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A Comparative Study of Recovery and Emergence Characteristics between Desflurane and Sevoflurane in Day Care Surgeries

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Abstract: ***Background: Ambulatory anaesthesia for day care surgeries with newer less soluble inhalation anaesthetics provides benefits to not only the patients but also the healthcare providers and hospital. The goal is to achieve optimal surgical conditions while ensuring a rapid early recovery with less side effects Desflurane and sevoflurane have low blood gas solubility co-efficient, allowing a rapid awakening from anaesthesia. Aim and objective: We planned this prospective randomized study to compare the emergence and recovery characteristics of sevoflurane and desflurane for day care surgeries. Material and methods: This prospective, randomized, double blinded comparative study was conducted on total of 60 patients belonging to American society of anaesthesia class I &II scheduled to undergo day care surgeries under general anaesthesia for duration of about 30 minutes. All patients were randomly allocated into 2 groups-Group D (n=30) –received desflurane inhalation with oxygen {(at 1.3 minimum alveolar concentration (MAC)} and Group S (n=30) received sevoflurane Inhalation with oxygen for maintenance (at 1.3 MAC) of anaesthesia. Results: The mean emergence time was significantly shorter in Group D (6.55 ± 1.31 min) as compared to Group S (11.65 ± 1.50 min) (P< 0.0001) and the mean recovery time was also significantly shorter in Group D (9.05 ± 1.37 min) as compared to Group S (17.94 ± 1.99 min) (P< 0.0001). Conclusion: We conclude that in comparison to sevoflurane the emergence and early recovery time were shorter after maintenance of anaesthesia with desflurane.***

Keywords: Desflurane recovery, sevoflurane comparison, day care anesthesia, emergency time, inhalational agents.

Key Message: Desflurane can be used in day care surgeries as it has significantly faster emergence and recovery from anaesthesia with less side effects as seen in our study

Standardized Study Reporting Requirements:
CONSORT: http://www.consort-statement.org/
TREND: http://www.cdc.gov/trendstatement/
STROBE: http://www.strobe-statement.org/
SQUIRE: http://www.squire-statement.org/
STARD: http://www.stard-statement.org/
ARRIVE: http://www.nc3rs.org.uk/arrive-guidelines

1. Introduction

Ambulatory surgery has increased rapidly in the last 20 years, and the availability of new minimally invasive surgical techniques has resulted in an increased emphasis on the expansion of day care surgeries. In providing general anesthesia for ambulatory surgery, the goal is to achieve optimal surgical conditions while ensuring a rapid early recovery with less side effects [1]. Emergence and recovery are two common problems after general anaesthesia. The use of volatile anesthetics that are rapidly eliminated with minimal metabolic breakdown may facilitate faster recovery from general anaesthesia. The availability of volatile anaesthetics with low blood-gas partition coefficients e. g., sevoflurane (0.69) and desflurane (0.42) [2, 3] provide shorter emergence time compared with traditional inhaled anaesthetics. [4, 5]

2. Material & Methods

This prospective randomized double blinded comparative study was conducted at a tertiary care hospital, after approval from the institutional ethical committee (order no- 43429-49 Acad – III/MCA/2021; 27/09/2021) registered under Clinical Trials Registry –India (ICMR-NIMS); ctri. nic. in; CTRI/2022/05/042545; 13/05/2022.60 patients of American Society of Anaesthesiologists (ASA) grade I and II, aged 16 to 60 years posted for day care surgeries under general anaesthesia were included in this study. Patients who were not willing to participate in the study, history of chronic disease hypertension, diabetes, respiratory disease, epilepsy and cardiac disease, allergy to study drugs were excluded from the study.

Written informed consent was obtained on the day of surgery. A total of 60 patients were randomized into two groups by using computerized randomization method (Random Allocation Software) figure 1.

- Group D (n=30): Desflurane group (desflurane inhalation with oxygen (50%) + nitrous oxide (50%) for maintenance of anaesthesia at 1.3 MAC)
- Group S (n= 30): Sevoflurane group (sevoflurane inhalation with oxygen (50%) + nitrous oxide (50%) for maintenance of anaesthesia at 1.3 MAC)

Pre-anaesthetic evaluation was done on the day before surgery according to standard protocol and relevant demographic data were collected from all the patients. All patients included in the study were kept nothing by mouth for a minimum period of 6 hours before the surgical procedure. Patient was taken in operating room and 20 gauge peripheral venous cannula was secured, ringer lactate was started. Pulse oxymeter, non invasive blood pressure, electrocardiograph were attached. Baseline data of heart rate (HR), systolic blood pressure (SBP), diastolic blood pressure (DBP), mean arterial pressure (MAP), oxygen saturation (SpO2) were recorded. Inj. glycopyrrolate 0.004 mg/kg and inj fentanyl 1mcg/kg were given as premedication to all patients before induction. Patients were preoxygenated with 100% oxygen. Induction was done with inj. Propofol 2mg/kg i. v. and inj

succinylcholine 1.5 mg/kg. Airway secured with adequate size I gel.

