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Emergence and Recovery Characteristics After Desflurane Versus Sevoflurane Anaesthesia: A Prospective Comparative Study

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Abstract

Background and Aims: Selection of inhalational anaesthetic agents are based on their safety, emergence and recovery characteristics and side effects. This study was to assess the emergence and recovery characteristics and side effect profile of desflurane and sevoflurane. *Methods:* 110 patients undergoing general anaesthesia for procedures below two hours were randomly assigned into two equal groups (n = 55). After intravenous induction, anaesthesia was maintained with 1.0 MAC (Minimum Alveolar Concentration) of desflurane (Group D) or sevoflurane (Group S) which was discontinued on skin closure. In Post-Anaesthesia Care Unit (PACU) patients were assessed by Modified Aldrete Scoring System and the emergence time was noted as the time to respond to verbal command. Patients were then assessed by Modified Post Anaesthetic Discharge Scoring System (PADSS) for their recovery from anaesthesia. Post-anaesthesia complications if any were also recorded. All parametric data were statistically analysed using Student's *t*-test and non-parametric data by Chi-square test. *Results:* Both groups were similar demographically with respect to age and sex ($p > 0.05$). Administration of desflurane resulted in faster emergence than sevoflurane (19±3.7 min vs. 27.04±6.7min, $p < 0.01$). The early and delayed recovery time were faster with desflurane than sevoflurane with $P< 0.01$. Side effects were also lesser with Group D when compared to Group S. *Conclusion:* Desflurane was found to be superior to sevoflurane as inhalational anaesthetic agent for short surgical procedures in terms of its faster emergence and rapid recovery with minimal side effects.

Keywords: Desflurane; Sevoflurane; Emergence; Recovery.

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Introduction

General anaesthesia is a state of controlled, reversible state of loss of consciousness produced by the administration of one or more anaesthetic agents. Anaesthetic agents used may be either intravenous or inhalational (volatile) agents or a combination of these. Induction of anaesthesia with intravenous agent followed by maintenance with inhalational agents is commonly used in current practice due to patient acceptability, safety profile and smooth emergence with minimal side effects.Inhalational anaesthetic agents allow rapid emergence from anaesthesia because of less blood solubility and easy titrability.

History of anaesthesia can be traced from the first successful public demonstration of inhalational anaesthesia by WTG Morton on October 16,1846 using diethyl ether. Even before this, Humphrey Davy in 1779 has suggested the

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anaesthetic properties of nitrous oxide and has been used as inhalational anaesthetic agent by Horace Wells from1844 for dental extractions. Inhalational anaesthetic agents are still the 'backbone' of modern anaesthetic practice due to its ease of administration, titratability, smooth emergence with quick recovery [1].

The ideal inhalational anaesthetic should produce smooth rapid induction with optimal operating conditions having rapid emergence and minimal side effects. Efforts to develop such a drug has led to the invention of various halogenated anaesthetic agents like halothane, isoflurane, desflurane and sevoflurane. However, evenwith these newer agents, there are side effects and problems with metabolism that keep them away from being the 'ideal' anaesthetic agent [2].

Desflurane and sevoflurane are among the most commonly administered inhaled anaesthetic drugs today due to their favourable pharmacokinetic profiles and lower incidence of untoward side effects [3]. Both of these drugs are halogenated ethers with low blood gas partition coefficients which allow rapid equilibration between delivered concentration and the effect site in central nervous system producing faster emergence from anaesthesia as compared to the older inhalation anaesthetic drugs [4].

Early emergence and speedy recovery from anaesthesia is advantageous due to the early return of patient's airway and other protective reflexes enhancing speedy recovery. This is specifically advantageous in short surgical procedures were the patients attain early "home readiness" for discharge, thus reducing the financial burden to the family.

This study was to compare the emergence and recovery characteristics and side effect profile in patients undergoing general anaesthesia receiving desflurane or sevoflurane as the inhalational agent for the maintenance of anaesthesia.

Methods

The study was undertaken atGovernment Medical College, Kozhikode, a tertiary care teaching hospital during a one-year period from July 2015. After obtaining Institutional Ethics Committee approval and patients consent, 110 patients between 18-65 years of age with no complicating systemic disorders [American Society of Anaesthesiologists' physical status (ASA PS) Class I or II] [5] scheduled for elective surgical procedures of less than two hours under general anaesthesia were included for analysis in this prospective comparative study. Pregnant and lactating women were excluded from the study.

