansetron 0.1mg/ kg mg was given to patients of both groups as antiemetic prophylaxis. On return of spontaneous ventilation, reversal was given with injection neostigmine

0.05mg/kg and injection glycopyrrolate 0.01mg/kg and extubation was done.

Early recovery was evaluated by time taken for response to painful stimulus, time taken for response to verbal commands, time taken for spontaneous eye opening, time taken for patient to state his own name which was assessed after every one minute. Thereafter patient was shifted to PACU immediately and subsequently intermediate recovery was assessed by Modified Aldrete Score upon arrival in PACU, 5minutes, 10 minutes, 20 minutes. Adverse postoperative complications like nausea, vomiting, coughing, and laryngospasm were also noted. Anaesthesia workstation (Datex Ohmeda, Model: Aspire 7100) was used for the present study.

All statistical calculations were done using SPSS (Statistical Package for the Social Science; SPSS Inc., Chicago, IL, USA) version 21. Comparison between two groups was done with help of unpaired t –test or Mann- Whitney test.

### Observations and Results

The demographic profiles of the patients and duration of surgery were comparable in both the groups. The most common surgery performed in both the groups was laparoscopic cholecystectomy, but the distribution of surgeries in both the groups were comparable ( $p>0.05$ ), (Table 1).

The mean values of MAP, HR, SpO<sub>2</sub> and EtCO<sub>2</sub> (end tidal carbon dioxide) at specified intervals were comparable in both groups ( $P>0.05$ ). After pneumoperitoneum, the mean MAP and mean HR in both groups showed rise (15 patients in desflurane group and 5 patients in sevoflurane group) which gradually settled round baseline in both the groups. Thereafter, mean MAP and HR were statistically comparable throughout the intraoperative period. (Figure 1, 2)

The end tidal CO<sub>2</sub> concentration was well maintained between 30-40 mm Hg. Also MAC equivalents for both sevoflurane and desflurane was maintained between 1-1.2 MAC intraoperatively and was comparable in both groups ( $p>0.05$ ). In desflurane group, statistically

significant number of patients (37.5%) required additional top up doses of fentanyl as compared to sevoflurane group (12.5%). Also, the total requirement of top up dose of fentanyl in desflurane group (660 mcg) was greater than sevoflurane group (220 mcg) ( $p<0.05$ ).

The difference between group S and group D to achieve all early recovery parameters was found to be statistically significant ( $p<0.01$ ). Time for response to painful stimulus was significantly earlier by 2.93 minutes, time for response to verbal commands was significantly faster by 3.0 minutes and time for spontaneous eye opening was earlier by 3.37 minutes in desflurane group than sevoflurane group which was significant. Time to state his/her own name was significantly faster in desflurane group by 3.63 minutes compared to sevoflurane group. Hence, the early recovery was significantly faster in desflurane group than sevoflurane group (Table 2).

In intermediate recovery, the Modified Aldrete Score on arrival to PACU, at 5 minutes, 10 minutes and 20 minutes was observed to be clinically satisfactory and statistically comparable between two groups ( $p>0.05$ ), (Table 3). Table 4 shows the comparison of post-operative complication between two groups.

**Table-1.** Demographic data, Duration and Type of surgery

Variable	Group D	Group S	P Value
Age (years)	37.30± 6.61	38.03± 7.70	P >0.01
Weight (kgs)	61.58± 7.07	59.63± 6.14	P >0.01
Sex (Male/Female)	14/26	15/25	P >0.01
Duration of surgery (mins)	83.70± 4.86	84.03± 5.67	P >0.01
Type of Surgery			
Appendicectomy	13(32.5%)	11(27.5%)	P >0.01
Cholecystectomy	27(67.5%)	29(72.5%)	

(p value < 0.05 is considered statistically significant)

**Table 2.** Early recovery parameters

Recovery parameters (min)	Group D	Group S	P Value
Response to painful stimulus	4.20± 1.38	7.13± 1.96	<0.01
Response to verbal commands	5.33± 1.12	8.33± 1.90	<0.01
Spontaneous eye opening	6.38±0.87	9.75±1.64	<0.01
Stating name	7.90± 0.96	11.53± 1.60	<0.01

(p value < less 0.05 is considered statistically significant)

**Table 3.** Modified Aldrete Score

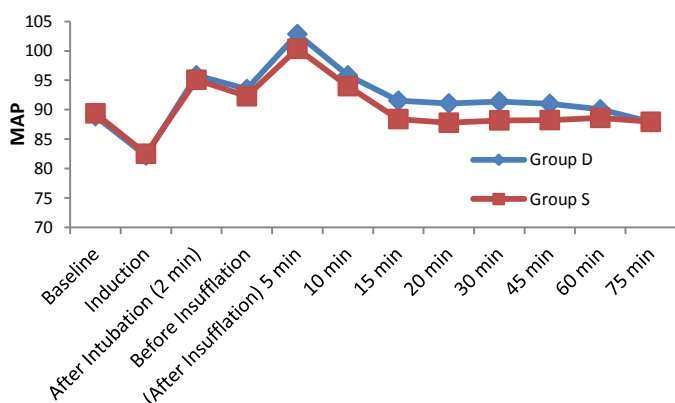
Time in minutes	Modified Aldrete Score (0-10)		P Value
	Group D	Group S	
Arrival	7.43± 0.93	7.23± 1.03	P >0.01
5 min	8.60± 0.98	8.63± 0.90	P >0.01
10 min	9.45±0.64	9.53±0.68	P >0.01
20 min	9.83± 0.38	9.85± 0.43	P >0.01

