# Comparison of dexmedetomidine and remifentanil infusion in geriatric patients undergoing outpatient cataract surgery: a prospective, randomized, and blinded study

**Cem Kaya[1], Nalan Ornek Celebi[1], Sehend Debbag[1], Ozgur Canbay[1], Ozkan Onal[2, 3, *]**
1 Department of Anesthesiology and Reanimation, Hacettepe University Faculty of Medicine, Ankara, Turkey
2 Department of Anesthesiology and Reanimation, Selcuk University Faculty of Medicine, Konya, Turkey
3 Department of Outcomes Research, Anesthesiology Institute, Cleveland Clinic Main Hospital, Cleveland Clinic, Ohio, USA

*Correspondence to: Ozkan Onal, MD, drozkanonal@selcuk.edu.tr or onali@ccf.org.
orcid: 0000-0002-2773-4392 (Cem Kaya); 0000-0001-7472-6275 (Nalan Celebi); 0000-0002-0869-7397 (Sehend Debbag); 0000-0001-7645-4947 (Ozgur Canbay); 0000-0002-5574-1901 (Ozkan Onal)

## Abstract

Dexmedetomidine is an $\alpha_2$ agonist and remifentanil is a short-acting μ opioid agonist. We aimed to compare the dexmedetomidine and remifentanil infusions used for conscious sedation in geriatric patients undergoing outpatient cataract surgery in terms of sedation quality, side effects, and surgeon satisfaction. Eighty patients were allocated into two groups as per the administration of dexmedetomidine (dexmedetomidine group) and remifentanil (remifentanil group) infusion in this randomized, prospective, double-blinded study. In dexmedetomidine group ($n = 40$), after a loading of 1 μg/kg dexmedetomidine in 10 minutes, 0.4 μg/kg/h infusion was administered. In the remifentanil group ($n = 40$), remifentanil at a dose of 0.05 μg/kg was administered for 10 minutes, and then 0.05 μg/kg/min infusion was continued. Observer Assessment Warning/Sedation Scale values evaluating sedation quality were lower in the dexmedetomidine group than in the remifentanil group, although it was not statistically significant ($P > 0.05$). Bispectral Index values evaluating sedation quality were lower in the dexmedetomidine group according to the remifentanil group ($P < 0.05$). The dexmedetomidine group had lower Verbal Rating Scale and Visual Analogue Scale scores evaluating pain intensity compared with the remifentanil group ($P < 0.05$). The nausea Visual Analogue Scale values evaluating the severity of postoperative nausea in the dexmedetomidine group were lower than those in the remifentanil group ($P < 0.05$). The surgeon satisfaction was found to be greater in the dexmedetomidine group compared with the remifentanil group ($P = 0.015$). In geriatric patients, the targeted sedation and analgesia levels were achieved more easily with dexmedetomidine infusion, without hemodynamic and respiratory side effects, compared to remifentanil infusion.

**Key words:** ambulatory surgery; anesthesia; cataract; conscious sedation; dexmedetomidine; geriatrics; remifentanil

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## Introduction

Cataract surgery can be performed with regional anesthesia methods such as retrobulbar, peribulbar or facial nerve block.[1] During the surgical procedure, the application of sedation in addition to the regional anesthesia method helps the patient to tolerate the surgical procedures with minimal anxiety and discomfort in maximum safety. Cataract surgery is one of the surgical procedures performed on an outpatient basis in geriatric patients. Although the intravenous administration of sedative drugs is intended to reduce the anxiety of geriatric patients undergoing cataract surgery, in cases where dose titration is not done appropriately, the patient's consciousness and spontaneous breathing completely disappear.[2] In this case, the endotracheal intubation procedure applied to secure the patient's airway causes contamination of the surgical site, failure to complete the surgical procedure, and the need for intensive care in the postoperative period, especially in geriatric patients.

Dexmedetomidine is an $\alpha_2$-adrenergic receptor agonist used for its sympatholytic effect, providing sedation, analgesia, and cardiovascular stabilization in the perioperative period. Dexmedetomidine begins to affect approximately 15 minutes after intravenous administration.[3] Remifentanil is a μ opioid agonist with a speedy onset and short period of activity, which is degraded by plasma esterase in tissues. The sedative effects of remifentanil start and end very quickly, causing it to be preferred in outpatient surgical procedures.[4]

Our primary outcome was to compare the effects of dexmedetomidine and remifentanil infusions on sedation quality in geriatric outpatients who underwent cataract surgery. Our secondary outcomes were to compare the effects of dexmedetomidine and remifentanil infusion on side effects, and surgeon's satisfaction.