After confirming the position of I gel and fixing it, anaesthesia was maintained with O2 (50%) + N2O (50%) + desflurane (2-6%) or sevoflurane (0.5-2%) according to group allocated. HR, SBP, DBP, MAP, SpO2 and MAC will be noted at every 5 min after induction. Patients were allowed to breath spontaneously. End tidal concentration of volatile inhalational agent was maintained at approximately 1.3 MAC throughout the surgery. All anaesthetic agents were discontinued when spontaneous recovery of neuromuscular function was confirmed at the end of surgery. I gel was removed after ensuring cough and gag reflex, and purposeful movements. Time of emergence (The time from discontinuation of anaesthetics to removal of I gel), recovery time (The time from discontinuation of anaesthetics until the achievement of Modified Steward Recovery Score of 6), post anaesthesia care unit (PACU) time (The time from receiving patient in PACU from the operation theatre thereafter till shifting them from PACU to ward) noted by modified aldrete score (fig.2), time to follow command and time to coherent speech was noted and then patients were shifted to recovery room after recording HR, SBP, DBP, MAP and SpO2. To assess late recovery, next day patients were contacted by telephone and asked about routine activity using activity assessement score (fig.3). Adverse effects were also observed such as nausea, vomiting, shivering, cough and emergence delirium.

Sample size was calculated based on Meena r et al [6] study. A total sample size of 50 patients with an alpha error of 0.05 and power of 90% was calculated but for compensating the loss to drop outs and attrition sample size was kept 60 (30 patients included in each group). Statistical analysis was done using Statistical Package for the Social Sciences (SPSS) version 21 (SPSS Inc, Chicago, USA). Level of significance was ascertained by chi square and student t- test. *P* value <0.05 was considered statistically significant.

3. Results

Comparison of demographic data (age, weight, gender and ASA physical status), duration of surgery and hemodynamic baseline parameters showed no significant difference between the groups (Table-1).). In the periaoperative period hemodynamic parameters between the two groups were comparable. Statistically significant difference were found in the mean emergence time between the groups which was significantly shorter in Group D (6.55±1.31) than Group S (11.65±1.50) with p value <0.0001 and mean recovery time was also significantly shorter in Group D (9.05±1.37) than Group S (17.94±1.99) with p value <0.0001. Comparision of two groups regarding time to follow command and coherent speech also showed significant difference (p value <0.0001) between the groups. There was statistically significant difference in modified aldrete score between both the groups. Score >9 was achieved earlier in group D as compared to group S. The mean time to discharge to home was comparable in both the groups (Table- 2). Both groups were comparable regarding occurrence of complications (Table- 3).

Table 1: Demographic profile and Baseline vital parameters

Parameters	Group D Desflurane Mean ± SD	Group S Sevoflurane Mean ± SD	P value	Significance
Age (yr)	31.73 ± 10.62	30.53 ± 10.29	0.658	NS
Weight (kg)	60.07 ± 10.32	62.97 ± 7.70	0.222	NS
HR (minute)	88.60 ± 8.83	87.87 ± 8.06	0.739	NS
SBP (mmHg)	128.94 ± 8.42	126.47 ± 8.87	0.273	NS
DBP (mmHg)	82.40 ± 7.11	83.15 ± 7.40	0.690	NS
MAP (mmHg)	97.91 ± 5.17	97.59 ± 5.82	0.823	NS

Values are expressed as mean±SD, ASA= American society of anaesthesiology, HR = Heart rate, SBP= systolic blood pressure, DBP= diastolic blood pressure, MAP= mean arterial pressure, NS = non sigificant

Table 2: Comparision of mean duration of emergence and recovery between both the groups

