

Comparison of the effects of sevoflurane and desflurane on the severity score of postoperative pain and discomfort after thyroidectomy

A prospective, double-blinded, randomized controlled study

Jun-Mo Park, MD, PhD^{a,*} 

Abstract

Background: Thyroidectomy is performed under general anesthesia using inhaled anesthetics such as sevoflurane or desflurane in many cases. The objective of this study was to investigate whether the incidence of postoperative pain and discomfort after thyroidectomy differed with the type of inhaled anesthetic.

Methods: Eighty-one female patients who underwent thyroidectomy were randomly assigned to the Sevo group (n = 42) or the Des group (n = 39). On the day of surgery and on the first, third, and seventh days after surgery, one registered nurse in charge of the entire questionnaire survey conducted the questionnaire assessment through face-to-face interviews or phone calls with the patients. The questionnaire evaluated the severity scores for seven items (sore throat, wound pain, nausea and vomiting, dizziness, occipital headache, posterior neck pain, and shoulder pain) regarding postoperative pain and discomfort experienced by patients and assessed which of these seven items caused the greatest discomfort to the patient on each day.

Results: Except for the severity score for dizziness on the day of surgery, the severity scores of postoperative pain and discomfort experienced by patients on the day of surgery and on the first, third, and seventh days after surgery showed no statistically significant differences between the two groups. In addition, on the day of surgery and on the first, third, and seventh days after surgery, patients reported that sore throat caused the greatest discomfort.

Conclusion: In patients undergoing thyroidectomy under general anesthesia using sevoflurane or desflurane, except for dizziness on the day of surgery, no other manifestation of postoperative pain and discomfort was influenced by the type of inhaled anesthetic. Moreover, after thyroidectomy, postoperative sore throat caused the greatest discomfort to patients from the day of surgery to the seventh day after surgery.

Abbreviations: ASA = American Society of Anesthesiologists, BIS = bispectral index, BMI = body mass index, bpm = beats per minute, CPSP = chronic postsurgical pain, ENT = Ear-Nose-and-Throat, PONV = postoperative nausea and vomiting, TIVA = total intravenous anesthesia.

Keywords: desflurane, ponv, postoperative discomfort, postoperative nausea and vomiting, postoperative pain, sevoflurane, thyroidectomy

1. Introduction

Thyroid cancer has a very high incidence worldwide, making thyroidectomy one of the most commonly performed surgeries.^[1] In general, thyroidectomy is known to require a small incision, and the procedure is, therefore, considered to cause relatively short-term mild-to-moderate postoperative pain and require a short hospital stay.^[2] However, in reality, most patients who undergo thyroidectomy experience pain significant enough to necessitate administration of opioids or non-steroidal anti-inflammatory drugs in the immediate

postoperative period, although the period of administration is relatively shorter than that in other surgeries.^[3] Moreover, 60%–80% of patients who undergo thyroidectomy show postoperative nausea and vomiting (PONV), unlike the PONV rate of <30% associated with other surgeries.^[4,5] In addition, as thyroidectomy often involves excessive extension of the patient's neck to increase access to the surgical site, patients often complain of postoperative pain in the posterior neck or both shoulders and dizziness.^[6]

To date, many studies have focused on drugs or procedures that can reduce PONV or postoperative wound pain after

The authors have no funding and conflicts of interest to disclose.

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

^a Department of Anesthesiology and Pain Medicine, School of Medicine, Kyungpook National University, Kyungpook National University Hospital, Daegu, South Korea.

*Correspondence: Jun-Mo Park, Department of Anesthesiology and Pain Medicine, Kyungpook National University Chilgok Hospital, 807 Hoguk-ro, Bukgu, Daegu 41404, South Korea (e-mail: pjm4013@naver.com).

Copyright © 2022 the Author(s). Published by Wolters Kluwer Health, Inc. This is an open-access article distributed under the terms of the Creative Commons Attribution-Non Commercial License 4.0 (CCBY-NC), where it is

permissible to download, share, remix, transform, and buildup the work provided it is properly cited. The work cannot be used commercially without permission from the journal.

How to cite this article: Park J-M. Comparison of the effects of sevoflurane and desflurane on the severity score of postoperative pain and discomfort after thyroidectomy: A prospective, double-blinded, randomized controlled study. *Medicine* 2022;101:43(e31393).

Received: 31 May 2022 / Received in final form: 26 September 2022 / Accepted: 28 September 2022

<http://dx.doi.org/10.1097/MD.00000000000031393>

thyroidectomy. However, empirically, patients who underwent thyroidectomy experienced pain or discomfort in a slightly different region or form from those previously known. For this reason, the present study attempted to accurately evaluate the actual level of pain and discomfort after thyroidectomy and identify the form in which it mainly appears.

If necessary, thyroidectomy can be safely performed under regional or local anesthesia.^[7] However, in most cases, it is performed under general anesthesia with endotracheal intubation. Although total intravenous anesthesia (TIVA) has recently gained prominence as an anesthetic method for thyroidectomy, general anesthesia using inhaled anesthetics such as sevoflurane or desflurane is also widely used.^[8] Thus, the main purpose of this study was to investigate whether the severity scores of postoperative pain and discomfort on the day of surgery and on the first, third, and seventh days after thyroidectomy performed under general anesthesia using sevoflurane or desflurane differed based on the type of inhaled anesthetic. Moreover, I also aimed to identify which postoperative adverse event caused patients the greatest discomfort on the day of surgery and on the first, third, and seventh days after surgery and whether this factor differed depending on the type of inhaled anesthetic.

2. Materials and methods

2.1. Study design

This study was conducted at the Kyungpook National University Chilgok Hospital (Daegu, South Korea) between December 2013 and February 2014. The study protocol was approved by the Research Ethics Committee of the Kyungpook National University Chilgok Hospital, Daegu, South Korea. The study received institutional approval (KNUMC_13-1008) and was conducted in accordance with the principles of the Declaration of Helsinki. All the participants provided their informed consent prior to participation.

