

# Comparative Study on Postoperative Recovery Profiles of Desflurane and Sevoflurane Using I-GEL in Elective Ambulatory Surgeries

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## ABSTRACT

### Introduction

In providing general anesthesia for ambulatory surgery, the goal is to achieve optimal surgical conditions while ensuring a rapid early recovery without side effects. Desflurane and sevoflurane are proven as effective ambulatory inhalational anesthetic agents. The aim of this research is to investigate and compared the hemodynamic stability, postoperative outcome and airway responses in elective ambulatory surgeries in patients receiving anesthesia with desflurane or sevoflurane using I-Gel supraglottic airway.

### Methods

A prospective, observational study was conducted involving 60 patients of age 18 – 50 years undergoing ambulatory surgeries under general anesthesia, randomly allocated into 2 equal groups receiving desflurane (Group D) or sevoflurane (Group S) for maintenance of anesthesia with suitable size I-Gel. Patients were monitored for hemodynamic parameters and postoperative recovery profile using fast track criteria (FTC) score at different time intervals. Pearson's Chi Square test and Mann-Whitney U test were used for statistical analysis.

### Results

The mean time taken for postoperative recovery characteristics were significantly lower in Group D than Group S ( $p < 0.001$ ). The FTC score was significantly higher ( $p < 0.001$ ) in Group D than Group S at all-time intervals for 30 minutes. The requirement of additional analgesics was 46.7% in Group D and 60% in Group S ( $p > 0.301$ ) and that of antiemetic was 30% in Group D and 26.67% in Group S ( $p > 0.774$ ).

### Conclusions

Desflurane showed superior postoperative recovery characteristics and better FTC score without any increase in adverse airway events than sevoflurane.

**Keywords:** Ambulatory surgeries; desflurane; I-Gel; post-operative recovery; sevoflurane.

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## INTRODUCTION

Ambulatory surgeries are becoming popular nowadays. The advancement in day care anesthesia is being guided by an increasing understanding of the pathophysiological basis of the disease, development in anesthetic techniques, availability of newer and shorter acting anesthetic drugs, acute pain management, as well as advances in monitoring, training, evaluation of patients. The evolution of peri-operative care plays the pivotal role for the safety in anesthesia for day care surgery.<sup>1</sup> Desflurane and sevoflurane are the two most commonly administered inhaled anesthetics for outpatient surgeries due to their favorable pharmacokinetic profiles and low incidence of untoward effects.<sup>2</sup> Both the agents have rapid induction and recovery capacity due to low blood:gas partition coefficient (0.65 for sevoflurane and 0.42 for desflurane) and fat:blood solubility (48 and 72) respectively and can be safely used for anesthesia maintenance.<sup>3,4</sup> In the present study, a comparison between desflurane and sevoflurane was done to assess postoperative recovery characteristics in patients undergoing elective short surgical procedures.

## METHODS

A prospective, observational study was performed at Calcutta National Medical College and Hospital, Kolkata, India, between February 2020 and July 2021 after taking Institutional Ethics Committee clearance (CNMC/20/01/2020) and informed written consent from each patient; 60 patients belonging to American Society of Anesthesiologists (ASA) physical status I and II, and aged 18-50 years, of either sex posted for elective day care surgeries under general anaesthesia were randomly selected for the study. Our exclusion criteria consisted of patients' refusal, history of allergy to any of the study drugs, surgeries of duration more than one hour, body mass index (BMI) >30 kg/m<sup>2</sup>, ASA-PS grades III, IV, V & emergency, patients with difficulty in communication, psychiatric illness,

alcohol abuse, heavy smokers, having history of gastro-oesophageal reflux, pregnancy and breast feeding mothers and patient with anticipated difficult airway. Pre-anaesthetic check-up was done prior to the day of surgery. All the selected patients were kept nil per oral for 8 hours before the surgery. On the day of surgery, the patient's identification were confirmed, and shifted to the operation theatre. The patients were connected to the multiparameter monitors recording their basal heart rate (HR), systolic blood pressure, diastolic blood pressure, and mean arterial blood pressure (MAP), electrocardiogram and oxygen saturation. After intravenous (i.v) cannulation, general anaesthesia using I-gel supraglottic airway was given according to the institutional protocol.