	Group D Desflurane Mean±SD	Group S Sevoflurane Mean±SD	P value	Significance
Mean emergence time (min)	6.55 ± 1.31	11.65 ± 1.50	<0.0001	S
Mean recovery time (min)	9.05 ± 1.37	17.94 ± 1.99	<0.0001	S
Mean time to follow command (min)	7.37 ± 1.27	14.03 ± 1.54	<0.0001	S
Mean time to coherent speech (min)	7.99 ± 1.27	16.07 ± 1.78	<0.0001	S
Mean time to achieve modified aldrete score >9	8.90 ± 1.30	17.94 ± 1.99	<0.0001	S
Mean time of discharge to home (hours)	5.33 ± 0.68	5.64 ± 0.50	0.072	NS

Values are expressed as mean±SD, S=significant, NS= non significant

Table 3: perioperative adverse effects

Adverse effects	Group D		Group S		P value
	No.	%	No.	%	
Nausea/vomiting	2	6.67	2	6.67	1.0 (NS)
Shivering	1	3.33	0	0.00	0.313 (NS)
Cough	2	6.67	1	3.33	0.554 (NS)
Emergence delirium	2	6.67	1	3.33	0.554 (NS)

4. Discussion

Ambulatory surgery is required to manage the needs of growing health-care system. Fast tracking of patients in day care surgery requires early recovery from anaesthesia with patient satisfaction. Ambulatory surgery not only helps in

managing the large volume of patients but also makes it more economical by decreasing the length of hospital stay. [7] Desflurane and sevoflurane have lower blood gas coefficient, which makes them the inhalational agent of choice for ambulatory anaesthesia by providing rapid induction as well as emergence from anaesthesia [8]

The pathogenesis of postoperative cognitive dysfunction is unclear; however, age, alcohol abuse, low baseline cognition, hypoxia, hypotension, and type of surgery have been alleged to contribute to this problem. [9] The choice of anaesthetic drugs can also affect postoperative cognition because residual levels of volatile anaesthetics can produce changes in central nervous system activity. [10, 11] Therefore, the use of anaesthetics with a rapid clearance and negligible metabolism may offer advantages in this patient population

Although there were studies comparing sevoflurane and desflurane anaesthesia, the results were varying and lack uniformity. [12, 13, 14] Most of them have either compared the rate of recovery and emergence or the incidence of emergence delirium or both. We have also taken into consideration both these factors in our study as our primary objective

So, we planned to conduct a study on total of 60 patients which were randomly divided in two groups to receive either desflurane (n =30) or sevoflurane (n=30) to compare the recovery and emergence profile of desflurane and sevoflurane in patients with spontaneous respiration assisted with supraglottic airway devices by trying to limit the confounding factors as much as possible which may affect the study results.

In our study there was no significant difference in demographic profile i. e., both Group D and Group S were comparable with respect to age (31.73 ± 10.62 and 30.53 ± 10.29 years, p= 0.658), weight (60.07 ± 10.32 and 62.97 ± 7.70 kg, p = 0.222), gender male/female (5/25 and 6/24, p = 0.738) and ASA physical status I/II (27/3 and 28/2, p =0.640) respectively which was similar to Meena r et al [6]

The emergence time was significantly shorter in desflurane group (6.55 ± 1.31 min.) than sevoflurane (11.65 ± 1.50 min.), p <0.0001. Hence our results were similar to Kotwani MB et al [15], in which time to awakening and time to removal of SGA were shorter with desflurane (5.3 ± 1.4 min and 5.8 ± 1.3 min respectively) than sevoflurane (9.1 ± 2.4 min and 10.0 ± 1.6 min respectively) (p value < 0.0001)

In our study recovery time was also significantly shorter in group D (9.05 ± 1.37 min) than group S (17.94 ± 1.99 min). This was similar to the previous studies by Gupta R et al [16]; recovery time in Group D vs Group S was (11.7 + 2.08 min vs 20 + 3.06 min) and in Kotwani et al [15], Group D vs Group S was (18 ± 8.4min vs 45.3 ± 9.7min) respectively.

In our study mean time to follow command was (7.37 ± 1.27 v/s 14.03 ± 1.54 min.) and mean time to coherent speech was (7.99 ± 1.27 v/s 16.07 ± 1.78 min.) in group D and group S respectively which was similar to the study done by Meena R et all. [6]

We compared Modified Aldrete Score ≥ 9 as the criteria for discharge from PACU, and we found that desflurane offering a faster discharge from PACU as compared to sevoflurane (8.90 ± 1.30 min vs 17.94 ± 1.99 min; p<0.001).