2.2. Patient selection

Eighty-six of the 212 patients who underwent thyroidectomy during the study period participated in this study. Only female patients aged between 20 and 80 years with an American Society of Anesthesiologists (ASA) physical status class I to III who had undergone thyroidectomy under general anesthesia using sevoflurane or desflurane in the Department of General Surgery at Kyungpook National University Chilgok Hospital were included in the current study.

Patients were excluded if they were male, refused to participate, exceeded ASA physical status class III, were younger than 19 years of age or older than 81 years of age, had difficulty communicating due to an intellectual disability, underwent thyroidectomy under general anesthesia using TIVA, underwent robotic thyroidectomy, underwent thyroidectomy in the Department of Ear-Nose-and-Throat (ENT), were obese (body mass index [BMI] > 30 kg/m²), underwent reoperation for the thyroid gland, underwent simultaneous radical neck lymph node dissection, or underwent other combined surgeries.

2.3. Randomization and blinding

Patients were randomly assigned to either the Sevo group (n = 43) or the Des group (n = 43) after computer-generated randomization (<https://www.randomizer.org>). After checking the group assigned to the patient, induction of general anesthesia was performed using an inhaled anesthetic suitable for the assigned group. One registered nurse, who did not enter the operating room and had no knowledge of the group assignment, was fully familiar with the methods and procedures of this study and was fully in charge of patient counseling and data collection.

2.4. General anesthesia and monitoring

None of the patients received premedication. Regardless of the assigned group, after routine monitoring using pulse oximetry, electrocardiography, and noninvasive blood pressure and bispectral index (BIS) measurements, general anesthesia was induced with propofol (1.5–2.0 mg/kg) and rocuronium (0.5–0.8 mg/kg). However, some older patients and/or those with cardiovascular diseases were monitored using invasive radial arterial blood pressure measurements after induction of general anesthesia. After intubation, routine monitoring using capnography and a nasopharyngeal temperature probe was also performed. To maintain general anesthesia, depending on the group to which the patients were assigned, sevoflurane or desflurane with air at 2.5 L/min and O₂ at 1.5 L/min were used. Remifentanyl was started at a dose of 3.0 ng/mL with a targeted injection of remifentanyl at the effect site and continuously adjusted to maintain a mean arterial pressure of \pm 20% of the reference value during the operation by using target-controlled infusion (Orchestra; Fresenius Vial, Auvergne Rhone Alpes, France). During the operation, the concentration of sevoflurane or desflurane was continuously adjusted such that the BIS values could be maintained between 40 and 60. The lungs were ventilated with a tidal volume of 5 to 7 mL/kg, and the respiratory rate was adjusted to maintain the end-tidal partial pressure of carbon dioxide at 30 to 40 mm Hg. To maintain the patient's vital signs, the remifentanyl concentration was maintained below 2 ng/mL; in addition, phenylephrine was injected when the patient's mean arterial blood pressure was maintained below 80% of the baseline. To maintain vital signs, nicardipine was administered when the remifentanyl concentration was maintained at \geq 8 ng/mL or when the patient's mean arterial blood pressure was maintained at or above 120% of the baseline value. Atropine and esmolol were administered separately when the patient's heart rate dropped to less than 46 beats per minute (bpm) for more than 30 s or increased to more than 90 bpm for more than 30 s. Repeated or continuous infusion was performed when deemed necessary. During the surgery, lactated Ringer's solution was continuously injected at 3 to 4 mL/kg/h. After sufficient endotracheal and oral suction, the inhaled oxygen fraction and fresh gas flow rate were increased to 100% and 8 L, respectively. The neuromuscular blockade was reversed with 0.4 mg of glycopyrrolate and 15 mg of pyridostigmine and confirmed by train-of-four monitoring. The endotracheal tube was removed when the patient regained spontaneous breathing and consciousness. The patient was then transferred to the postoperative recovery room.

2.5. Survey on the severity scores for postoperative pain and discomfort

A registered nurse who was blinded to information about patient grouping but fully understood the purpose of this study and the contents of the questionnaire conducted the questionnaire survey using face-to-face or telephone interviews with the patient. Interviews were conducted on the day of surgery and on the first, third, and seventh days after surgery. Owing to the nature of thyroidectomy, which often requires a short hospital stay, the interviews on the seventh day were conducted over the phone in some cases.

The questionnaire surveyed postoperative complaints of sore throat, wound pain, nausea/vomiting, dizziness, occipital headache, posterior neck pain, and shoulder pain by the patients on the day of surgery and the first, third, and seventh days after surgery. All seven survey items were scored as follows: 1, very severe; 2, severe; 3, moderate; 4, mild; and 5, none. Among these, "1, very severe" was defined as pain or discomfort that was so severe that the patient wanted medication, while "5, none" was defined as the absence of postoperative pain or discomfort; these definitions were explained to the patients. In addition, on the day of surgery and on the first, third, and seventh days after surgery, nine survey items were evaluated to determine which item caused the greatest

discomfort to the patient: the nine items included the seven items described above, 0 that was defined as a state without any pain or discomfort, and 8 that was defined as pain or discomfort in parts in the body other than those covered by these seven items.

2.6. Study outcomes

The main purpose of this study was to investigate differences in the severity scores of postoperative pain and discomfort related to the type of inhaled anesthetic on the day of surgery and on the first, third, and seventh days after surgery in patients who underwent thyroidectomy under general anesthesia using sevoflurane or desflurane. I also determined the source of greatest discomfort for the patients on the day of surgery and on the first, third, and seventh days after surgery and to evaluate whether this finding differed depending on the type of inhaled anesthetic. Finally, I also evaluated whether the two groups showed significant differences in the frequency of the use of analgesics, antiemetics, and drugs for dizziness during hospitalization.