Patients were chosen by computerised randomisation in either Group D (n=30) or Group S (n=30) who received desflurane and sevoflurane respectively for maintenance of anaesthesia. Patients received preanaesthetic medication with i.v glycopyrrolate (0.01mg/kg), midazolam (0.03mg/kg) and fentanyl (2mcg/kg). Anaesthesia was induced with i.v. propofol (2mg/kg) with 2% lignocaine 2ml to reduce the pain caused by propofol during injection. After placement of appropriate sized well lubricated I-Gel, study patients were randomised to receive either desflurane 6-8% (Group D) or sevoflurane 2-3% (Group S) in O<sub>2</sub>:N<sub>2</sub>O in 50:50 for initial maintenance of anaesthesia at total gas flow rate of one litres/min. The inspired concentration of both the agents were subsequently adjusted to maintain clinically acceptable depth of anaesthesia (0.5-0.7 MAC; MAC *unconscious*) while maintaining stable haemodynamic values within 20% of pre-induction baseline values. Intraoperative haemodynamic variables namely heart rate (HR), mean arterial pressure (MAP), oxygen saturation, respiratory rate, and end tidal concentration of volatile agent were monitored every 5 minutes throughout the surgery. Before the end of surgery, i.v ondansetron (0.1mg/kg) and dexamethasone

(0.1mg/kg) were administered for antiemetic prophylaxis. Analgesia was provided by i.v paracetamol (20mg/kg) and diclofenac (1.5mg/kg). The inhalational agent and N<sub>2</sub>O were discontinued after the closure of surgical wound. On awakening from anaesthesia, the I-Gel was removed. A qualified anaesthetist assessed the time taken from switching off the vaporizer to eye opening, time to obey verbal commands, time to shift out to the recovery room and orientation to time, place and person. The occurrence of any adverse events like coughing, hiccups, breath holding (>10 sec), laryngospasm were noted in the postoperative period. After achieving the above parameters, patients were shifted to post anaesthesia care unit (PACU), where the time of sitting, achievement of Fast Track Criteria (FTC) (Figure-1) were assessed at 5min interval. Discharge criteria from PACU included FTC score >12. The discharge criteria from PACU required patients to be awake and alert with stable vitals, without experiencing any side effects like nausea, vomiting, moderate to severe pain which were assessed at every five minutes in recovery room at the time of discharge. The recovery room stay duration was also noted. Side effects were recorded by recovery room nursing staff and rescue analgesic was administered in the form of injection tramadol (1mg/kg i.v) with anti-emetics, if required.

Injection metoclopramide (10 mg) was given as an additional antiemetic if postoperative nausea and vomiting occurred. Assuming p value <0.05 to be significant and considering effect to be both sided, we got  $Z\alpha=1.96$ ; assuming power of study to be 90%, we got  $Z_{1-\beta}=1.28$ ; considering an effect size {d (difference in FTC in 5 minutes)} of 1.05 to be statistically significant, we got  $n>2(Z\alpha+Z_{1-\beta})^2 \times SD^2 / d^2$  we got n=30. Hence, minimum thirty patients were taken in each group. Therefore, total sample size required was sixty patients. Data was entered in Microsoft Excel and analysis was performed using Statistical Package for the Social Sciences for Windows, Version 20.0 software (IBM, Bengaluru, India). Categorical variables were expressed as number of patients and percentage and compared across the groups using Pearson's Chi Square test for Independence of Attributes/ Fisher's Exact Test as appropriate. Continuous variables were expressed as mean, median and standard deviation and compared across the groups using Mann-Whitney U test. An alpha level of 5% has been taken, i.e. if any p value is less than 0.05 it has been considered as significant.

## RESULTS

The study groups were comparable with no statistically significant difference in their demographic profile (Table-1).