Our results were similar to the study done by, Meena R et al [6] (5.89 ± 1.77 min in desflurane and 15.68 ± 4.52 min in sevoflurane group; p=0.0001) and Jindal R et al (2011) [17] (10.80 ± 3.77 min in desflurane and 16.20 ± 3.87 min in sevoflurane group; p=0.0001)

However, in the study done by Mayer et al [18] they found that there was no difference in the mean discharge time in desflurane and sevoflurane group (39.31 ± 8.1 min vs 36.2 ± 9.9 min; p>0.05).

In our study maximum patients in both groups achieved AAS 4 within 24 hours (28 in group D and 25 in group S) and remaining patients (2 in group D and 5 in group S) achieved AAS 3.

In our study we found all haemodynamic parameters (intra-operative and post-operative) including PR, SBP, DBP, SpO2 were comparable in both groups (p>0.005).

Nathanson MH et al [19], Patel M et al. [20] also reported non-significant fall in pulse rate and blood pressure after induction in both the groups.
Similarly, Locatelli BG et al [21] and Gupta P et al [22] also found no significant haemodynamic changes in their studies.

In our study no patient had emergence agitation when compared in both groups. Oofuvong M et al [23] found that the incidence of emergence agitation between sevoflurane and desflurane was not significantly different at 36.8% in sevoflurane and 41.2% in desflurane (p = 0.73) nor was the median (IQR) of severity of EA (2 (1, 3) in sevoflurane and 2 (1, 3) in desflurane, p = 0.4).

We found no major respiratory and haemodynamic adverse effects in both the study groups similar to the observations of Kotwani et al [15].

Limitations of our study were that further studies should be carried out on smokers, patients with reactive airway and obese patients to evaluate the incidence of adverse airway events, especially at higher MAC.

5. Conclusion

From our study we concluded that emergence and recovery from anaesthesia were significantly faster in the desflurane group based on time to eye opening, following commands, removal of i-gel and duration of PACU stay with no adverse event in perioperative period in patients who underwent day care surgeries. So, desflurane has an overall better quality of early recovery in patients as compared to sevoflurane.