2.7. Sample size

The sample size was calculated using G*Power 3.1.9.4. To determine the appropriate sample size for this study, the difference in the severity score of PONV on the day of surgery, one of the most frequent sources of postoperative discomfort after thyroidectomy, was evaluated in a preliminary study of six patients in each group. In this preliminary study of 12 patients, the mean \pm standard deviations of the severity score of PONV on the day of surgery in the Sevo and Des groups were 4.17 ± 1.602 and 2.83 ± 1.602 , respectively. Considering 95% power and a 5% significance level, the target sample size was calculated as 39

patients per group. Next, assuming a 10% dropout rate, a minimum of 43 patients per group was considered to be required to achieve meaningful results in this study.

2.8. Statistical analysis

Data were entered into a study database and analyzed using IBM SPSS Statistics (v. 27.0; IBM Corp, Armonk, NY). Statistical analysis was performed using the χ^2 test for comparative evaluations by the ASA class (among the demographic data), and independent *t* tests were used to evaluate the distributions of the other demographic data across groups. The significance of differences between the Sevo and Des groups in the severity scores for postoperative pain and discomfort on the day of surgery and on the first, third, and seventh days after surgery was verified using independent *t* tests. Pearson correlation analysis was performed to identify statistically significant differences between the two groups in the items that patients described as causing the greatest discomfort on the day of surgery and on the first, third, and seventh days after surgery. In addition, frequency analysis of these items was performed. An independent *t* test was conducted to compare the frequency of the use of analgesics, antiemetics, and drugs for dizziness during hospitalization between the two groups. All continuous variables were expressed as means \pm standard deviations, and categorical variables were expressed as frequencies and percentages. All reported *P* values were two-sided, and *P* values $< .05$ were considered to indicate statistical significance.

3. Results

3.1. Patient characteristics

Of the 212 patients who underwent thyroidectomy during the study period, 29 were men, five refused to participate in this

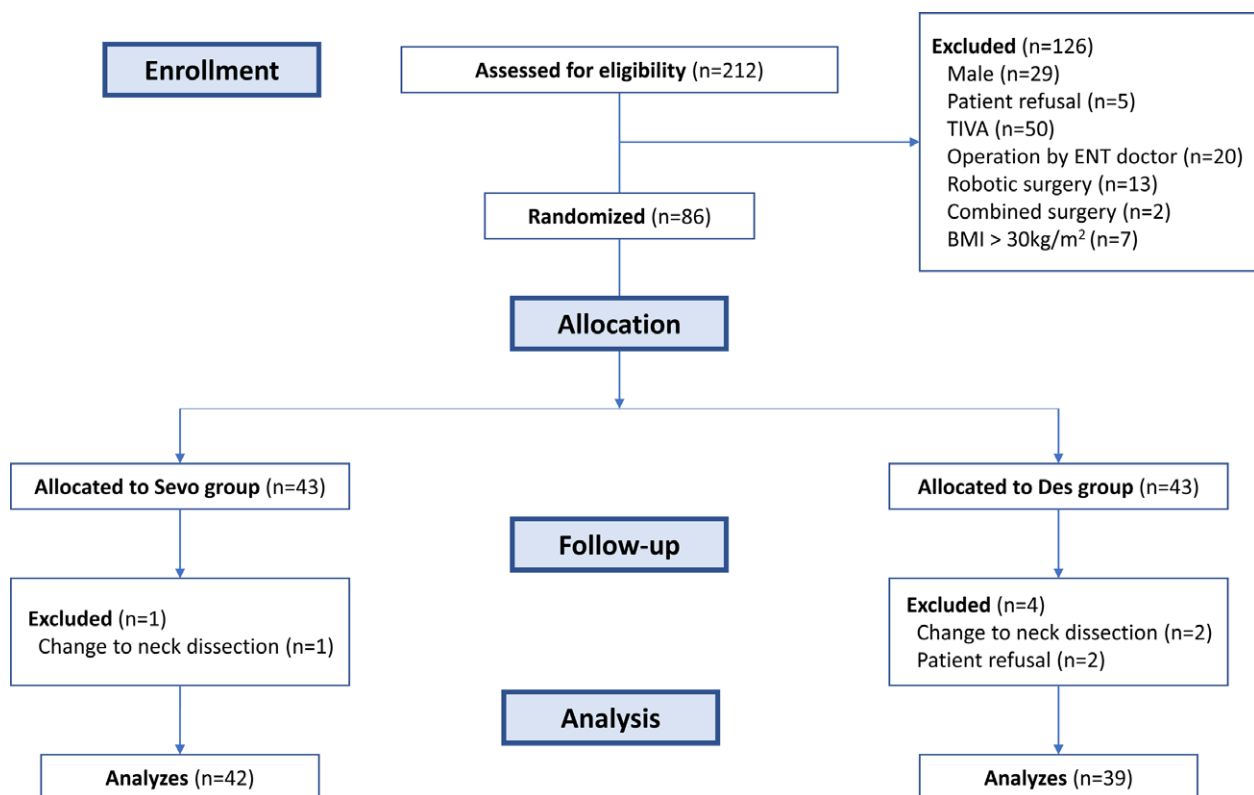


Figure 1. Patient flowchart outlining the process of patient inclusion in the enrollment, group allocation, follow-up, and analysis phases of the study. BMI = body mass index, ENT = Ear-Nose-and-Throat, TIVA = total intravenous anesthesia.

study, 50 underwent thyroidectomy under TIVA, 20 underwent thyroidectomy by an ENT doctor, 13 underwent robotic surgery, two underwent combined surgeries, and seven had a BMI of >30 kg/m². Thus, a total of 86 patients were randomly assigned to the two groups. One patient from the Sevo group and two patients from the Des group were excluded from the study, as the procedure was changed to neck dissection during surgery. Two patients from the Des group were excluded from the study because they wanted to withdraw from the study after surgery. A total of 81 patients (Sevo group, n = 42; Des group, n = 39) were included in the final study population (Fig. 1). The comparative demographic and perioperative characteristics for the two groups are presented in Table 1. The two groups showed no statistically significant differences in these patient characteristics.

