

Comparison of hemodynamic parameters and recovery characteristics between sevoflurane and desflurane in patients undergoing day care gynecological laparoscopic surgery

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Abstract

Background: General anesthesia is the most commonly used technique in day care setup. An ideal general anesthetic should provide smooth and rapid induction, optimal operating conditions, and rapid recovery with minimal side effects such as nausea, vomiting, bleeding, and postoperative pain. Inhaled anesthetics allow rapid emergence from anesthesia because of easy titrability with inherent neuromuscular blocking effects that make them more suitable for day care anesthesia.

Objective: To compare intraoperative hemodynamic profile of desflurane and sevoflurane as maintenance anesthetic in patients undergoing day care gynecological laparoscopic surgery.

Materials and Methods: This was a prospective randomized single-blind study that was conducted by the Department of Anesthesiology at Krishna Institute of Medical Science, Secunderabad, India, during the period of January 2010 to May 2011 in patients undergoing day care gynecological laparoscopic surgery. The study was approved by the hospital ethics committee. A total of 100 female patients belonging to the American Society of Anesthesiologists grade I or II, scheduled to undergo day care laparoscopic gynecological surgery were recruited for the study. Patients were randomized into two groups to receive either desflurane (group D; $n = 50$) or sevoflurane (group S; $n = 50$) for maintenance of anesthesia.

Result: All demographic parameters, such as age, weight, and height, were compared in both the groups and all parameters are statistically insignificant. The mean duration of surgery in the groups of desflurane and sevoflurane was 38.90 and 41.30 min, respectively. The groups did not differ in blood pressure (systolic, diastolic, and mean) or heart rate throughout the surgery. During the maintenance period, heart rate and mean arterial pressure were satisfactorily maintained within 20% of baseline values with both anesthetics. The time from administration of reversal agent to response to painful stimuli, to eye opening, to verbal commands, and spontaneous eye opening were significantly shorter in patients given desflurane than in patients given sevoflurane ($p = 0.000$). For a given duration of anesthesia, emergence from anesthesia was significantly faster in desflurane group as compared to sevoflurane group. There was no difference in both the groups as far as the incidence of complications is concerned.

Conclusion: Desflurane anesthesia produces faster emergence and early recovery from anesthesia compared to sevoflurane anesthesia. Time to home readiness is similar with both agents. Intraoperative hemodynamic parameters are similar in both desflurane and sevoflurane anesthesia.

KEY WORDS: Desflurane, sevoflurane, hemodynamic changes

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Introduction

Day care anesthesia is as old as the anesthesia itself but contributes to a greater proportion of overall surgeries carried out today than 15 years ago. This is because of the availability of new minimally invasive surgical techniques and addition of new short acting and rapidly metabolized anesthetic agents. Very high-risk patients and major surgical procedures can

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now be carried out safely because of the precision in monitoring and advanced surgical techniques.^[1] One of the major factors that determine speed of recovery from anesthesia is the choice of anesthetic technique. General anesthesia is the most commonly used technique in day care setup. An ideal general anesthetic should provide smooth and rapid induction, optimal operating conditions, and rapid recovery with minimal side effects such as nausea, vomiting, bleeding, and post-operative pain. Inhaled anesthetics allow rapid emergence from anesthesia because of easy titrability with inherent neuromuscular blocking effects that make them more suitable for day care anesthesia.^[2] The availability of less soluble inhalation anesthetics such as sevoflurane and desflurane has made us rethink about the selection of volatile anesthetics for outpatient surgical procedures. Given the low blood/gas partition coefficient of sevoflurane and desflurane, faster emergence from anesthesia is expected compared to traditional inhalation anesthetics.^[3] Sevoflurane, a volatile anesthetic agent, is a halogenated methyl propyl ether. It is nonirritant, noninflammable, and produces bronchodilatation. It has rapid induction due to low blood/gas partition coefficient. It can be used for inhalational induction.^[4,5] It produces dose-dependent cardiovascular and respiratory depression. Sevoflurane does not activate the sympathetic nervous system.^[6] Desflurane is a fluorinated methyl ethyl ether. It has a pungent odor, is irritable to the respiratory tract, and is noninflammable. Low solubility of desflurane in blood and body tissues leads to rapid induction and recovery. It does not predispose to ventricular arrhythmias.^[4,5] Maintenance characteristics can be assessed by various monitoring techniques, which include electrocardiogram, oxygen saturation, noninvasive mean arterial pressure (MAP), heart rate, and ETCO₂. The advent of rapid and short-acting drugs for induction and maintenance of anesthesia has facilitated early recovery following day care surgery.