(p value < less 0.05 is considered statistically significant)

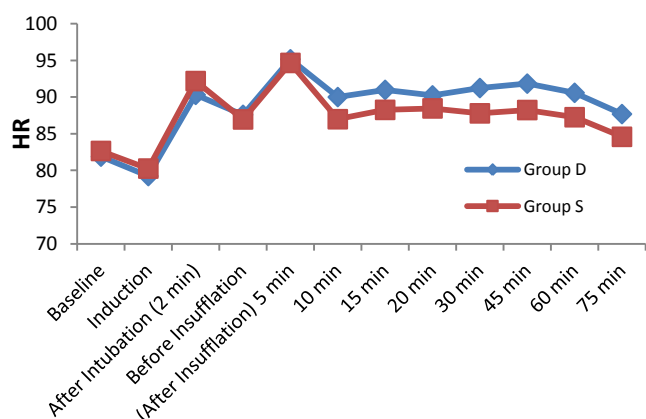
**Table 4.** Post-operative Complications

Complications	Group D	Group S	P Value
Nausea/Vomiting	5 (12.5%)	4 (10.0%)	NS
Cough	17 (42.5%)	3 (7.5%)	<0.01;S
Laryngospasm	0 (0%)	0 (0%)	NA

**Figure 1.** Variation in Mean Arterial Pressure (MAP)



**Figure 2.** Variation in Heart Rate (HR)



**Discussion**

In the present study, intraoperative cardiovascular stability was easily achieved with both desflurane and sevoflurane. MAP and HR maintained within

±20% of baseline values during the entire maintenance period in both groups. The results of present study were supported by other studies (2,9). However, Ebert TJ et al (6) and Weiskopf RB et al(7) observed that increase in desflurane concentrations can transiently increase arterial blood pressure or heart rate or both during induction of anaesthesia which they observed after a rapid increase in inspired desflurane concentration from 7.2 % (MAC 1.0) to 11% (MAC 1.5). This response has been attributed to sympathetic hyperactivity, possibly mediated by airway irritation. This goes in contrast with present study as we preferred to use concentration of desflurane at 1 -1.2 times MAC and avoided rapid increase in desflurane concentration. Although, in present study statistically significant tachycardia and hypertension did not occur in patients receiving desflurane, MAP and HR remained on a higher side in desflurane group as compared to sevoflurane group (p>0.05). This may be due to sympathetic stimulation caused by desflurane or alternative explanation for these findings is that sevoflurane may lead to a small reduction in HR (6,7). This could be reason for higher fentanyl requirement in desflurane group to maintain MAP and HR within 20% of baseline. There was no incident of desaturation in both the groups denoting respiratory stability of both the groups intraoperatively and similarly, while observing Modified Aldrete Score.

Various studies (2,10-13) used only MAC equivalents to ensure adequate depth of anaesthesia, similar to the present study. However, several authors (9,14) preferred to use BIS monitor over MAC equivalents to monitor depth of anaesthesia.

The present study used the early recovery parameters as the study by Kaur A et al (9) Jindal R et al (14) and those parameters included response to painful stimulus, response verbal commands, spontaneous eye opening and stating own name. In both the studies early recovery was found to be faster in desflurane group which was similar to present study. However, the time

required to achieve early recovery parameters in study conducted by Jindal R et al <sup>(14)</sup> was comparatively less than the present study, this could be due to shorter duration of surgery (51.3 minutes in desflurane group and 53.1 minutes in sevoflurane group) in their study as compared to present study (83.7 minutes in desflurane group and 84.03 minutes in sevoflurane group).

In current study, intermediate recovery was assessed by Modified Aldrete Score on arrival in PACU, at 5 minutes, 10 minutes and 20 minutes and was comparable in both the groups. Similarly, several studies <sup>(9, 15)</sup> also observed Modified Aldrete Score as criteria for intermediate recovery. In 2016, Erhan Gökçek et al <sup>(16)</sup> used Modified Aldrete Score in their study to assess intermediate recovery. The time to achieve Modified Aldrete Score of 9 was significantly less in desflurane group as compared to sevoflurane group. This difference with respect to present study could be due to use of shorter acting remifentanyl as top up doses to maintain MAP and HR. Although requirement of fentanyl was more, early recovery was faster in desflurane group. This proves faster emergence property with desflurane even with the use of opioids.

Our study showed a significantly higher incidence of coughing in desflurane group during emergence which may be explained by the fact that desflurane allows an earlier return of protective airway reflexes during emergence when compared to sevoflurane apart from airway irritant properties of desflurane. The coughing episodes that occurred in present study were short lasting, self limiting and did not lead to laryngospasm which may be attributed to use of fentanyl and propofol induction technique. The incidence of coughing was correlated with other studies <sup>(17, 18)</sup>.

### Conclusion

Observations of the present study showed that desflurane provides satisfactory hemodynamic stability and advantage of faster early recovery over sevoflurane. This may be beneficial where laparoscopic surgeries are carried on day care

basis and where quick case turnover and reduced post-anesthesia care unit (PACU) time is essential to ensure a good workflow. However, the difference in intermediate recovery with desflurane and sevoflurane was too small to impress a clinician caring for an individual patient. Moreover, the cost effective benefits of desflurane needs further evaluation.

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