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Anesthesia: Essays and Researches

Original Article

The recovery time of sevoflurane and desflurane and the effects of anesthesia on mental and psychomotor functions and pain

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Abstract

Background: Inhalation anesthetics have many advantages for outpatient general anesthesia, such as minimal postoperative side-effects and rapid and full recovery. The aim of this randomized study was to compare the postoperative recovery time of sevoflurane and desflurane and to observe the effects of anesthesia on mental, psychomotor and cognitive functions and pain in outpatients undergoing arthroscopic surgery.

Patients and Methods: This study included 40 American Society of Anesthesiologists I-II patients who were divided into two groups via sealed envelopes. For maintenance of anesthesia, a mixture of 66% N_2O and 33% O_2 and 4–7% desflurane was used in Group D, and a mixture of 66% N_2O and 33% O_2 and 1–2.5% sevoflurane was used in Group S. The modified Aldrete score (MAS) was evaluated postoperatively at time points determined previously. An MAS of 8 or higher was considered to indicate alertness. Mental and psychomotor functions of the patients were evaluated using the short cognitive examination (SCE), and postoperative pain levels were evaluated using the visual analogue scale (VAS).

Results: There was no difference between the groups in terms of demographic data ($P > 0.05$). The mean time to reach MAS 8, eye-opening, and orientation were higher in Group S as compared to Group D ($P < 0.01$). The mean MAS initially and at 5 and 10 min was higher in Group D as compared to Group S ($P < 0.001$). The mean SCE at 5 and 15 min was higher in Group D as compared to Group S ($P < 0.01$). There was no significant difference between the groups in terms of VAS scores ($P > 0.05$).

Conclusion: It has been determined that desflurane provided better quality and more rapid recovery than sevoflurane, and the return of cognitive functions in the early postoperative period was faster. In conclusion, both agents can apparently be used safely in outpatient anesthetic procedures.

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Key words: Desflurane, outpatient anesthesia, pain, psychomotor functions, recovery, sevoflurane

INTRODUCTION

The numbers of day surgeries performed have increased rapidly due to technological advances for modern anesthesiologists.[1] The use of rapid and short-acting intravenous (IV) anesthetics, inhalation anesthetics, analgesics and muscle relaxants in anesthesia, in addition to new minimally invasive surgery options, have made outpatient general anesthesia possible in many patients with concomitant illness.[1] General anesthesia is fairly commonly used for outpatient surgery. It is often preferred because of the favorable properties at the surgical site as well as due to the patients' desire to be rendered unaware of the procedure.[2]

Inhalation anesthetics are often preferred because they have minimal postoperative side effects and usually allow a quick and complete recovery.[3] Easier control of the depth of intraoperative anesthesia and rapid recovery with inhalation anesthetics provide a significant advantage.[4] The ideal inhalation anesthetic must have certain properties: Chemical purity, good stability, resistance to metabolism by the body, no organ-specific toxic effects, low blood/gas solubility which will enable rapid induction and elimination, low flammability (in air, oxygen or nitrous oxide), no long-term adverse effects on employees, be fragrant and nonirritating, minimal effects on vital functions, good analgesic effects, short-acting effects on the central nervous system, and reasonably priced.[5] Halothane was the first halogenated agent, which gave rise to the development of isoflurane, desflurane, and sevoflurane, all of which have drawbacks and are not considered the "ideal" volatile anesthetic.

In this study, we aimed to compare the postoperative recovery time and the effects of sevoflurane and desflurane on mental, psychomotor and cognitive functions and pain in patients undergoing outpatient arthroscopic surgery.

PATIENTS AND METHODS

This study included 40 patients (20 females, 20 males) between the ages of 22 and 63 and of the American Society of Anesthesiologists (ASA) I-II classification, who had been admitted to the Haseki Training and Research Hospital Clinic of Orthopedics and Traumatology to undergo outpatient arthroscopy. For this prospective, randomized, double-blinded study, local ethics committee approval and informed consent were obtained. Exclusion criteria were as follows: Patients with significant coronary, pulmonary, renal, or hepatic disease; medical history of neurological disease; chronic alcoholism or drug use; diabetes; medical or family history of malignant hyperthermia; allergy to any medications to be used; morbidly obese patients; those who had undergone general anesthesia in the last 7 days; and patients who were illiterate. Patients with ASA II classification who used regular medications and had normal arterial blood pressure were included in the study.