The 110 patients were randomly allocated into two equal groups (n=55) by computer-generated random number table, Group D to receive desflurane and Group S, sevoflurane as the inhalational anaesthetic agent for the maintenance of anaesthesia. After routine pre-anaesthetic evaluation and written informed consent, all the patients were premedicated on the previous night with tab. alprazolam 0.25 mg and tab ranitdine 150 mg orally and were fasted 8 hours before surgery.

In the operating room, intravenous access was established in the non-dominant forearm. Electrocardiogram (ECG), non-invasive blood pressure (NIBP), pulse oximetry (SpO_2) and capnography ($EtCO_2$) were monitored. All the patients were given ondansetron 4mg, glycopyrrolate 0.2mg and fentanyl 2μg/kg intravenously before the induction of anaesthesia.

After preoxygenation, general anaesthesia was induced with sodium thiopentone (5-6 mg/kg) followed by lignocaine (1.5 mg/kg) and suxamethonium (2mg/kg) intravenously. After tracheal intubation, capnogram was connected and bilateral equal air entry confirmed, followed by vecuronium (0.1mg/kg) which was repeated intravenously to maintain neuromuscular blockade. Intravenous infusion of paracetamol 1 g was started for intraoperative analgesia.

General anaesthesia was maintained by intermittent positive pressure ventilation (IPPV) using a mixture of 60% nitrous oxide (N_2O), 40% oxygen (O_2) and the test inhalational anaesthetic agent, either desflurane in Group D patients or sevoflurane in Group S patients at 1.0 MAC (Minimum Alveolar Concentration). The inhalational anaesthetic agent was discontinued towards the end of the surgery at the initiation of skin closure and this time was noted. Later, residual neuromuscular blockade was reversed with neostigmine (0.05 mg/kg) and glycopyrrolate (0.01 mg/kg) intravenously followed by tracheal extubation on recovery with return of airway reflexes.

The time from stoppage of the inhalational anaesthetic agent to the patient response to verbal command (lifting of the hand) was noted as the emergence time. The patients were then shifted to the Post-Anaesthesia Care Unit (PACU) and assessed by Modified Aldrete Scoring System [6] (Table 1) every 5 min. When a score of 9 was attained,

which was taken as early recovery time, patients were shifted to second stage recovery. In second stage recovery area, patients were assessed by Modified Post Anaesthetic Discharge Scoring System (PADSS) [7] every 15 min and were transferred to the post-surgical ward when they attained a score of 9. This time was noted as delayed recovery time. Any post-anaesthesia complications like nausea, vomiting, heaviness of head, headache and delirium if present were also recorded.

The primary outcome variables studied were the emergence time, early recovery time and delayed recovery time. Statistical analysis was done using PASW statistics 18 software. The data collected was analysed and the results were tabulated using Statistical Package for the Social Sciences (SPSS). All parametric data were presented as mean±SD and non-parametric data were tabulated. Parametric data were statistically analysed using Student's *t*- test and non-parametric data by Chi-square test. $p< 0.05$ was considered as statistically significant in all the analyses.

Results

One hundred ten patients undergoing surgical procedures under general anaesthesia of less than two hours were enrolled in the study. This included thyroidectomy, mastectomy, parotidectomy, branchial cyst and thyroglossal cyst excisions. They were divided as two equal groups (n=55), Group D were administered desflurane and Group S, sevoflurane as the inhalational anaesthetic drug for maintenance of anaesthesia. Both the groups did not show statistically significant differences in the demographic data comparing the age and sex ($p> 0.05$) as shown in figure 1 and 2. Our results showed statistically significant difference between the emergence and recovery profiles among the two groups with $p< 0.01$.