The objective of this study was to compare intraoperative hemodynamic profile of desflurane and sevoflurane as maintenance anesthetic in patients undergoing day care gynecological laparoscopic surgery and to compare early and intermediate emergence characteristics with desflurane and sevoflurane in day care gynecological laparoscopic surgery patients.

Materials and Methods

This was a prospective randomized single-blind study that was conducted by the Department of Anesthesiology at Krishna Institute of Medical Science, Secunderabad, India, during the period of January 2010 to May 2011 in patients undergoing day care gynecological laparoscopic surgery, laparoscopic hysterectomy. The study was approved by the hospital ethics committee.

Design of Study

After obtaining ethics committee approval, patients were thoroughly explained regarding the nature of the study and a written informed consent was obtained from all the patients.

A total of 100 female patients belonging to the American Society of Anesthesiologists (ASA) grade I or II, scheduled to undergo day care laparoscopic gynecological surgery were recruited for the study. Patients were randomized into two groups to receive either desflurane (group D; $n = 50$) or sevoflurane (group S; $n = 50$) for maintenance of anesthesia.

Groups

Patients were randomly divided into 2 groups of 50 each by a computer-generated randomization sheet.

- Group I (D): Anesthesia was induced using propofol and maintained with 60% N₂O in O₂ and desflurane.
- Group II (S): Anesthesia was induced using propofol and maintained with 60% N₂O in O₂ and sevoflurane.

Inclusion criteria were as follows: (1) patients undergoing elective surgery under general anesthesia, (2) surgery lasting more than 30 min or less than 90 min, (3) age group between 18 and 60 years, and (4) ASA I and ASA II.

Exclusion criteria were as follows: (1) emergency surgery under general anesthesia; (2) surgery lasting less than 30 min or more than 90 min; (3) age below 18 years and above 60 years; (4) ASA III and ASA IV; (5) patients with significant cardiopulmonary, respiratory, hepatic, renal, endocrinal, neurological, psychiatric, and metabolic diseases; (6) patients on central nervous system depressants and sedatives; (7) patients with allergy to any drug; (8) drug abuse; (9) pregnant/breast-feeding women; and (10) women who have undergone recent anesthesia (within the previous 7 days).

Statistical Analysis

A study population of 50 patients for each group was determined to have 99% power at $\alpha = 0.05$ (two-tailed) to detect a difference of 10% in the time to early recovery with desflurane group compared to sevoflurane group. Data are expressed as mean \pm SD. Statistical analysis of data among the groups was done by Student's *t*-test for independent samples and for categorical value Fisher's exact test has been applied. For nonparametric data, Mann-Whitney *U*-test was used, $p < 0.05$ has been considered as statistically significant. SPSS 17 statistics package has been used for analysis.

Result

A total of 100 patients were recruited for the study and 50 patients were allocated in each group. There was no pre-mature study withdrawal due to failure of surgery to proceed as planned or the development of complications hindering the assessment of study variables. All demographic parameters such as age, weight, and height were compared in both the groups and all parameters were statistically insignificant as shown in Figure 1.

The mean duration of surgery in the groups of desflurane and sevoflurane was 38.90 and 41.30 min, respectively. There was no statistical difference in desflurane and sevoflurane groups. Intraoperative changes in heart rate and mean

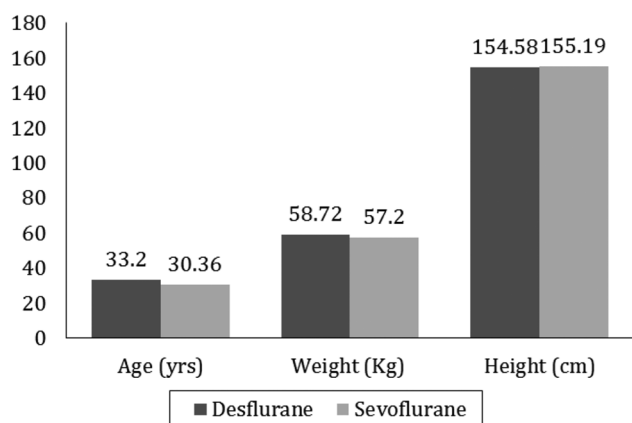


Figure 1: Comparison of age, weight, and height between the two groups.

arterial blood pressure of desflurane and sevoflurane groups are summarized in Tables 1 and 2, respectively. The groups did not differ in blood pressure (systolic, diastolic, and mean) or heart rate throughout the surgery. During the maintenance period, heart rate [Table 1] and MAP [Table 2] were satisfactorily maintained within 20% of baseline values with both anesthetics.