On the day of surgery, a preoperative short cognitive examination (SCE) [Table 1] was applied to the patients in the operating room, and the control values were calculated. For the patients who did not receive premedication, a PETAS KMA 260R monitor was used after vascular access was obtained with a 22 G cannula and an infusion of 0.9% NaCl was started. Anesthesia was induced with thiopental (5 mg/kg) and vecuronium bromide (0.1 mg/kg) was administered for muscle relaxation and endotracheal intubation. Endotracheal intubation was performed after 2 min of who were 100% O_2 mask ventilation.

Patients were divided into two groups using sealed envelopes. For Group D, anesthesia was maintained with a mixture of 66% N_2O and 33% O_2 and 4–7% desflurane, while Group S received a mixture of 66% N_2O and 33% O_2 and 1–2.5% sevoflurane. No opioid medications were used for the patients preoperatively, and 0.03 mg/kg vecuronium bromide was administered when muscle relaxation was

Table 1: SCE

Questions	Score
What country are we in?	1
What province are we in?	1
What is today's date?	4
What year is this?	1
Count backwards from 100 to 10?	7
"LİVE" do you read in reverse?	2
Where and when were you born?	2
What did you eat last?	1
What is the street address of this house?	6
"Ball, book, dress" repeat again.	3
Who is the president?	1
Who was the previous president?	1
Who was the first president?	1
Say the name of five cities.	5
How many seconds are there in two minutes?	1
How many hours are there in two days?	1
How many days are there in two weeks?	1
Who is Yunus Emre?	1
Who is Mimar Sinan?	1
Who is İsmet İnönü?	1
Repeat again this address.	6
Repeat again this object name.	3
What are they (same object).	3
Calculate "75-15 = ? 10-2 = ?".	2
Tell logical sentence.	1
"The rotten apple injures its neighbors". Repeat again.	2
Repeat this sentence and make. "Holding my right hand with my left hand I will put on my belly" .	3

SCE: Short cognitive examination

required. At the end of surgery, patients were ventilated with 100% O_2, and 0.01 mg/kg atropine and 0.04 mg/kg neostigmine were administered to patients exhibiting increased respiratory effort. When spontaneous respiration was adequate, patients were extubated. Following extubation, the modified Aldrete score (MAS) [Table 2] value was recorded as the baseline value.

The MAS of patients taken to the recovery room was re-evaluated at 5, 10, 15, 20, 25, 30, 40, 50 and 60 min after the baseline measurement. MAS[6] was used as a unit for evaluation of the activity, respiration, circulation, consciousness, and color of the patients. After recovery from anesthesia, following a painful stimulus, MAS values of 8 and higher were considered to indicate consciousness. The time required to reach an MAS of 8 was recorded. Patients' eye-opening and orientation time (able to provide their year and location of birth) were recorded. Sixty minutes after recovery, tenoxicam 20 mg IV was administered to all patients. To evaluate the patients' mental and psychomotor functions, the SCE test[7] was used, which has 29 questions with a total value of 64. A chart was used to assess orientation (1–4 questions), attention (5 and 6 questions), memory (7–10 questions), general information (ll-20 questions), short-term memory (21–22 questions), dyscalculia, dysgraphia, dyslexia, nominal aphasia and disorientation (23–29 questions). The questions included and the scoring for each are shown in Table 1. To assess postoperative pain levels, a visual analogue scale (VAS)[8] was used [Table 3]. The VAS was evaluated at 5, 10, 15, 20, 25, 30, 40, 50 and 60 min postoperatively.

Statistical analysis

The SPSS for Windows 10.0 statistical software package was used to analyse the data. For comparisons, Student's *t*-test, Mann–Whitney *U*-test, a paired *t*-test, and Chi-square tests were used. $P < 0.05$ and <0.01 were considered to indicate statistically significant and highly significant, respectively.

RESULTS

The groups were evaluated in terms of demographic data; no differences were identified [$P > 0.05$, Table 4]. There was no statistically significant difference between Groups D and S in terms of mean duration of the operation (61.80 ± 15.08, 63.65 ± 13.65, respectively) or the mean duration of anesthesia (78.25 ± 14:37, 79.65 ± 12.45, respectively) [$P > 0.05$, Table 5].