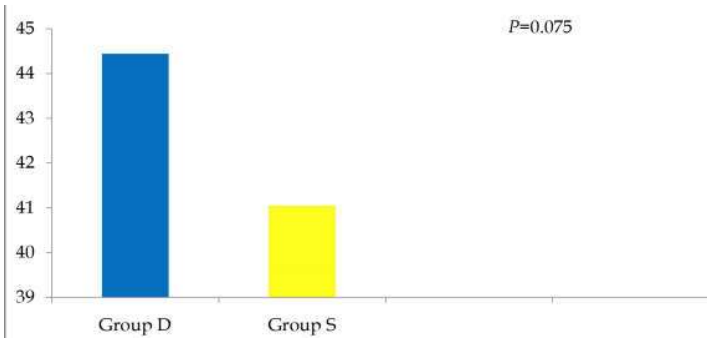

Fig. 1: Age distribution

Table 1: Modified Aldrete Scoring System

Criteria	Point Value
Oxygenation	
SpO_2> 92% on room air	2
SpO_2> 90% on room air	1
SpO_2< 90% on room air	0
Respiration	
Breathes deeply and coughs freely	2
Dyspnoeic, shallow or limited breathing	1
Apnoea	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 responsive	0
Activity	
Moves all extremeties	2
Moves two extremeties	1
No movement	0

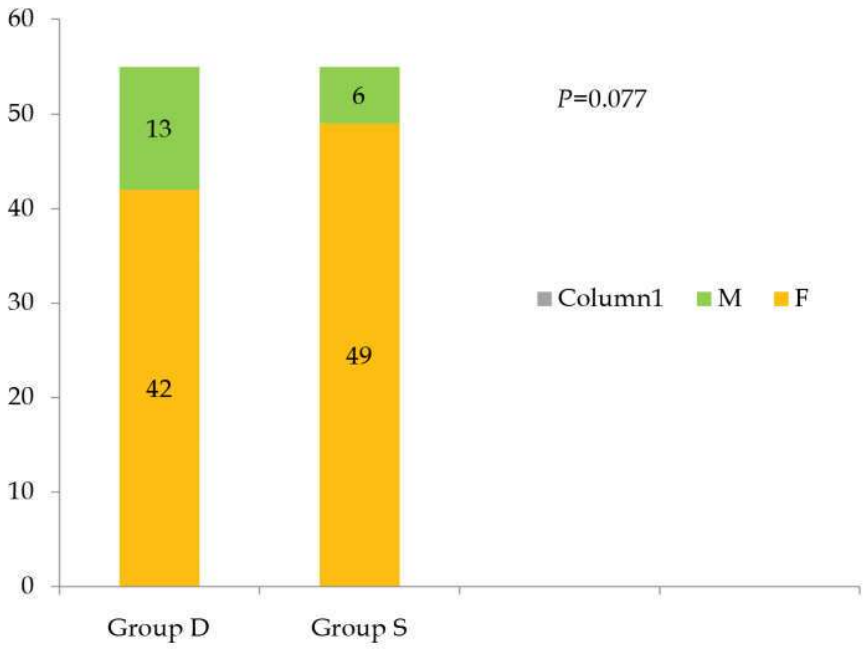

Fig. 2: Sex distribution

Table 2: Modified Post Anaesthetic Discharge Scoring System (PADSS)

Categories	Points
Vital signs	
BP and HR ± 20% of preoperative value	2
BP and HR ± 20% - 40% of preoperative value	1
BP and HR ± 40% of preoperative value	0
Ambulation	
Steady gait, no dizziness	2
Requires assistance	1
Unable to ambulate	0
Nausea and vomiting	
No or minimal/treated with oral medication	2
Moderate/treated with parenteral medication	1
Severe/continues despite treatment	0
Pain	
Minimal / no pain (Numerical Analogue Scale = 0-3)	2
Moderate (Numerical Analogue Scale = 4-6)	1
Severe (Numerical Analogue Scale = 7-10)	0
Surgical bleeding	
None or Minimal	2
Moderate	1
Severe	0

Table 3: Emergence time

Group	Number of patients[n]	Mean(min.)	Standard Deviation
D	55	19	3.717
S	55	27.04	6.719

We found that maintenance of anaesthesia with desflurane resulted in early emergence with mean value of 19±3.7 min versus 27.04±6.7 min with sevoflurane. This difference of 8.04 min was statistically significant with $p< 0.01$ (Table 3). The early recovery time as assessed by Modified Aldrete Scoring System was found to be faster with Group D with a mean value of 25.64±4.5 min versus 44.45±9.1 min with Group S, which was also statistically significant with $p< 0.01$ (Table 4). The delayed recovery time as assessed by PADSS had a mean value of 34.45±6.9 min with Group D versus 65.82±10.8 min with Group S (Table 5). This was also statistically significant with $p< 0.01$.