3.2. Severity scores of postoperative pain and discomfort

Table 2 shows the mean values and standard deviations of the severity scores for postoperative pain and discomfort on the day of surgery and on the first, third, and seventh days after surgery in both groups, together with the probability of statistical significance. Except for dizziness on the day of surgery, none of the other items for the postoperative pain and discomfort experienced by the patients on the day of surgery and on the first, third, and seventh days after surgery differed between the two groups (Fig. 2). Postoperative dizziness on the day of surgery was more severe in the Des group (3.4 ± 1.4) than in the Sevo group (4.1 ± 1.3) ($P = .047$).

3.3. Analysis of items causing the greatest discomfort

The survey item that caused the greatest discomfort on all days in both groups was sore throat. The two groups showed no significant differences in their responses to this assessment on the day of surgery and on the first and third days after surgery (on the day of surgery: $P = .358$, first day: $P = .206$, third day: $P = .771$). However, they showed a statistically significant intergroup difference on the seventh day after surgery ($P = .025$). The three items that caused patients the greatest discomfort on the day of surgery and on the first, third, and seventh days after surgery were as follows: on the day of surgery, sore throat (54.3%) > wound pain (14.8%) > nausea and vomiting (4.9%); first day after surgery, sore throat (67.9%) > wound pain (11.1%) > none (6.2%); third day after surgery, sore throat (55.6%) > wound pain (14.8%) > none (13.6%); and seventh day after surgery, sore throat (33.3%) > none (25.9%) > wound pain (18.5%). Figure 3 shows the results of frequency analysis for the items that caused patients the greatest discomfort on the day of surgery and on the first, third, and seventh days after surgery. On the seventh day after surgery, the three items that caused the greatest discomfort in

each group were as follows: Sevo group, none (31.0%) = sore throat (31.0%) > posterior neck pain (11.9%); Des group, sore throat (35.9%) > wound pain (30.8%) > none (20.5%). Figure 4 shows the results of frequency analysis for the items causing the greatest discomfort in each group on the seventh day after surgery.

3.4. Rescue drugs

Drugs for dizziness were never used in the patients. The two groups showed no statistically significant differences in the frequency of use of analgesics (Sevo group, 5.7 ± 0.8 ; Des group, 5.9 ± 1.2 ; $P = .437$) and the same was true for antiemetics (Sevo group, 0.1 ± 0.3 ; Des group, 0.3 ± 0.6 ; $P = .233$).

4. Discussion

The principal results of this study indicated that after thyroidectomy under general anesthesia using sevoflurane or desflurane, except for dizziness on the day of surgery, the severity scores for postoperative pain and discomfort on the day of surgery and on the first, third, and seventh days after surgery did not differ significantly in relation to the inhaled anesthetic used. Moreover, on the day of surgery and on the first, third, and seventh days after surgery, sore throat caused patients the greatest discomfort in both groups.

The only difference between the two groups in this study was in postoperative dizziness on the day of surgery, which was more severe in the Des group (3.4 ± 1.4) than in the Sevo group (4.1 ± 1.3) ($P = .047$). Several possible reasons for this result may be postulated. First, although the present study showed no statistically significant intergroup difference in the severity scores for PONV on the day of surgery ($P = .125$), the absolute value for the Des group (3.1 ± 1.6) was greater than that for the Sevo group (3.7 ± 1.6). Thus, the relatively severe nausea and vomiting may have contributed to the more severe dizziness. Second, none of the patients received medication for dizziness, and there was no statistically significant difference in the frequency of the use of antiemetics between the two groups. However, the absolute value of the frequency of the use of antiemetics was higher in the Des group (Sevo group, 0.1 ± 0.3 ; Des group, 0.3 ± 0.6 ; $P = .233$). Ondansetron (a serotonin receptor antagonist) was used as an antiemetic in this study, and headache and dizziness are its main side effects in the dosages used to treat PONV.^[9] Based on this information, the fact that the absolute value of the frequency of the use of antiemetics was higher in the Des group could be considered to be one of the reasons for the more severe dizziness in the Des group.

Most of the anesthesiologists and surgeons are already well aware of PONV and postoperative pain, which occur frequently after thyroidectomy, and many studies have been conducted to prevent and manage them. However, the patients

Table 1
Patient characteristics and intraoperative data.

	Sevo (n = 42)	Des (n = 39)	P value*
Age, yr	47.2 ± 12.3	48.0 ± 10.6	.752
Height, cm	157.9 ± 4.6	157.8 ± 6.0	.943
Weight, kg	58.8 ± 7.7	58.9 ± 8.2	.932
BMI, kg/m ²	23.5 ± 2.8	23.7 ± 3.0	.857
ASA class (1/2/3)	23/19/0	20/18/1	.569
Operation time, min	81.5 ± 31.0	81.1 ± 31.2	.960
Hospital time, d	5.0 ± 0.9	5.3 ± 1.2	.192

Results are presented as means ± standard deviations, or numbers of patients.

ASA = American Society of Anesthesiologists, BMI = body mass index.

* $P < .05$ means significant statistical difference between groups.

Table 2
The severity scores of postoperative pain and discomforts.