Table 1. Description of demographics and ASA classification among the groups			
Variable	Group D (n=30)	Group S (n=30)	p-value
<b>Sex</b>			
Male	17(57%)	19(63%)	0.598*
Female	13(43%)	11(37%)	
<b>Mean age (years)</b>	37.57 (9.7)	33.37 (10.53)	0.113 <sup>#</sup>
<b>Body mass index(kg/sq.m)</b>	25.83 ( 3.29)	25.47 ( 3.21)	0.650 <sup>#</sup>
<b>ASA</b>			
I	12(40)	16(53)	0.301*
II	18(60)	14(47)	

ASA, American Society of Anesthesiologists physical status \* Chi Square test <sup>#</sup> Mann-Whitney U test P-value <0.05 considered statistically significant.

The hemodynamic parameters (HR and MAP)) showed no statistically significant differences throughout the perioperative period in group D when compared group S [Figure-3, 4].

that the average time for desflurane group with regards to eye opening, obeying verbal commands, orientation, ability to sit, stay in recovery room was significantly lower ( $p < 0.001$ ) than sevoflurane group.(Table-2)

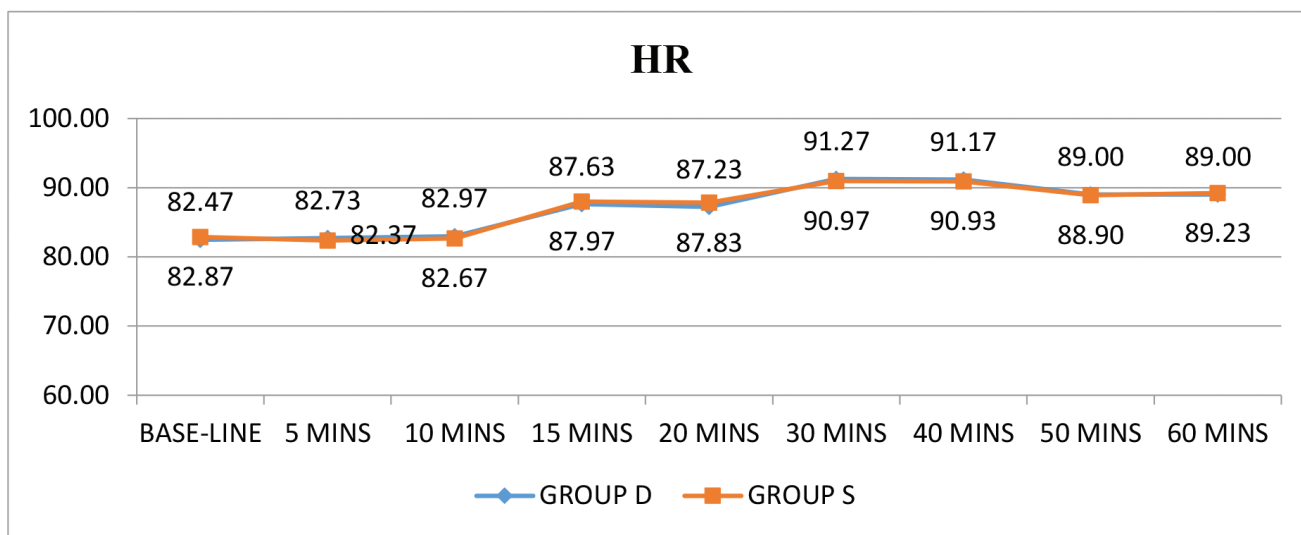


Figure 1. Distribution of HR between the 2 groups.