Regarding the side effect profile in the postoperative period, in Group D, two patients had heaviness of head. Among the Group S patients, five patients had delirium, eight had headache and ten had heaviness of head (Table 6).

Table 4: Early Recovery time

Group	Number of patients[n]	Mean(min.)	Standard Deviation
D	55	25.64	4.519
S	55	44.45	9.112

Table 5: Delayed Recovery time

Group	Number of patients[n]	Mean(min.)	Standard Deviation
D	55	34.45	6.984
S	55	65.82	10.877

Table 6: Postoperative side effects

Side Effects	Group S	Group D
Delirium	5	Nil
Headache	8	Nil
Heaviness of head	10	2

Discussion

Inhalational anaesthetic agents are commonly used to maintain general anaesthesia as they are easy to deliver with relatively stable haemodynamic profile having smooth induction and emergence. The speed of recovery from general anaesthesia is determined by the pharmacodynamic profile of the anaesthetic agents.

We compared the emergence and recovery characteristics of two commonly used inhalational anaesthetic agents, desflurane versus sevoflurane. Two groups of 55 patients each who underwent surgical procedures of less than two hours duration under general anaesthesia were included. After intravenous induction, general anaesthesia was maintained by either desflurane or sevoflurane and their recovery characteristics on awakening from anaesthesia were studied.

Demographic data comparing the age, sex showed no statistically significant difference among both the groups ($p> 0.05$). There was statistical difference between the emergence and recovery profiles from general anaesthesia between the two groups of patients who received desflurane versus sevoflurane. The time from stoppage of the test drug to response to verbal command, which was the ability to lift hand was taken as the emergence time. We observed that maintenance of anaesthesia with desflurane resulted in early emergence with a mean value of 19±3.7 min versus 27.04±6.7 min with sevoflurane. This difference of 8.04 min was found to be statistically significant with $p< 0.01$. The data is consistent with the faster kinetic profile of desfluranecompared to sevoflurane. This resulted in reduction in recovery time from anaesthesia, enabling early shifting of the patient from the operating room.

In our study, the early recovery parameters, which was a total score of 9 in Modified Aldrete scoring system. This was achieved much faster in patients who were given desflurane with a mean time of 25.64±4.5 min compared with sevoflurane whose mean time was 44.45±9.1 min. Studies have found that only early recovery was faster with desflurane compared to sevoflurane even when the duration of surgery exceeded two hours. Eger and colleagues showed that recovery was faster with desflurane than sevoflurane which is comparable to our study [8].

The delayed recovery time, assessed by Modified PADSS, was 34.45±6.9 min with desflurane group, while with sevoflurane group it was 65.82±10.8 min. There appears a significant early return to normal activities by patients who received desflurane. This finding is in conflict with the study of Heavner et al. [9] and Tarazi et al. [10].

Regarding the side effect profile, among the patients who received desflurane, only two patients complained of heaviness of head. However, in those who received sevoflurane, five patients had delirium, eight complained of headache and ten had heaviness of head.

Our study had several limitations, of which the lack of investigator blinding was a major one, which could influence the

results due to individual bias. As the study was limited to short exposure of anaesthesia below two hours, the effect of the drugs after lengthy procedures cannot be commented upon. We maintained a constant minute volume and fresh gas flow throughout the procedure, and at the end there was abrupt discontinuation of the inhaled anaesthetic agent. Further studies are required to examine whether gradual tapering of the anaesthetic agent affects emergence time in a different way. Use of monitors like bi spectral index (BIS) to titrate the drugs for the depth of anaesthesia was not done. Objective end points were used to assess the recovery profile, which can have individual variations. Further studies are needed to study the effect of gradual tapering of inhalational anaesthetic agents on emergence phenomenon.

Conclusion

From this study, we conclude that desflurane provides early emergence from anaesthesia compared to sevoflurane when used for surgical procedures below two hours. The early recovery and delayed recovery times were also faster with desflurane than from sevoflurane anaesthesia. The postoperative recovery profile was better with desflurane than sevoflurane, due to the lesser incidence of side effects. Hence desflurane was found to be superior to sevoflurane as an inhalational anaesthetic agent for short surgical procedures below two hours due to its faster emergence, rapid recovery with minimal side effects.

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