		Sevo group (n = 42)	Des group (n = 39)	P value*
1. Sore throat	0	2.0 ± 0.9	1.9 ± 1.0	.733
	1st	2.7 ± 0.8	2.7 ± 0.7	.870
	3rd	3.2 ± 0.8	3.3 ± 0.6	.653
	7th	3.6 ± 0.6	3.7 ± 0.4	.201
2. Wound pain	0	2.5 ± 1.2	2.5 ± 1.4	.885
	1st	3.7 ± 1.0	3.3 ± 1.2	.109
	3rd	4.1 ± 0.7	3.9 ± 0.9	.349
	7th	4.5 ± 0.6	4.3 ± 0.7	.057
3. Nausea and vomiting	0	3.7 ± 1.6	3.1 ± 1.6	.125
	1st	4.9 ± 0.4	4.7 ± 0.7	.095
	3rd	4.8 ± 0.6	4.9 ± 0.3	.541
	7th	4.9 ± 0.5	5.0 ± 0.2	.259
4. Dizziness	0	4.1 ± 1.3	3.4 ± 1.4	.047*
	1st	4.8 ± 0.5	4.5 ± 0.6	.083
	3rd	4.9 ± 0.4	4.7 ± 0.6	.071
	7th	4.8 ± 0.5	4.7 ± 0.4	.680
5. Occipital headache	0	4.1 ± 1.2	4.1 ± 1.3	.926
	1st	4.4 ± 0.9	4.5 ± 0.9	.350
	3rd	4.8 ± 0.5	4.7 ± 0.8	.642
	7th	4.8 ± 0.5	4.9 ± 0.4	.381
6. Posterior neck pain	0	3.9 ± 1.4	3.8 ± 1.4	.917
	1st	4.3 ± 1.1	4.3 ± 1.0	.841
	3rd	4.5 ± 0.7	4.6 ± 0.5	.532
	7th	4.6 ± 0.8	4.8 ± 0.5	.123
7. Shoulder pain	0	4.1 ± 1.4	3.6 ± 1.3	.171
	1st	4.2 ± 1.2	4.3 ± 1.0	.560
	3rd	4.5 ± 0.7	4.5 ± 0.9	.829
	7th	4.6 ± 0.8	4.6 ± 0.7	.673

Results are presented as mean ± standard deviations.

*P < .05 means significant statistical difference between groups.

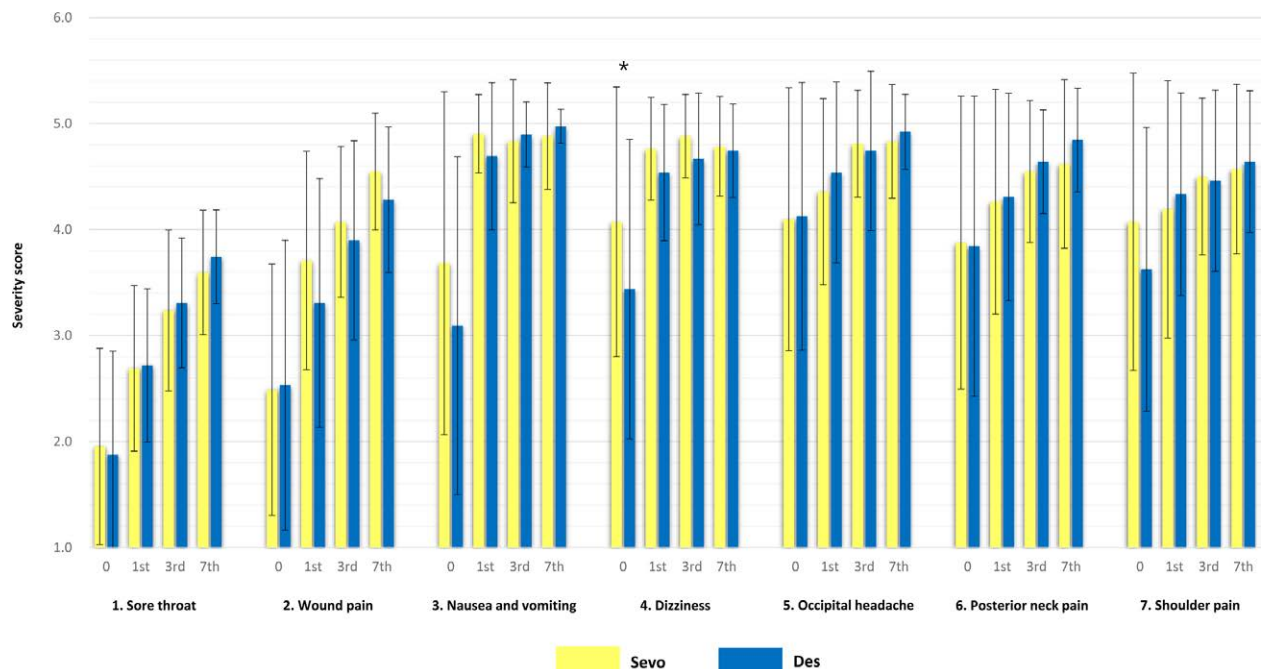


Figure 2. The severity scores for postoperative pain and discomfort on the day of surgery and on the first, third, and seventh days after surgery. *P < .05 indicates a statistically significant difference between groups.

in this study primarily identified sore throat as the aspect that caused them the greatest discomfort from the day of surgery to the seventh day after surgery. This can be attributed to several reasons. The first reason is the misconceptions harbored by anesthesiologists and surgeons about postoperative sore throat. Postoperative sore throat is one of the most common

complications after general anesthesia through tracheal intubation.^[10] Although clinicians often regard this as a relatively minor complication, it is very uncomfortable for patients, and patients consider it very important to avoid it. Postoperative sore throat is known to occur in 14.4% to 50% of cases after tracheal intubation and in 5.8% to 34% of cases after