## Subjects and Methods

### Study design and ethics approval

Ethics approval was obtained from the Ethics Committee

of Hacettepe University Faculty of Medicine in 2009 with approval No. HEK 09/59-19. The procedures followed were under the ethical standards of the responsible committee on human experimentation (Hacettepe University Faculty of Medicine Clinical Research Ethics Committee) and with the Helsinki Declaration. The trial was registered with the ClinicalTrials.gov (identifier No. NCT04935541). Informed consent was obtained from all patients who planned to participate in this prospective, double-blinded, randomized study.

## Participants

Eighty patients at the age of 65–80 years, who underwent cataract surgery in Hacettepe University Faculty of Medicine Hospital between 2009–2010, with the American Society of Anesthesiologists scores I–III were included. The following were determined as exclusion criteria: Second- or third-degree heart block, chronic $\alpha_2$-agonist use, inability to communicate with the patient, uncontrolled systemic disease, allergy to local anesthetics, chronic analgesic or sedative drug use, history of alcohol or substance addiction. Demographic data of all patients were recorded in the operating room and each patient was monitored with electrocardiogram, non-invasive blood pressure (NIBP), peripheral oxygen saturation ($SpO_2$).

## Scales and questionnaires used in the study

The Observer Assessment Warning/Sedation Scale (OAA/S) was used together with the bispectral index (BIS) to determine the sedation level of each patient. Both BIS monitoring and the OAA/S scale were used to find out the sedation level of each patient since we cannot use BIS monitoring in the postoperative period, and there was no consensus on which one was superior to the other.[5] Sedation levels according to the OAA/S scale were classified as follows; 5 = easily responds to a name spoken in a normal tone, 4 = lethargic response to a name spoken in a normal tone, 3 = response only after the name is spoken out loud or repeatedly, 2 = response after shaking, 1 = response only after trapezius contraction, 0 = does not respond to painful trapezius compression.[6]

The Verbal Rating Scale (VRS) was used to determine the severity of pain in the perioperative period. VRS is a 5-point scale including expressions defining the level of pain intensity (no pain, mild pain, moderate pain, intense pain and maximum pain).[7] The Visual Analogue Scale (VAS) was used to determine the pain intensity in the postoperative period. The pain score is discovered by measuring the distance (mm) on the 100-mm line. Pain level was classified as follows; no pain (0–4 mm), mild pain (5–44 mm), moderate pain (45–74 mm), and severe pain (75–100 mm). VAS is the most appropriate tool for assessing pain intensity or intensity in such studies. Because it has simplicity, reliability, validity and ratio scale.[8] And also, nausea VAS ($VAS_{75}$) was used to measure the severity of postoperative nausea, as recommended by Wengritzky et al.[9] Because vomiting and dry retching or nausea are thought to reflect similar physiological processes. Patients scoring 75 mm or more were considered to have clinically significant nausea. Patients were asked to provide a global rating of their nausea intensity using a 100 mm nausea VAS. The limits of the nausea VAS were "no nausea" to "nausea as bad as it possibly could be."

In addition, the surgeon's satisfaction in terms of the patient's sedation level, cooperation, and anesthesia management was evaluated using a questionnaire. The clinician satisfaction questionnaire was also classified as follows: 0: not satisfied, 1: less satisfied, 2: satisfied.[10]

## Study groups and sedation procedure

Eligible patients were randomized into two study groups. Dexmedetomidine group ($n = 40$) included patients who were sedated with dexmedetomidine. Remifentanil group ($n = 40$) included patients who were sedated with remifentanil. Oxygen (4 L/min) was given to each patient through nasal cannula throughout the surgical procedure. All patients received 4 mg ondansetron (Zofer, Adeka, Turkey) to prevent nausea and vomiting. The target sedation level for each patient was determined to be OAS/S score of 3 and the BIS to be 60–80.