The time from administration of reversal agent to response to painful stimuli, to eye opening, to verbal commands, and spontaneous eye opening were significantly shorter in patients given desflurane than in patients given sevoflurane ($p = 0.000$). For a given duration of anesthesia, emergence from anesthesia was significantly faster in desflurane group as compared to sevoflurane group as shown in Table 3.

Early recovery as assessed by modified Aldrete score was compared in both the groups. Patients given desflurane achieved modified Aldrete score of 9 significantly faster than patients given sevoflurane. Postanesthesia discharge scoring system (PADSS) for time to home readiness is compared in both the groups. The two groups were comparable with respect to time to achieve PADSS of 9 or above, the difference being insignificant. Both the groups were compared for postoperative incidence of nausea, vomiting, drowsiness, respiratory distress, laryngospasm, sore throat, and headache. There was no difference in both the groups as far as the incidence of these complications is concerned.

Discussion

Emergence and early recovery from anesthesia was faster with desflurane compared to sevoflurane. However, intermediate recovery time, including time to discharge, was similar after desflurane and sevoflurane. As doses of the adjuvant drugs were similar in the two groups, differences in later recovery times may have been masked by the use of these supplemental drugs (e.g., opioid analgesics).

Desflurane offered an advantage over sevoflurane with respect to early recovery end points (i.e., emergence from

anesthesia). However, the intermediate recovery end points (readiness for home discharge) did not differ significantly between the two anesthetic groups. The current findings are consistent with previously published comparative study conducted by Heavner et al.^[7] demonstrating that the faster emergence from desflurane (versus sevoflurane) anesthesia failed to lead to an earlier discharge from hospital after both outpatient and inpatient surgical procedures. It also suggested that sevoflurane and desflurane provided similar intraoperative conditions during the maintenance period. Although early recovery was faster with desflurane, there was no difference in the intermediate recovery end points. Kim et al.^[8] also found that late recovery profiles and incidences of postoperative side effects were similar after desflurane and sevoflurane. It also showed that regardless of the duration of anesthesia, elimination was faster and recovery was quicker for inhaled anesthetic desflurane than for the inhaled anesthetic sevoflurane. The study conducted by Vallejo et al.^[9] showed that despite the faster initial recovery with desflurane, no significant differences were found between the two volatile anesthetics in the later recovery period. Findings of the present study are consistent with the earlier reported data of faster early recovery with desflurane compared to sevoflurane. White et al.^[10] studied the hemodynamics, emergence, and recovery characteristics of sevoflurane with those of desflurane in nitrous oxide anesthesia and concluded that the groups did not differ in these hemodynamic measures. Findings in our study are also similar. As a result of the lower solubility of desflurane compared with sevoflurane in blood and lean tissues, one might expect to find differences in the intermediate and late recovery end points when these two anesthetics are used for longer surgical procedures. However, studies have found that only early recovery was faster with desflurane compared to sevoflurane even when the duration of surgery exceeded 2 h.^[3,11] 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 day care surgery and older patients undergoing more prolonged general anesthesia for inpatient procedures. Yet, even these studies accept the possibility that the difference in intermediate recovery and cognitive function recovery might not have been detected due to lack of sensitivity and selectivity of digit-symbol substitution test and mini-mental state test used in these studies. Intraoperative cardiovascular stability was easily achieved with both sevoflurane and desflurane, with MAP – mean arterial Pressure and HR – heart rate maintained within $\pm 20\%$ of baseline values during the entire maintenance period. The cardiovascular stability during the maintenance period and the lack of any difference between the two groups were predictable, as the study was designed to maintain MAP within 20% of the baseline values by varying the inspired concentration of the volatile anesthetics. In our study, we found that both desflurane and sevoflurane group had rapid recovery. There was a significant difference in the emergence and early recovery between the two groups. The early recovery was faster with desflurane compared to

Table 1: Hemodynamic (heart rate)