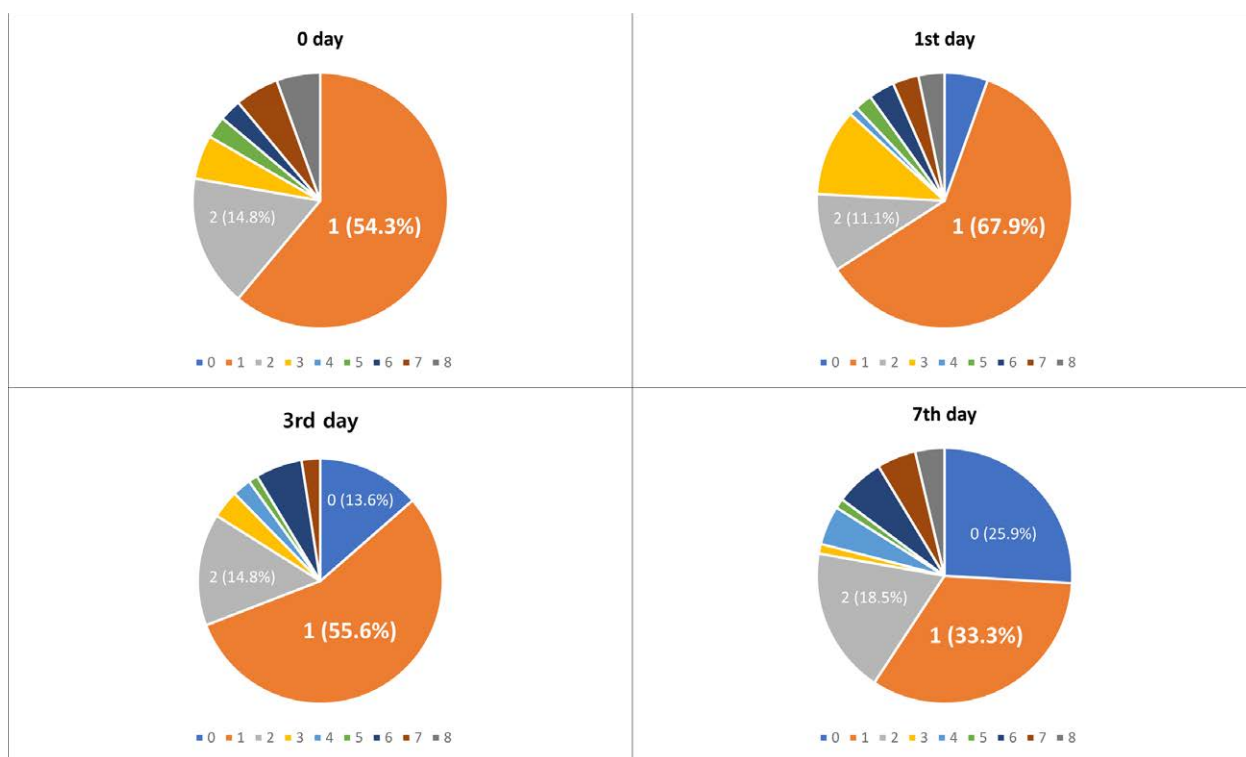


Figure 3. The greatest discomfort experienced on the day of surgery and on the first, third, and seventh days after surgery. 0 = none, 1 = sore throat, 2 = wound pain, 3 = nausea and vomiting, 4 = dizziness, 5 = occipital headache, 6 = posterior neck pain, 7 = shoulder pain, 8 = other region.

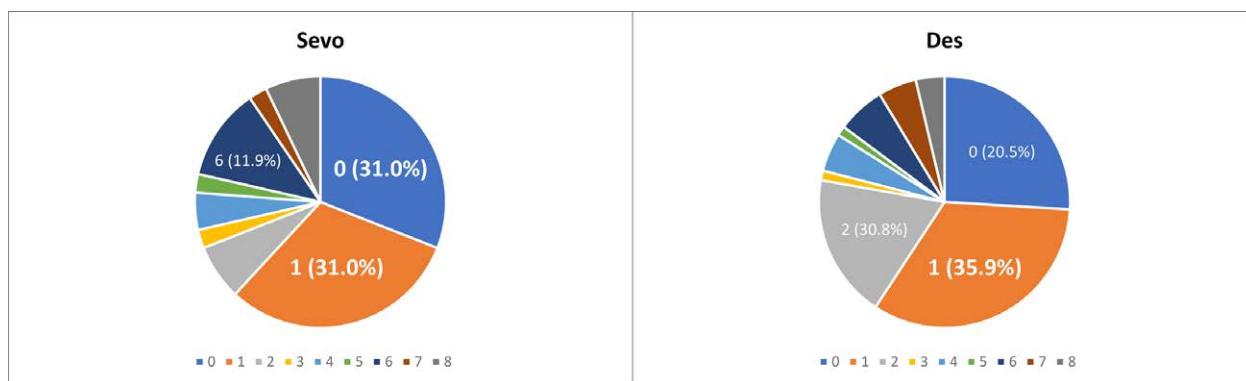


Figure 4. The greatest discomfort reported on the seventh day after surgery in both groups. 0 = none, 1 = sore throat, 2 = wound pain, 3 = nausea and vomiting, 4 = dizziness, 5 = occipital headache, 6 = posterior neck pain, 7 = shoulder pain, 8 = other region.

laryngeal mask insertion, and it can occur even after using a face mask.^[11,12] The large deviations in the aforementioned percentage values are probably attributable to differences in the technique, skill, and experience among anesthesiologists as well as differences in the definition of postoperative sore throat between individual anesthesiologists and patients.^[12] The second aspect is the approach used for enquiring about postoperative sore throat, as the questioning method has been previously reported to affect its incidence.^[13] Only 2 out of 129 patients complained of postoperative sore throat in response to indirect questioning. On the other hand, with direct questioning, approximately 28 out of 113 patients complained of postoperative sore throat. This difference may be because patients tend to focus on symptoms directly related to the surgical site and do not regard a postoperative sore throat as a symptom directly related to anesthesia or surgery. Third, according to the results obtained in recent studies on antiemetics and postoperative pain control, the active use of analgesics and antiemetics

can reduce postoperative pain and PONV; therefore, patients may feel more uncomfortable when affected by postoperative sore throat. In a study of postoperative patient complaints through a prospective interview of 12,276 patients, 3652 of them (30%) reported at least one perioperative complaint.^[14] The leading adverse events reported were PONV (1705 cases), postoperative sore throat (1228 cases), and hoarseness (802 cases), in that order.