In the dexmedetomidine group, dexmedetomidine (Precedex; Pfizer, New York, NY, USA) was administered at a loading dose of 1 μg/kg for 10 minutes before local anesthesia was applied to the eye by the surgeon. During the surgical procedure, it was administered at a dose of 0.4 μg/kg/h infusion as previously reported.[11]

In the remifentanil group, remifentanil (Ultiva, Glaxo SmithKline, Istanbul, Turkey) infusion was started at a dose of 0.05 μg/kg/min, 10 minutes before the start of the surgery as baseline infusion and continued at the same infusion dose throughout the surgical procedure. Study drugs were administered via a volumetric infusion pump (Perfusor Space, B-Braun, Melsungen AG, Hessen, Germany).

After both study drugs were given for 10 minutes, each patient was administered a sub-hypnotic (i.e., 0.5 mg/kg) dose of propofol (Propofol-Lipuro 1%, Braun, Melsungen, Germany). Then, local anesthesia was applied by the surgeon. Peribulbar block and periorbital infiltration application were performed by applying a mixture of lidocaine (Jetokain, Adeka, Istanbul, Turkey) and 1/200,000 adrenaline. After the local anesthetic agent was applied by the surgeon, orbital compression was provided for 5 minutes with maximum pressure to block the eyelid movements. The same surgeon performed surgical procedures of all patients involved in the study. In both study groups, when sedation was not sufficient according to the OAA/S scale (i.e., OAA/S $\geq$ 4), 0.5 mg/kg propofol bolus was administered and the frequency of propofol administered to the groups separately was determined.

When systolic blood pressure dropped below 90 mmHg or mean arterial pressure fell 15% below baseline, 5 mg of ephedrine hydrochloride (ePHEDrine, Hameln Pharma, Gloucester, UK) was administered intravenously. Esmolol (Brevibloc, Baxter Healthcare, Berkshire, UK) infusion was started when the mean arterial pressure increased 15% above the baseline value. When the heart ratio (HR) was below 45 beats/min, 0.5 mg of atropine (AtropinSulfat, Turktıpsan, Ankara, Turkey) was administered intravenously. When the respiratory rate was less than 10 per minute or less than 90% of $SpO_2$, the chin was raised back as an airway opening maneuver. Ephedrine, esmolol, atropine administration, and airway opening maneuver frequencies were also recorded. In cases where bradypnea continued, infusion doses of study drugs were reduced by 50% considering excessive sedation (i.e., OAA/S < 3) (**Figure 1**).

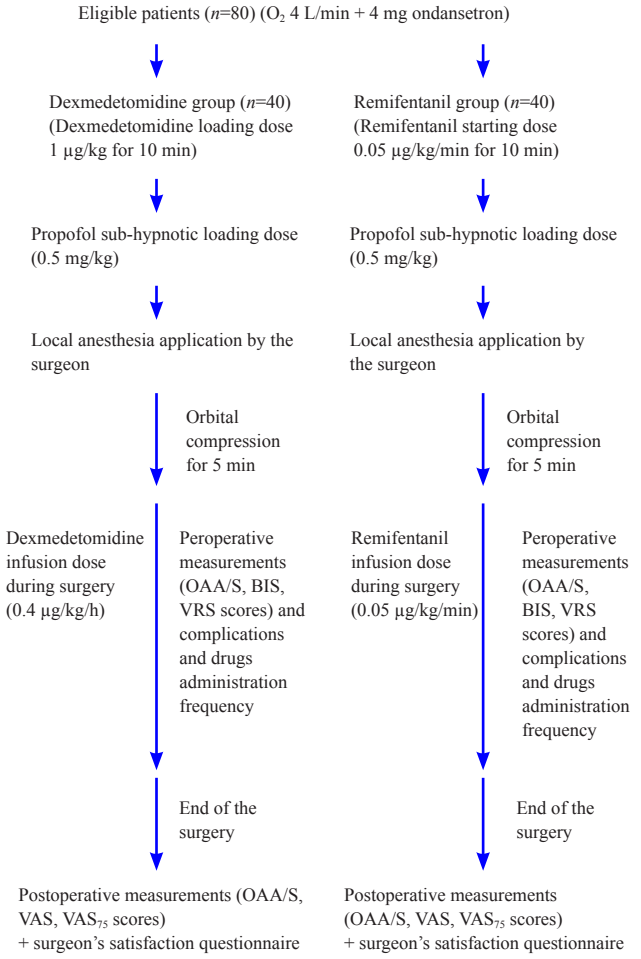


**Figure 1: Flow chart of the study.**
Note: OAA/S: Observer Assessment Warning/Sedation Scale; VAS: Visual Analogue Scale; $VAS_{75}$: nausea Visual Analogue Scale.