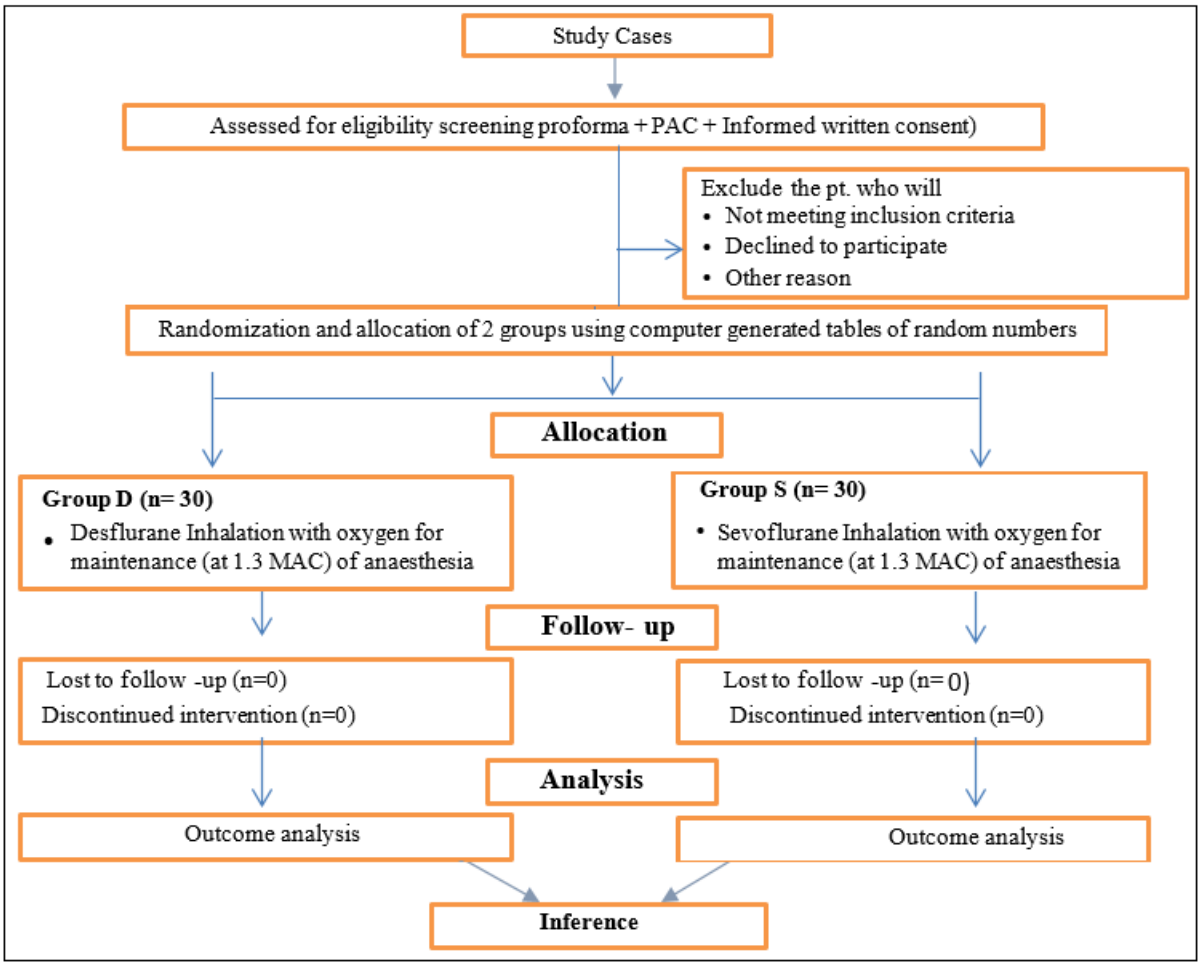

Figure 1: Flow Chart

Parameter Response of patient		Score
Oxygenation	SpO_2> 92% on room air	2
	SpO_2> 90% on room air	1
	SpO_2< 90% on room air	0
Respiration	Breaths deeply and coughs freely	2
	Dyspneic, shallow or limited breathing	1
	Apneic	0
Circulation	Blood pressure ± 20 mm Hg of normal	2
	Blood pressure ± 20 -50 mm Hg of normal	1
	Blood pressure more than ± 50 mm Hg of normal	0
Consciousness	Fully awake	2
	Arousable on calling	1
	Not responding	0
Activity	Moves all extremities	2
	Moves two extremities	1
	No movement	0

Figure 2: Modified Aldrete Score

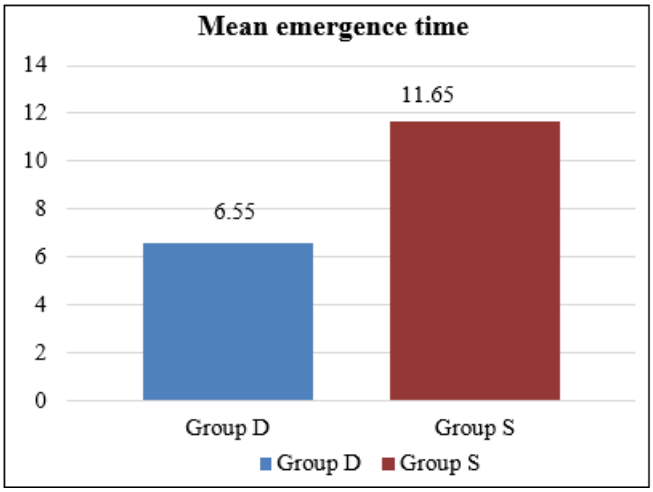

Figure 4: Mean emergence time

Grade	Level of activity
4	Full return to normal activity
3	Up & dressed but still housebound
2	Up but not dressed
1	Still in Bed

Figure 3: Activity assessment score

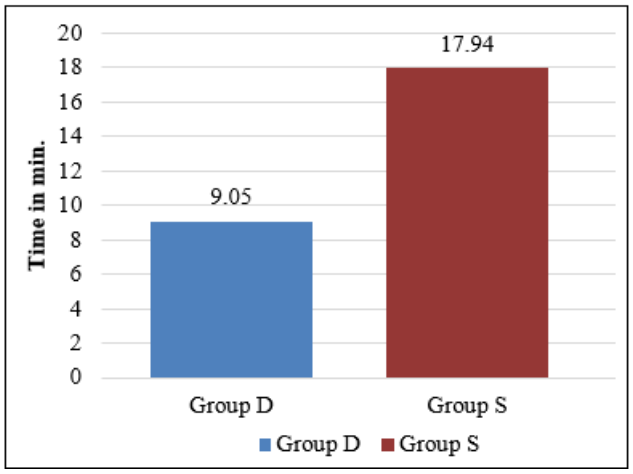

Figure 5: Mean recovery time

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Conflicts of interest: Nil

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