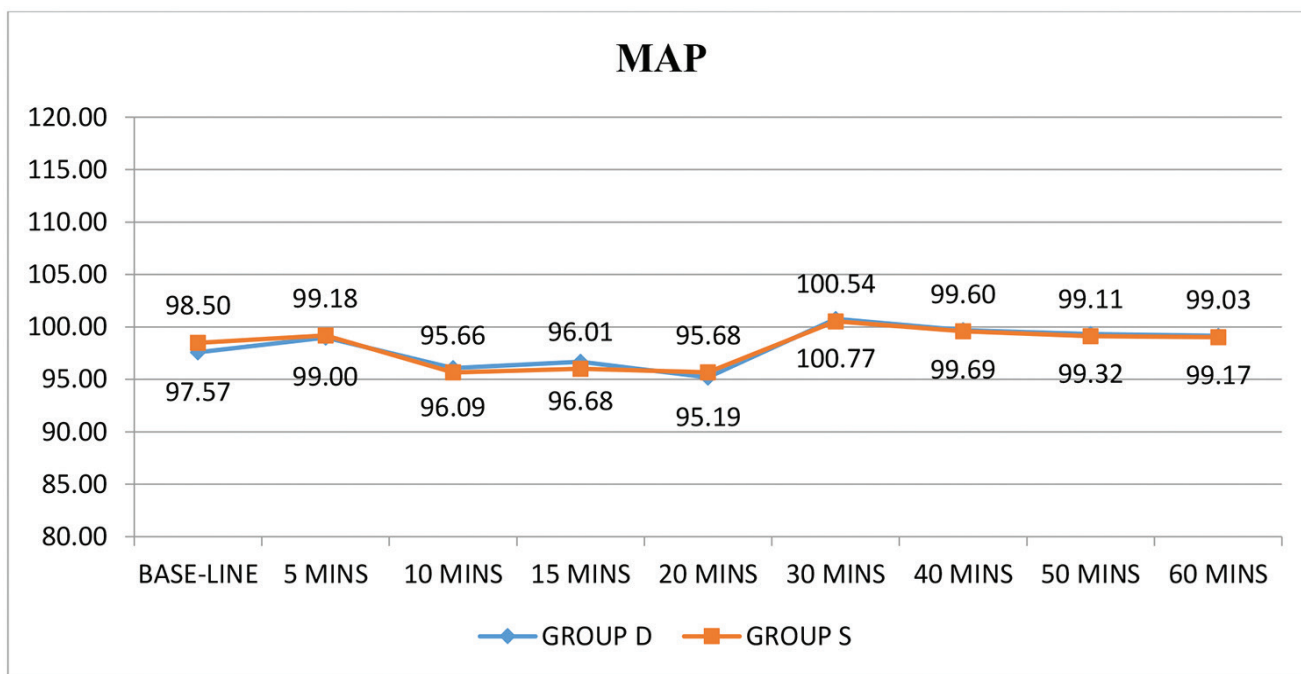


Figure 2. Distribution of MAP between the 2 groups.

Statistically significant difference between the 2 groups was found in post-operative recovery profile (PRP) in minutes. It was also noted

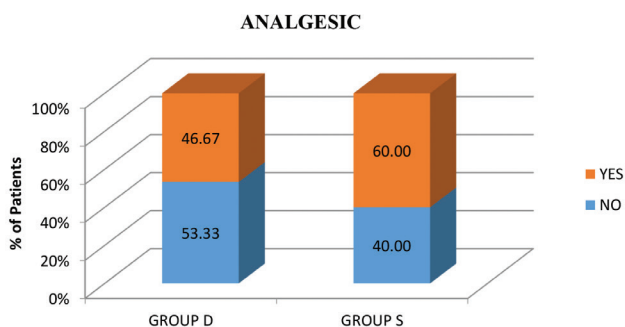
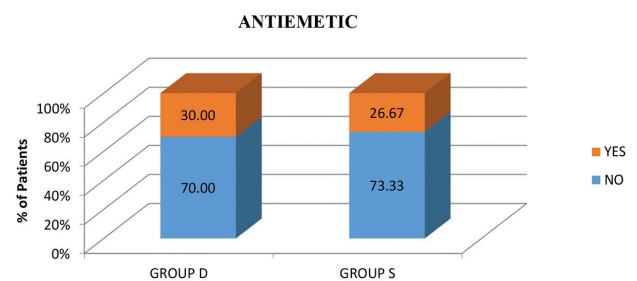
**Table 2.** Comparison of postoperative recovery profiles (PRP) between the 2 groups.