### Follow-up times

The follow-up times of the patients were determined as; before the drugs start to be infused "before induction" , after the study drugs were infused for 10 minutes and the propofol loading dose was administered "after induction", after local anesthesia and orbital compression procedure (0 minute), at the beginning of the surgical procedure ($5^{th}$ minute), during the perioperative period ($10^{th}$, $15^{th}$, $20^{th}$, $25^{th}$, $30^{th}$ minute), at the end of the surgical procedure ($35^{th}$ minute) and at the postoperative period ($40^{th}$, $45^{th}$ minute).

### Sample size estimation

Based on a previous study,[12] we calculated that there should be at least 30 patients in each group to be able to detect a 10% difference between groups, at 90% power, and 5% significance ($\alpha = 0.05$, $\beta = 0.90$) by using Minitab 16 statistical software (Minitab Inc., State College, PA, USA). Considering possible losses, 40 patients were planned to be included in each group.

### Randomization

Each patient was randomly assigned to one of two parallel groups in a 1:1 ratio by the resident using a number and letter randomizer (Microsoft Excel, Redmond, WA, USA). The patients' data included in the study were collected by an anesthesia technician blinded to the sedation drugs used in the study groups.

### Statistical analysis

SPSS 20.0 (IBM SPSS Statistics, Chicago, IL, USA) package program was used for the analysis of the data. Shapiro-Wilk test was used to determine the distribution of variable groups in the comparisons. Descriptive statistics were expressed as mean [± standard deviation (SD)] for continuous variables, and nominal variables were expressed as the number (percentage). Independent samples *t*-test was used for the data showing the normal distribution in the comparisons of differences between two different drug applications, and the Mann-Whitney *U* test was used for the data not showing normal distribution. Also, respiration rates, $SpO_2$, NIBP, HR, OAA/S, BIS, VAS, and VRS scores were evaluated with repeated-measures analysis of variance and Friedman test as well as Bonferroni correction as a *post hoc* test. The gender of the patients, dose increase due to insufficient sedation, nausea, and pain severity scores, as well as clinician satisfaction questionnaire scores, were compared with the Chi-square test. A $P$ value of $< 0.05$ was considered significant.

## Results

### Demographic and surgery duration

There was no significant difference between the two groups in terms of demographic data and surgery duration (**Table 1**). Also, there was no significant difference between the two groups in terms of baseline NIBP and HR.

**Table 1: Comparison of demographic data and surgery duration data in geriatric patients undergoing outpatient cataract surgery**

| | Dexmedetomidine group (*n*=40) | Remifentanil group (*n*=40) | *P*-value |
|---|---|---|---|
| Age (yr) | 68.0±5.7 | 67.0±5.8 | 0.956 |
| Body mass (kg) | 69.0±7.7 | 72.0±11.2 | 0.890 |
| Height (cm) | 161.0±4.0 | 161.0±5.9 | 0.828 |
| Surgery time (min) | 24.0±11.7 | 23.0±17.0 | 0.052 |

Note: Data are expressed as mean ± SD, and were analyzed by independent samples *t*-test.

### $SpO_2$ levels

It was observed that the dexmedetomidine group had statistically significantly higher $SpO_2$ levels compared to the remifentanil group at the $5^{th}$, $10^{th}$, $15^{th}$, $20^{th}$, $25^{th}$, and $35^{th}$ minutes of the perioperative period and at the $40^{th}$ and $45^{th}$ minutes of the postoperative period ($P < 0.05$; **Figure 2**).

### Respiratory rates

And also, respiratory rates in the dexmedetomidine group were higher than those in the remifentanil group at the 0, $5^{th}$, $10^{th}$, $15^{th}$, and $20^{th}$ minutes ($P < 0.05$; **Figure 3**).