The mean time to reach MAS of 8, eye opening and orientation in Group S was significantly higher than in Group D ($P < 0.01$). The mean MAS initially and after 5 and 10 min was significantly higher in Group D as compared to Group S ($P < 0.01$). No significant difference was observed between the groups in the MAS at other time points [$P > 0.05$, Table 5].

Table 2: MAS

Activity	Able to move 4 extremities voluntarily on command	2
	Able to move 2 extremities voluntarily on command	1
	Able to move no extremities voluntarily on command	0
Respiration	Able to breathe deeply and cough freely	2
	Dyspnea or limited breathing	1
	Apneic	0
Circulation	Blood pressure (BP) + 20 of preanesthetic level	2
	BP+22-49 of preanesthetic level	1
	BP+50 of preanesthetic level	0
Consciousness	Fully awake	2
	Arousable on calling	1
	Not responding	0
Color	Pink	2
	Yellow	1
	Cyanotic	0

MAS: Modified aldrete score

Table 3: VAS

No pain	0-2
Mild, annoying pain	3-4
Nagging, troublesome pain	5-6
İntense, horrible pain	7-8
Worst possible, unbearable, excruciating pain	9-10

VAS: Visual analog scale

Table 4: Sex and ASA score

	Desflurane		Sevoflurane			
	n	%	*n*	%	Chi-square	*P*
Sex						
Male	10	50	10	50		
Female	10	50	10	50	-	-
ASA						
I	15	75	14	70		
II	5	25	6	30	0,12	0,73

ASA: American Society of Anesthesiologists

Table 5: Comparison of the groups in terms of recovery

(Minute)	Desflurane	Sevoflurane	*P*
MAS 8	5.35±0,93	7.10±1.17	0.0001*
Time to eye opening	7.20±1.01	8.80±0.95	0.0001*
Orientation time	9.25±1.02	10.10±0.91	0.0008*
Duration of operation	61.80±15.08	63.65±13.65	NS
Duration of anesthesia	78.25±14.37	79.65±12.45	NS

Data are given as mean±standard deviation. NS: Not significant. *: Significant difference

The mean SCE values of Group D at 5 and 15 min were significantly higher than those of Group S ($P < 0.01$). No significant difference was observed in the SCE at other time points between the groups [$P > 0.05$, Table 6].

In Group D, the mean SCE values at 5, 10, 15, 20, 25, 30, 40 and 50 min were significantly lower than those at

baseline ($P < 0.01$). In Group S, the mean SCE at 5, 10, 15, 20, 25, 30, 40, 50 and 60 min was significantly lower than those at baseline [$P < 0.01$, Table 7].

There was no significant difference between the groups in terms of VAS score [$P > 0.05$, Table 8].

DISCUSSION

Due to the increasing incidence of outpatient surgical applications, full return of complex physiological functions after general anesthesia with a short-duration and reliable recovery has become increasingly important. Due to the low solubility of sevoflurane and desflurane, they have the advantages of easier control of anesthetic depth and more rapid recovery from anesthesia. In our study of physical score ASA I-II patients who underwent outpatient arthroscopic surgery under general anesthesia, we compared the postoperative recovery time for desflurane and sevoflurane and the effects of anesthesia on mental, psychomotor and cognitive functions and pain.

Table 6: Comparison of the groups in terms of SCE

SCE	Desflurane	Sevoflurane	P
0 min	62.65±1.27	62.55±1.28	NS
5 min	41.20±4.30	37.75±3.37	0.81*
10 min	44.50±4.68	42.85±2.66	NS
15 min	51.05±3.75	48.20±1.82	0.01*
20 min	54.05±3.12	52.95±2.33	NS
25 min	55.50±2.70	58.15±2.68	NS
30 min	57.85±3.27	59.85±2.76	NS
40 min	60.15±2.92	59.85±2.76	NS
50 min	60.40±2.84	59.85±2.76	NS
60 min	61.85±1.53	61.45±1.79	NS

Data are given as mean±standard deviation NS: Not significant *: Significant difference