Postoperative sore throat is undoubtedly one of the most common complications after general anesthesia, but there is still no precise definition for it.^[11] While the expression “sore throat” is common to the vernacular of many different cultures, the expression “postoperative sore throat” is a rather concise description of a wide range of signs and symptoms. There are so many physical factors involved in the development of postoperative sore throat, that it becomes difficult to pinpoint a specific cause.^[15] Although many methods are available to reduce postoperative sore throat, none of the interventions have proven to

be completely effective. Postoperative sore throat may not be the most important side effect to avoid from a patient's point of view, but it is nonetheless an adverse event that deserves more attention in order to increase the patient's satisfaction with surgery.^[10,16]

Desflurane and sevoflurane have the advantages of a rapid onset of action and quick awakening from anesthesia due to their low blood solubility and a lowering effect on the incidence or severity of PONV compared to inhaled anesthetics used in the past.^[17] However, both have the disadvantage of increasing PONV in a dose-dependent manner.^[18] Many studies have shown conflicting results regarding the effects of desflurane and sevoflurane on PONV. Some meta-analyses showed that the incidence of PONV did not differ in relation to the use of sevoflurane and desflurane,^[19,20] whereas other studies revealed that desflurane was a risk factor for PONV.^[21,22] It has also been reported that sevoflurane is more useful than desflurane in the treatment of PONV.^[23] Risk factors predictive of PONV include being a female, having a PONV history, being a nonsmoker, being of a lower age, postoperative usage of opioids, and the duration of anesthesia with inhaled anesthetics.^[18] There are many factors that influence PONV: Inhaled anesthetics were the leading cause of PONV up to 2 hours after surgery, and the emetic-inducing effect of inhaled anesthetics was greater than that of other risk factors.^[24] In this study, there was no difference in the effect of sevoflurane and desflurane on PONV. Although these results may be due to the effect of inhaled anesthetics, it is thought that active prevention and management of PONV also play a role.

PONV has always been a major concern for anesthesiologists, as it is known to occur in up to 60% to 84% of patients after thyroidectomy if prophylactic antiemetics are not administered.^[25] Therefore, most of the studies on postoperative complications after thyroidectomy are based on anesthesia methods or related drugs to reduce PONV or postoperative pain. However, postoperative pain after thyroidectomy is known to be mild to moderate.^[2] Therefore, PONV can be a major cause of discomfort after thyroidectomy and can be recognized as the most unpleasant aspect of recovery after surgery. Although PONV may not be life-threatening, it is common and difficult to control in high-risk patients or patients undergoing major outpatient surgery.^[26,27] PONV can cause complications such as aspiration pneumonia, fluid and electrolyte imbalances, or esophageal rupture, increasing the length of the patient's hospital stay and medical costs and reducing the patient's satisfaction with the surgery.^[25,28] In particular, if it occurs after thyroidectomy, it may cause bleeding in or rupture of the surgical site, leading to airway obstruction due to hematoma in severe cases.^[25]

Although postoperative pain after thyroidectomy is known to be mild to moderate,^[2] chronic postsurgical pain (CPSP) is not limited to major surgery and can occur even after minor procedures, such as hernia repair, which are thought to be simpler than thyroidectomy.^[29] A clear understanding of the fact that such pain is never harmless is essential to prevent transition to CPSP, and active pain control is needed without waiting for the patient to complain about pain, since the patient may regard such pain as "normal" to some extent.^[30] In this study, there was no difference in the effects of sevoflurane and desflurane on postoperative pain. This result may be due to the effect of inhaled anesthetics, but it may also be the result of active management for acute postoperative pain. In order to prevent progression to CPSP, even if the pain after thyroidectomy is mild, it should not be ignored.^[31]

The comparison between the two groups on the seventh day after surgery showed a statistically significant intergroup difference for the adverse effect causing the greatest discomfort to the patients. However, the possibility that the difference in inhaled anesthetics did not have a significant effect on the first and third days and only showed a significant effect on the seventh day after surgery is not easy to accept. In fact, there is no

way to clearly explain the reason for this difference in this study. Despite this finding, postoperative sore throat caused the greatest discomfort in both groups, even on the seventh day after surgery. Thus, the difference in inhaled anesthetics may not have been actually responsible for the difference observed on the seventh day after surgery.

This study has some limitations. The registered nurse who conducted the entire survey in this study did not provide a clear definition of postoperative sore throat, which had not then been precisely defined, to the patients and only asked direct questions. The patients who underwent thyroidectomy were visited by the registered nurse only once a day on the day of surgery and on the first, third, and seventh postoperative days to evaluate postoperative pain and discomfort. This could have led to recall bias. Remifentanyl, which may be significantly associated with postoperative pain or PONV, was used to maintain adequate anesthesia during surgery, but the amount of remifentanyl used during surgery was not confirmed.

In conclusion, when thyroidectomy is performed under general anesthesia using sevoflurane or desflurane, the type of inhaled anesthetic does not influence the occurrence of postoperative pain and discomfort, except for dizziness on the day of surgery. In addition, after thyroidectomy, postoperative sore throat causes patients the greatest discomfort from the day of surgery to the seventh day after thyroidectomy.