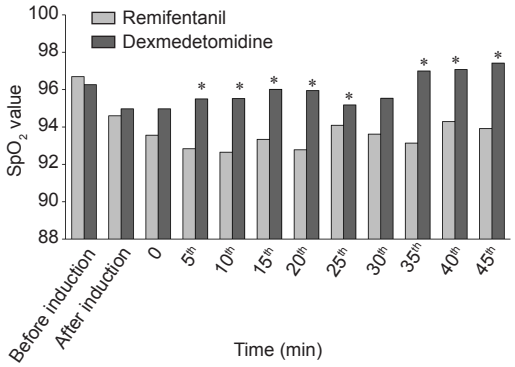


**Figure 2: The comparison of the $SpO_2$ values over time with dexmedetomidine and remifentanil use in geriatric patients undergoing outpatient cataract surgery.**
Note: Data are expressed as mean ($n$ = 40), and were analyzed by repeated-measures analysis of variance or Friedman test followed by Bonferroni correction. *$P$ < 0.05, *vs.* dexmedetomidine group. $SpO_2$: Peripheral oxygen saturation. 0: After local anesthesia and orbital compression procedure; 5th: at the beginning of the surgical procedure; 10th, 15th, 20th, 25th, 30th: during the perioperative period; 35th: at the end of the surgical procedure; 40th, 45th: at the postoperative period.

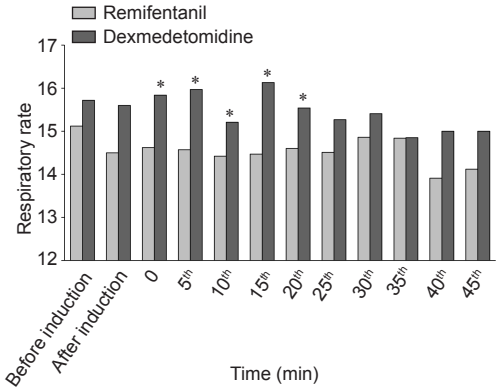


**Figure 3: The comparison of the respiratory rates depending on time with dexmedetomidine and remifentanil use in geriatric patients undergoing outpatient cataract surgery.**
Note: Data are expressed as mean ($n$ = 40), and were analyzed by repeated-measures analysis of variance or Friedman test followed by Bonferroni correction. *$P$ < 0.05, *vs.* dexmedetomidine group. 0: After local anesthesia and orbital compression procedure; 5th: at the beginning of the surgical procedure; 10th, 15th, 20th, 25th, 30th: during the perioperative period; 35th: at the end of the surgical procedure; 40th, 45th: at the postoperative period.

## OAA/S scores

OAS/S scores detected during the whole perioperative period were lower in the dexmedetomidine group than the remifentanil group, although it was not statistically significant ($P$ > 0.05). But, the OAA/S values detected at the 40th and 45th minutes of the postoperative period were significantly greater in the dexmedetomidine group than the remifentanil group ($P$ < 0.05). A statistically significant difference was found between the two groups in terms of OAS/S scores after induction ($P$ < 0.05; **Figure 4**).

## BIS values

BIS values measured during the whole perioperative period were lower in the dexmedetomidine group than the remifentanil group after induction, 0, 5th, 10th, 15th, 20th, 25th, and 45th minutes (P < 0.05; **Figure 5**).

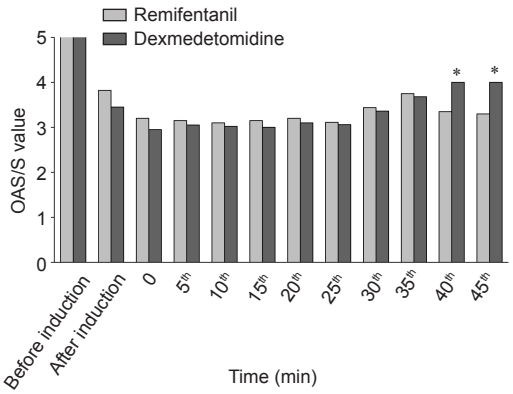


**Figure 4: The comparison of OAS/S scores depending on time with dexmedetomidine and remifentanil use in geriatric patients undergoing outpatient cataract surgery.**
Note: Data are expressed as mean ($n$ = 40), and were analyzed by repeated-measures analysis of variance or Friedman test followed by Bonferroni correction. *$P$ < 0.05, *vs.* dexmedetomidine group. OAS/S: Observer Assessment Warning/Sedation Scale. Lower OAA/S scale values mean deeper sedation. 0: After local anesthesia and orbital compression procedure; 5th: at the beginning of the surgical procedure; 10th, 15th, 20th, 25th, 30th: during the perioperative period; 35th: at the end of the surgical procedure; 40th, 45th: at the postoperative period.