PRP	GROUP D		GROUP S		p Value
	Mean	SD	Mean	SD	
Eye opening (min)	8.03	0.89	10.87	0.78	<0.001
Obedying verbal commands (min)	10.2	0.85	13	0.83	<0.001
Orientation (min)	12.77	0.82	16.1	1.06	<0.001
Ability to sit (min)	27.03	0.85	34.07	1.36	<0.001
Stay at recovery (min)	37.37	1.96	46.1	2.19	<0.001

**Table 3.** Comparison of Fast track criteria (FTC) scores between the 2 groups.

FTC	GROUP D		GROUP S		p Value
	Mean	SD	Mean	SD	
FTC at 5 min	10.5	0.51	7.97	0.89	<0.001
FTC at 10 min	11.63	0.49	10.37	0.49	<0.001
FTC at 15 min	12.5	0.51	11.53	0.51	<0.001
FTC at 20 min	13.43	0.5	12.5	0.51	<0.001
FTC at 25 min	14	0	13.63	0.49	<0.001
FTC at 30 min	14	0	13.67	0.48	0.001

Table-3 shows distribution of FTC scores between the 2 groups. There was statistically significant difference in FTC score at all the time points between the 2 groups. It was also observed that FTC score in desflurane group was significantly higher at all the time points than sevoflurane group ( $p < 0.001$ ). The study groups were comparable with no statistically significant difference in requirement of analgesics and antiemetics (Figures- 5,6)

**Figure 3.** Distributin of usage of analgesics between the 2 groups.**Figure 4.** Distribution of usage of antiemetic among the 2 group.

## DISCUSSION

Day care anaesthesia is undergoing a phase of evolution from the traditional methods. The definition of ambulatory surgery as proposed by International Association for Ambulatory Surgery (IAAS): "A surgical day case is a patient who is admitted for investigation or operation on a planned non-resident basis and who none the less requires facilitates for recovery. The procedure should not require an overnight stay in a hospital bed".<sup>5,6</sup> The advancement in day



care anaesthesia is being guided by an increasing availability of newer advanced anaesthetic techniques, shorter acting anaesthetic drugs, pioneering acute pain management facilities, advances in monitoring, training as well as introduction of minimally invasive surgical techniques that result in less tissue damage and post-operative pain. Along with these, economic factors and patient preferences have provided additional impetus to the popularity of day care surgery and an increase demand for fast tracking<sup>7,8,9,10,11,12</sup>. Both sevoflurane and desflurane have maintained the place in day care ambulatory anaesthesia.<sup>13</sup> We studied a more heterogenous ambulatory surgery population undergoing a wide variety of superficial surgical procedures, including both male and female outpatients. The current findings were consistent with previously published comparative studies. In our study, we did a comparison between desflurane and sevoflurane while using I-gel in study groups, in sixty patients undergoing elective short surgical procedures and assessed postoperative recovery characteristics. The demographic parameters like age, sex, BMI, ASA classification were noted and analysed between both the groups and the results were statistically non-significant ( $p>0.05$ ) in our study which were corroborative with the study by Chudasma PA et al.<sup>14</sup> Chaitali S Patil et al<sup>15</sup> observed the effects of sevoflurane and desflurane on haemodynamic parameters and recovery characteristics in patients undergoing laparoscopic gynaecological surgeries and all demographic parameters were statistically insignificant in their study. Our findings were consistent with the above study. Inhaled anaesthetics allow rapid emergence from anaesthesia because of easy titratability with inherent neuromuscular blocking effects that make them more suitable for ambulatory anaesthesia. The availability of less soluble inhalation anaesthetics such as sevoflurane and desflurane made us rethink about the