References

- Rossi L, Materazzi G, Bakkar S, et al. Recent trends in surgical approach to thyroid cancer. *Front Endocrinol (Lausanne)*. 2021;12:699805.
- Kalmovich LM, Cote V, Sands N, et al. Thyroidectomy: exactly how painful is it? *J Otolaryngol Head Neck Surg*. 2010;39:277–83.
- Jo JY, Kim YJ, Choi SS, et al. A prospective randomized comparison of postoperative pain and complications after thyroidectomy under different anesthetic techniques: volatile anesthesia versus total intravenous anesthesia. *Pain Res Manag*. 2021;2021:8876906.
- Choi EK, Seo Y, Lim DG, et al. Postoperative nausea and vomiting after thyroidectomy: a comparison between dexmedetomidine and remifentanyl as part of balanced anesthesia. *Korean J Anesthesiol*. 2017;70:299–304.
- Gan TJ. Postoperative nausea and vomiting – can it be eliminated? *JAMA*. 2002;287:1233–6.
- Genç A, Çelik SU, Genç V, et al. The effects of cervical kinesiotaping on neck pain, range of motion, and disability in patients following thyroidectomy: a randomized, double-blind, sham-controlled clinical trial. *Turk J Med Sci*. 2019;49:1185–91.
- Farling PA. Thyroid disease. *Br J Anaesth*. 2000;85:15–28.
- Bajwa SJ, Sehgal V. Anesthesia and thyroid surgery: the never ending challenges. *Indian J Endocrinol Metab*. 2013;17:228–34.
- Kovac AL. Prevention and treatment of postoperative nausea and vomiting. *Drugs*. 2000;59:213–43.
- El-Boghdady K, Bailey CR, Wiles MD. Postoperative sore throat: a systematic review. *Anaesthesia*. 2016;71:706–17.
- Scuder PE. Postoperative sore throat: more answers than questions. *Anesth Analg*. 2010;111:831–2.
- McHardy FE, Chung F. Postoperative sore throat: cause, prevention and treatment. *Anaesthesia*. 1999;54:444–53.
- Harding CJ, McVey FK. Interview method affects incidence of postoperative sore throat. *Anaesthesia*. 1987;42:1104–7.
- Lehmann M, Monte K, Barach P, et al. Postoperative patient complaints: a prospective interview study of 12,276 patients. *J Clin Anesth*. 2010;22:13–21.
- Mitobe Y, Yamaguchi Y, Baba Y, et al. A literature review of factors related to postoperative sore throat. *J Clin Med Res*. 2022;14:88–94.
- Mayhood J, Cress K. Effectiveness of ketamine gargle in reducing postoperative sore throat in patients undergoing airway instrumentation: a systematic review. *JBI Database System Rev Implement Rep*. 2015;13:244–78.
- Wallenborn J, Rudolph C, Gelbrich G, et al. The impact of isoflurane, desflurane, or sevoflurane on the frequency and severity of postoperative nausea and vomiting after lumbar disc surgery. *J Clin Anesth*. 2007;19:180–5.
- Apfel CC, Heidrich FM, Jukar-Rao S, et al. Evidence-based analysis of risk factors for postoperative nausea and vomiting. *Br J Anaesth*. 2012;109:742–53.

- [19] 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.
- [20] Wang TT, Lu HF, Poon YY, et al. Sevoflurane versus desflurane for early postoperative vomiting after general anesthesia in hospitalized adults: a systematic review and meta-analysis of randomized controlled trials. *J Clin Anesth.* 2021;75:110464.
- [21] Choi JB, Shim YH, Lee YW, et al. Incidence and risk factors of postoperative nausea and vomiting in patients with fentanyl-based intravenous patient-controlled analgesia and single antiemetic prophylaxis. *Yonsei Med J.* 2014;55:1430–5.
- [22] Hough MB, Sweeney B. Postoperative nausea and vomiting in arthroscopic day-case surgery: a comparison between desflurane and isoflurane. *Anaesthesia.* 1998;53:910–4.
- [23] Yoon IJ, Kang H, Baek CW, et al. Comparison of effects of desflurane and sevoflurane on postoperative nausea, vomiting, and pain in patients receiving opioid-based intravenous patient-controlled analgesia after thyroidectomy: propensity score matching analysis. *Medicine (Baltim).* 2017;96:e6681.
- [24] Apfel CC, Kranke P, Katz MH, et al. Volatile anaesthetics may be the main cause of early but not delayed postoperative vomiting: a randomized controlled trial of factorial design. *Br J Anaesth.* 2002;88:659–68.
- [25] Cho YJ, Choi GJ, Kang H. Pharmacologic interventions for postoperative nausea and vomiting after thyroidectomy: a protocol for systematic review and network meta-analysis. *Medicine (Baltimore).* 2019;98:e14542.
- [26] Veiga-Gil L, Pueyo J, López-Olaondo L. Postoperative nausea and vomiting: pathophysiology, risk factors, prophylaxis and treatment. *Rev Esp Anesthesiol Reanim.* 2017;64:223–32.
- [27] Chatterjee S, Rudra A, Sengupta S. Current concepts in the management of postoperative nausea and vomiting. *Anesthesiol Res Pract.* 2011;2011:748031.
- [28] Cao X, White PF, Ma H. An update on the management of postoperative nausea and vomiting. *J Anesth.* 2017;31:617–26.
- [29] Pak DJ, Yong RJ, Kaye AD, et al. Chronification of pain: mechanisms, current understanding, and clinical implications. *Curr Pain Headache Rep.* 2018;22:9.
- [30] Wattier JM, Caiazzo R, Andrieu G, et al. Chronic post-thyroidectomy pain: incidence, typology, and risk factors. *Anaesth Crit Care Pain Med.* 2016;35:197–201.
- [31] Katz J, Seltzer Z. Transition from acute to chronic postsurgical pain: risk factors and protective factors. *Expert Rev Neurother.* 2009;9:723–44.