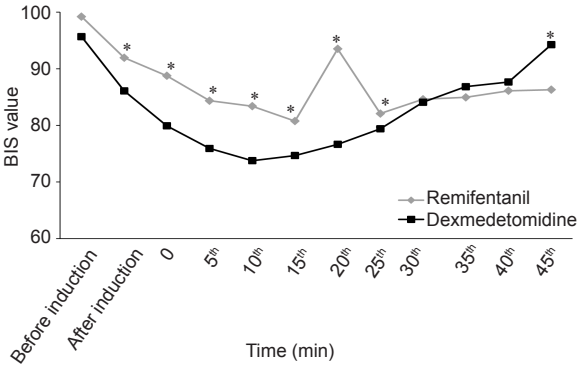


**Figure 5: The comparison of BIS values depending on time with dexmedetomidine and remifentanil use in geriatric patients undergoing outpatient cataract surgery.**
Note: Data are expressed as mean ($n$ = 40), and were analyzed by repeated-measures analysis of variance or Friedman test followed by Bonferroni correction. *$P$ < 0.05, *vs.* dexmedetomidine group. Lower BIS values mean deeper sedation. 0: After local anesthesia and orbital compression procedure; 5th: at the beginning of the surgical procedure; 10th, 15th, 20th, 25th, 30th: during the perioperative period; 35th: at the end of the surgical procedure; 40th, 45th: at the postoperative period; BIS: bispectral index.

## VRS scores

Although the dexmedetomidine group had lower VRS scores evaluating pain intensity in the whole perioperative period compared with the remifentanil group, the statistical difference was found between the groups only at the 10th, 15th, 20th, 25th, and 30th minutes ($P$ < 0.05; **Figure 6**).

## VAS scores

The VAS scores evaluating pain intensity in the postoperative period measured at the 40th and 45th minutes were significantly lower in the dexmedetomidine group than the remifentanil group ($P$ < 0.05; **Figure 7**).

## $VAS_{75}$ scores

The $VAS_{75}$ scores evaluating postoperative nausea in the dex-

medetomidine group were found to be statistically significantly lower than those in the remifentanil group at the 40th and 45th minutes ($P < 0.05$; **Figure 8**).

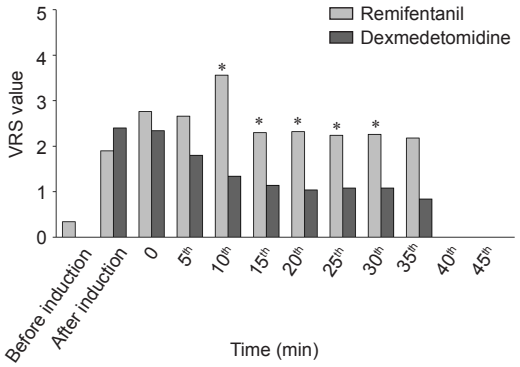


**Figure 6: The comparison of VRS scores evaluating pain intensity in the perioperative period with dexmedetomidine and remifentanil use in geriatric patients undergoing outpatient cataract surgery.**
Note: Data are expressed as mean ($n$ = 40), and were analyzed by repeated-measures analysis of variance or Friedman test followed by Bonferroni correction. *$P$ < 0.05, *vs.* dexmedetomidine group. VRS: Verbal Rating Scale. Lower VRS scores mean less severe pain in the perioperative period. 0: After local anesthesia and orbital compression procedure; 5th: at the beginning of the surgical procedure; 10th, 15th, 20th, 25th, 30th: during the perioperative period; 35th: at the end of the surgical procedure; 40th, 45th: at the postoperative period.