Table 7: Internal comparison of the groups in terms of SCE

(Minute)	Desflurane	Sevoflurane
5 min	0.01	0.01
10 min	0.01	0.01
15 min	0.01	0.01
20 min	0.01	0.01
25 min	0.01	0.01
30 min	0.01	0.01
40 min	0.01	0.01
50 min	0.02	0.01
60 min	NS	0.09

NS: Not significant. *: Significant difference

Table 8: Comparison of the groups in terms of VAS

VAS	Desflurane	Sevoflurane	P
5 min	6.30±1.31	6.30±1.34	0.48*
10 min	6.30±1.34	6.30±1.34	1.0*
15 min	6.30±1.34	6.30±1.34	1.0*
20 min	5.95±1.00	6.30±1.34	0.36*
25 min	5.95±1.00	6.30±1.34	0.36*
30 min	5.95±1.00	6.30±1.34	0.36*
40 min	5.95±1.00	6.30±1.34	0.36*
50 min	5.95±1.00	6.30±1.34	0.36*
60 min	5.95±1.00	6.30±1.34	0.36*

Data are given as mean±standard deviation. *: Significant difference

We determined that the mean time to reach MAS 8, eye opening and orientation of the sevoflurane group were significantly higher compared to those in the desflurane group, the mean SCE values at 5 and 15 min were higher in the desflurane group than the sevoflurane group, but there was no statistically significant difference between the groups in terms of VAS values. Nathanson *et al*.[9] compared the recovery characteristics of sevoflurane and desflurane, and extubation, waking up, and orientation duration was found to be shorter in the desflurane group than the sevoflurane group. In our study, we found similar results.

Dupont *et al*.[10] found that the time until extubation and eye-opening were significantly shorter in the desflurane group. They used the MAS to assess the recovery and reported that recovery of the desflurane group was significantly rapider than the sevoflurane group. The prolonged effect of residual sevoflurane with hexafluoroisopropanol was considered to account for the slower recovery from sevoflurane. In addition, the degradation of sevoflurane to compound A has been reported to delay waking after sevoflurane anaesthesia.[11] We believe that the slower elimination and recovery of sevoflurane compared with desflurane can be explained by the irreversible binding of the compound A to body proteins. The study by Eger *et al*.[12] supports this finding. In the meta-analysis of Macario *et al*.,[13] the time until extubation, fulfill the commands and orientation in patients administered desflurane was l. 0–l. 2 min shorter than in the patients administered sevoflurane.

Song *et al*.[14] recorded wake-up times and the MAS and compared the effects of propofol, desflurane, and sevoflurane in patients undergoing ambulatory anesthesia. Desflurane was found to have the fastest recovery time. In this study, we recorded the time needed to reach MAS 8, eye-opening, and orientation. The mean MAS initially and after 5 and 10 min was significantly higher in the desflurane group compared to the sevoflurane group ($P < 0.0l$). There was no significant difference between the groups in terms of MAS values at other time points ($P > 0.05$). The mean time required to reach MAS 8, eye opening and orientation was significantly longer in the sevoflurane group than the desflurane group ($P < 0.0l$).

Larsen *et al*.[15] used the Trieger Dot Test and Digit Substitution Test (DSST) to assess cognitive functions and reported no difference between the groups in terms of

postoperative TDT. They also reported that 30 min after the operation, more patients in the desflurane group than in the sevoflurane group successfully passed the DSST. In addition, they reported a difference between the sevoflurane and desflurane groups at 60 min.

Chen *et al*.[16] reported no difference between the desflurane and sevoflurane groups in terms of mini-mental state examination (MMSE) values; the MMSE values in the first postoperative hour were significantly lower than the baseline values. It was reported that, in both groups, 85% of patients returned to initial values by the 3rd hour and all patients (with the exception of one patient in the sevoflurane group) returned to the initial MMSE values at by 24 h postoperatively. Furthermore, there was no significant difference between the two groups regarding the preoperative and postoperative l, 3, 6 and 24-h MMSE values.

Dupont *et al*.[10] reported that the time until eye opening, extubation, orientation, being able to say their date of birth and to name three flowers or cars in 100 patients who underwent unilateral ventilation was significantly shorter in the desflurane group compared with the sevoflurane and isoflurane groups ($P < 0.01$). It has also been reported that while return of cognitive functions (ability to name places, date of birth, and three flowers or cars) was significantly enhanced at 5 min in the desflurane group, there was no difference at 15 min.