selection of volatile anaesthetics for outpatient surgical procedures.<sup>16</sup> In our study, time to eye opening was defined as time in minutes between discontinuation of volatile anaesthetic agent to eye opening on calling. The mean time to eye opening on calling in desflurane group was  $8.03\pm 0.89$  min, which was significantly shorter than in sevoflurane group which was  $10.87\pm 0.78$  min ( $p<0.05$ ). These findings were consistent with the observations made by White et al.<sup>2</sup> Time of response to verbal commands is defined as time between closure of anaesthetic agent and response to verbal commands by hand squeeze. The mean time of response to verbal commands, example, squeezing the hand in group D was  $10.2\pm 0.85$  min, which was significantly shorter than in group S which was  $13\pm 0.83$  min ( $p<0.05$ ). Similar findings were seen in the study by Strum et al<sup>17</sup>. Jindal et al<sup>16</sup> observed that, time for response to verbal commands in desflurane group was 3.48 mins and in sevoflurane was 5.04 mins which was statistically significant ( $p<0.05$ ), similar to our study. But the mean duration was much shorter than our study, which was most likely due to not using benzodiazepine in their study. The mean time of orientation by uttering his or her name was  $12.77\pm 0.82$  min in group D and was  $16.10\pm 1.06$  min in group S which was statistically significant ( $p<0.05$ ). Similar finding was seen in study by Mahmoud et al.<sup>18</sup> As a result of the lower solubility of desflurane in blood and lean tissues compared to sevoflurane, it might be expected to find differences in the intermediate and late recovery end points when these two anaesthetics were used for longer surgical procedures. However, several studies<sup>17,19,20</sup> have found that only early recovery was more rapid after desflurane than sevoflurane, even during long duration surgeries (exceeding 2 h). Furthermore, the recovery of psychomotor and cognitive function after desflurane and sevoflurane were similar after the first 30 – 45 min in both younger

patients undergoing ambulatory surgery and elderly patients undergoing more prolonged general anesthesia for inpatient procedures.<sup>19,20</sup> The duration of stay in recovery room was determined by achievement of FTC score. It was 37.36±1.95 min in group D which was significantly shorter than in group S which was 46.1±2.19 min ( $p<0.05$ ). Our results were similar to Mayer et al.<sup>21</sup> The FTC score was significantly higher in group D as compared to group S at all times ( $p<0.05$ ), which was measured every 5 minutes for 30 minutes. Discharge criteria from PACU in all patients was achieved at 20th min in group D while in group S, it was achieved at 25th min. Our findings corroborate with the studies made by White et al.<sup>2</sup> Analgesic consumption was 46.7% in group D and 60% in group S respectively and it was statistically not significant ( $p=0.301$ ). We used paracetamol 1gm (i.v) and diclofenac 75mg (i.v) at the same time in our study. Our findings corroborate with the studies made by Jadhav et al.<sup>22</sup> The use of antiemetics in our study was greater in group D (30%) and 26% in group S but it was statistically insignificant ( $p=0.774$ ). We used ondansetron 4mg and dexamethasone 8mg in our study. This result was supported by the findings of Song D et al.<sup>23</sup> Desflurane, owing to its greater

pungency as compared to sevoflurane, is known to have a higher incidence of airway-related complications such as coughing, laryngospasm, and bronchospasm. We found no difference in respiratory-related complications between the two groups. Use of intravenous induction with propofol and fentanyl minimized the airway reflexes resulting in absence of any airway-related complications.

**Limitations** of this study were inability of double-blinding as the operator was the person turning off the vaporiser and observing for the data. We did not also calculate the quantity of the agent required, hence the cost of the inhalational agent was not noted. Further studies would be required on smokers with reactive airway disease and obese individuals to evaluate the incidence of airway events.

## CONCLUSIONS

We conclude that desflurane is superior to sevoflurane in terms of post-operative recovery characteristics without any increase in adverse airway events for daycare surgeries.

**Conflict of interest:** Nil.

**Financial help:** Nil

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**Citation:** Paul S, Saikia M, Nayak SK, Dutta S, Biswas C. Comparative Study on Postoperative Recovery Profiles of Desflurane and Sevoflurane Using I-GEL in Elective Ambulatory Surgeries. 2023; 19(2); 150-58.