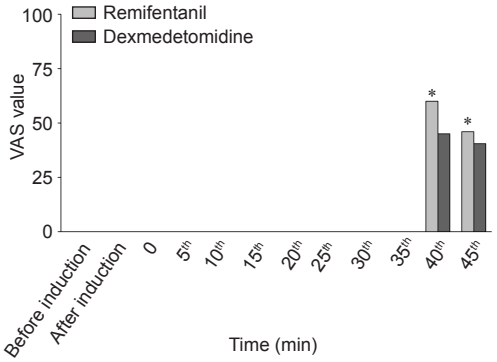


**Figure 7: The comparison of VAS scores evaluating pain intensity in the postoperative period with dexmedetomidine and remifentanil use in geriatric patients undergoing outpatient cataract surgery.**
Note: Data are expressed as mean ($n$ = 40), and were analyzed by repeated-measures analysis of variance or Friedman test followed by Bonferroni correction. *$P$ < 0.05, *vs.* dexmedetomidine group. VAS: Visual Analogue Scale. Lower VAS scores mean less severe pain in the postoperative period. 0: After local anesthesia and orbital compression procedure; 5th: at the beginning of the surgical procedure; 10th, 15th, 20th, 25th, 30th: during the perioperative period; 35th: at the end of the surgical procedure; 40th, 45th: at the postoperative period.

### Complications and drugs administration frequency

There was no statistically significant difference between the groups in terms of the development of bradycardia, the total frequency of propofol, and ephedrine administration ($P$ > 0.05). However, both the development of respiratory depression ($P$ = 0.02) and the esmolol administration frequency ($P$ = 0.15) were found to be greater in the remifentanil group compared with the dexmedetomidine group (**Table 2**).

### Clinician's satisfaction questionnaire

In terms of the satisfaction of the clinician performing cataract surgery, it was evaluated that dexmedetomidine was superior to remifentanil ($P$ = 0.015; **Table 3**).

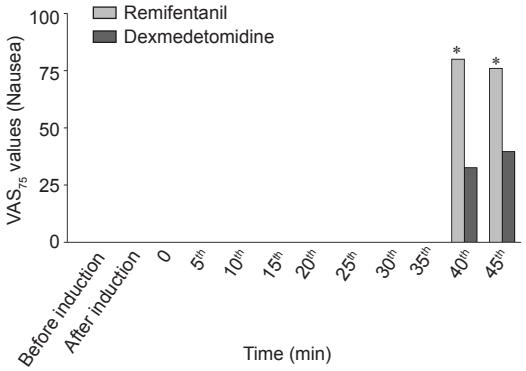


**Figure 8: The comparison of $VAS_{75}$ values evaluating postoperative nausea depending on time with dexmedetomidine and remifentanil use in geriatric patients undergoing outpatient cataract surgery.**
Note: Data are expressed as mean ($n$ = 40), and were analyzed by repeated-measures analysis of variance or Friedman test followed by Bonferroni correction. *$P$ < 0.05, *vs.* dexmedetomidine group. $VAS_{75}$: Visual Analogue Scale for assessment of postoperative nausea. Lower $VAS_{75}$ scores mean less severe nausea in the postoperative period. 0: After local anesthesia and orbital compression procedure; 5th: at the beginning of the surgical procedure; 10th, 15th, 20th, 25th, 30th: during the perioperative period; 35th: at the end of the surgical procedure; 40th, 45th: at the postoperative period.

**Table 2: Comparison of complications and drugs administration frequency in geriatric patients undergoing outpatient cataract surgery**

| | Dexmedetomidine group ($n$=40) | Remifentanil group ($n$=40) | $P$-value |
|---|---|---|---|
| Respiratory depression | 0 | 10 (25) | 0.02 |
| Bradycardia | 0 | 2 (5) | 0.494 |
| Propofol administration frequency | 4 (10) | 6 (15) | 0.421 |
| Ephedrine administration frequency | 4 (10) | 8 (20) | 0.348 |
| Esmolol administration frequency | 2 (5) | 11 (27.5) | 0.015 |

Note: Data are expressed as number (percentage) and were analyzed by Chi-square test.

**Table 3: Comparison of clinician's satisfaction questionnaire scores in geriatric patients undergoing outpatient cataract surgery**

| | 0 | 1 | 2 |
|---|---|---|---|
| Dexmedetomidine group | 0 | 6 (15) | 34 (85) |
| Remifentanil group | 4 (10) | 11 (28) | 25 (62) |

Note: 0: Not satisfied, 1: little satisfied, 2: satisfied. Data are expressed as number (percentage) and were analyzed by Chi-square test.