Chen *et al*.[16] used the VAS not only to assess pain but also to assess sedation, fatigue, discomfort and nausea, and detected no difference between the groups in terms of side effects. Nathanson *et al*.[9] also used the VAS to assess sedation, confusion, coordination, nausea, and pain. They found that the VAS scores and the incidence of postoperative nausea and vomiting were similar in both groups. In our study, we found no significant difference between the groups in terms of VAS scores.

CONCLUSION

The study results indicate that the desflurane provides a shorter-duration, better-quality recovery than sevoflurane; return of cognitive functions was also faster in the early postoperative period. Postoperative pain, blood pressure, heart rate and SpO_2 values were affected similarly by both agents. In conclusion, both agents can be used safely for outpatient anesthesia.

REFERENCES

1. Verma R, Alladi R, Jakson I, Johnston I, Kumar C, Page R, *et al.* Day case and short stay surgery: 2. Anaesthesia 2011;66:417-34.
2. Ebert TJ, Muzi M, Lopotka CW. Effects of sevoflurane on hemodynamics and sympathetic neural activity in humans: A comparison to isoflurane. Anesthesiology 1994;81:A133.
3. Motsch J, Wandel C, Neff S, Martin E. A comparative study of the use of sevoflurane and propofol in ambulatory surgery. Anaesthesist 1996;45 Suppl 1:S57-62.
4. Jones RM. Desflurane and sevoflurane: Inhalation anaesthetics for this decade? Br J Anaesth 1990;65:527-36.
5. Vlymen JM, White PF. Outpatient anesthesia. In: Miller RD, editor. Anesthesia. 5th ed. Pennsylvania, USA: Churchill Livingstone; 2000. p. 2213-46.
6. White PF, Song D. New criteria for fast-tracking after outpatient anesthesia: A comparison with the modified Aldrete's scoring system. Anesth Analg 1999;88:1069-72.
7. Kayatekin MS, Ozturk MO, Savasir I. The reliability and validity studies of a brief cognitive status schedule (KKM). Dusunen Adam: The Journal of Psychiatry and Neurological Sciences 1986;1:63-6.
8. Melzack R, Katz J. Pain measurement in persons in pain. In: Wall PD, Melzack R, editors. Textbook of Pain. 3rd ed. London: Churchill Livingstone; 1994. p. 337-51.
9. Nathanson MH, Fredman B, Smith I, White PF. Sevoflurane versus desflurane for outpatient anesthesia: A comparison of maintenance and recovery profiles. Anesth Analg 1995;81:1186-90.
10. Dupont J, Tavernier B, Ghosez Y, Durinck L, Thevenot A, Moktadir-Chalons N, *et al.* Recovery after anaesthesia for pulmonary surgery: Desflurane, sevoflurane and isoflurane. Br J Anaesth 1999;82:355-9.
11. Muzi M, Ebert TJ, Hope WG, Robinson BJ, Bell LB. Site (s) mediating sympathetic activation with desflurane. Anesthesiology 1996;85:737-47.
12. Eger EI 2nd, Gong D, Koblin DD, Bowland T, Ionescu P, Laster MJ, *et al.* The effect of anesthetic duration on kinetic and recovery characteristics of desflurane versus sevoflurane, and on the kinetic characteristics of compound A, in volunteers. Anesth Analg 1998;86:414-21.
13. Macario A, Dexter F, Lubarsky D. Meta-analysis of trials comparing postoperative recovery after anesthesia with sevoflurane or desflurane. Am J Health Syst Pharm 2005;62:63-8.
14. Song D, Joshi GP, White PF. Fast-track eligibility after ambulatory anesthesia: A comparison of desflurane, sevoflurane, and propofol. Anesth Analg 1998;86:267-73.
15. Larsen B, Seitz A, Larsen R. Recovery of cognitive function after remifentanil-propofol anesthesia: A comparison with desflurane and sevoflurane anesthesia. Anesth Analg 2000;90:168-74.
16. Chen X, Zhao M, White PF, Li S, Tang J, Wender RH, *et al.* The recovery of cognitive function after general anesthesia in elderly patients: A comparison of desflurane and sevoflurane. Anesth Analg 2001;93:1489-94.

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