Heart rate (beats/min)	Desflurane group	Sevoflurane group	<i>p</i>
Preoperative	81.58 (10.025)	83.98 (10.790)	0.252
Induction	85.32 (12.891)	83.54 (10.752)	0.455
At intubation	82.36 (12.116)	84.34 (13.514)	0.442
Immediately after intubation	92.02 (12.290)	89.26 (13.521)	0.288
2 min	88.96 (11.150)	87.32 (13.942)	0.517
3 min	83.64 (10.883)	82.94 (11.883)	0.759
4 min	78.54 (11.433)	79.70 (11.182)	0.609
5 min	75.56 (11.207)	77.44 (11.418)	0.408
10 min	73.00 (11.053)	73.58 (11.720)	0.800
15 min	73.08 (11.130)	74.42 (11.009)	0.546
20 min	72.90 (10.403)	75.72 (10.958)	0.190
30 min	72.16 (10.001)	74.38 (8.051)	0.224
45 min	74.54 (9.671)	77.38 (9.005)	0.132
60 min	76.24 (7.968)	79.14 (8.804)	0.087

Table 2: Hemodynamic (mean arterial pressure [MAP])

MAP (mm Hg)	Desflurane group	Sevoflurane group	<i>p</i>
Preoperative	89.013 (9.371)	89.160 (7.891)	0.933
Induction	89.98 (8.823)	89.31 (10.933)	0.723
At intubation	78.01 (12.111)	76.65 (9.874)	0.538
Immediately after intubation	89.43 (11.083)	86.59 (11.576)	0.189
2 min	86.85 (11.723)	83.71 (10.404)	0.160
3 min	79.007 (10.220)	82.16 (11.175)	0.144
4 min	80.56 (9.822)	82.68 (13.411)	0.369
5 min	80.360 (9.406)	84.333 (11.605)	0.063
10 min	90.82 (7.482)	91.26 (10.515)	0.810
15 min	91.56 (7.941)	92.953 (9.791)	0.436
20 min	89.733 (7.770)	92.953 (9.791)	0.072
30 min	91.307 (9.670)	91.767 (12.023)	0.833
45 min	92.47 (7.609)	93.80 (8.549)	0.414
60 min	93.63 (5.974)	94.09 (8.596)	0.757

Table 3: Time to recovery in both groups

Time to recovery (min)	Desflurane group	Sevoflurane group	<i>p</i>
Response to painful stimuli	2.75 (1.411)	4.02 (1.767)	0.000
Response to verbal commands	3.48 (1.488)	5.04 (1.616)	0.000
Spontaneous eye opening	4.18 (1.548)	6.80 (2.259)	0.000
Stating name	5.34 (1.944)	7.62 (2.079)	0.000
Date of birth	5.56 (1.955)	8.00 (2.399)	0.000
Place of stay	5.66 (1.955)	8.16 (2.289)	0.000
Squeeze fingers	6.76 (2.016)	9.36 (2.038)	0.000
Lift limb	7.14 (2.250)	10.08 (1.947)	0.000

sevoflurane. Although there was difference in intermediate recovery time, the magnitude of the difference was small and insignificant. This was despite stepwise reduction of anesthetic concentration was not allowed toward the end of the procedure, which is a common clinical practice. One explanation for this small magnitude of difference could be residual effects of drugs used for premedication, opiates, and muscle relaxants, which could have interfaced with the anesthetic agents. Because of the greater pungency and airway irritant properties of desflurane, sevoflurane has been called “the ideal agent for adult day-case anesthesia.” Previous studies comparing desflurane and sevoflurane when administered for minor outpatient surgical procedures using an laryngeal mask airway for airway management have reported a low incidence of respiratory complications and no significant differences between the two volatile anesthetics.^[12–14] Our study also found no difference in the incidence of respiratory complications between the two groups. Perhaps this could be attributed to propofol used for induction. It is also possible that the use of fentanyl during the intraoperative period may have minimized the difference between the airway responses to desflurane and sevoflurane. The incidence of other postoperative complications (postoperative nausea and vomiting, headache, drowsiness) was also similar in both the groups.

This study can be criticized because the design did not permit a double-blind comparison of the two volatile anesthetics. However, all patients were undergoing identical procedure. In addition a cost analysis with the use of the two agents was not a part of this study. The cost saving due to lesser use of opioids, muscle relaxants, carrier gases, and early discharge from the postanesthesia care unit could impinge on the decision regarding use of either sevoflurane or desflurane in a day care setting.

Conclusion

We concluded from the study that desflurane anesthesia produces faster emergence and early recovery from anesthesia compared to sevoflurane anesthesia. Time to home readiness is similar with both agents. Intraoperative hemodynamic parameters are similar in both desflurane and sevoflurane anesthesia. Both the agents produce similar incidence of postoperative complications. Because of the greater pungency and airway irritant properties of desflurane, sevoflurane has been called “the ideal agent for adult day-case anesthesia.”

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