## Discussion

This study, conducted on geriatric patients who underwent cataract surgery, showed that reaching intraoperative target OAA/S values and recovery after the surgical procedure was faster by dexmedetomidine infusion than remifentanil infusion. In addition, it was found that the sedation provided by

dexmedetomidine infusion was both deeper and safer than the sedation provided by remifentanil infusion.

Sedation provided with dexmedetomidine differs significantly from other sedatives by providing an image similar to physiological sleep on the electroencephalogram.[12] When the sedation levels measured by BIS monitoring were compared between the two drugs, deeper sedation levels were provided with dexmedetomidine, and patients developed respiratory depression with remifentanil, which should be given to reach the sedation level at the same BIS values.

During ocular surgery performed with local anesthesia, insufficient deep sedation makes patients prone to the trigeminocardiac reflex development during the surgical procedure. Hence, it was shown that low BIS values measured due to deep sedation during ocular surgery reduce the possibility of developing intraoperative bradycardia in the studies conducted by Yi et al.[13] and Karaman et al.[14]

During ophthalmic surgery, sedation combined with regional anesthesia provides the immobilization of the patients, the ability to cooperate with the patient when necessary, the low-medium intraocular pressure, and a clean surgical area required by the ophthalmologists and the cardiovascular respiratory stabilization required by the anesthesiologists. While regional block provides ocular akinesia and analgesia during the surgical procedure, sedation provides both low intraocular pressure and prevents hypertensive response by increasing patient comfort.[15]

For all these reasons, cataract surgery, one of the most commonly performed ophthalmic surgery procedures, is usually performed with regional anesthesia supported by sedation.[1] However, it is quite difficult for the anesthesiologist to provide sufficient sedation depth and stabilize hemodynamics in geriatric patients.[16] Because drugs used to provide sedation have disadvantages and side effects in geriatric patients.[17,18] For example, propofol may cause very deep sedation, disorientation, respiratory depression,[17] benzodiazepines may cause confusion, loss of cooperation,[16] opioids may cause respiratory depression, and late recovery.[18]

These side effects due to sedative drugs may prevent safe surgical procedures, delay the operation and lead to hospitalization for a long time.[19] During the infusion of remifentanil, an opioid frequently used for sedation, potential side effects on the respiratory system should be taken into account when titrating the dose to achieve the desired level of sedation.[20] Because, although remifentanil is an opioid that stands out with its rapid onset of action and rapid end-of-action, its side effects on the respiratory system are frequently seen depending on the dose used for sedation.[20]

The severe side effects of drugs used for sedation on geriatric patients led to the emergence of dexmedetomidine, a selective α-agonist that provides sedation but does not cause respiratory depression.

In our study, although deep sedation levels were reached with dexmedetomidine infusion, no respiratory depression occurred. Moreover, the oxygen saturation levels of the patients who were given remifentanil infusion were found to be lower than the oxygen saturation levels of the patients who were infused with dexmedetomidine in all periods. The statistical difference between the groups in terms of oxygen saturation values, especially in the first and last stages of the surgery, shows that the level of sedation provided by dexmedetomidine infusion is achieved by using a deeper, safer, and less amount of drug compared to the sedation level provided by remifentanil infusion. Besides, patients sedated with dexmedetomidine infusion recovered much more quickly in the postoperative period than patients sedated with remifentanil infusion.

In parallel with our study, Üzümcügil et al.[21] compared propofol-fentanyl with dexmedetomidine and showed that dexmedetomidine does not cause hemodynamic variability, especially in geriatric patients. In another study, it was shown that remifentanil reduces the NIBP and HR more than dexmedetomidine and requires more time to restore hemodynamic equilibration.[22]

A study conducted by Candiotti et al.[23] compared dexmedetomidine infusion and midazolam-fentanyl infusion. Although deeper sedation levels were achieved in the dexmedetomidine group, less respiratory depression was found in the dexmedetomidine group compared with the midazolam-fentanyl group.

Apart from respiratory depression, another complication that occurs frequently as an opioid infusion used for sedation is nausea and vomiting.[24] As a matter of fact, we evaluated the severity of postoperative nausea using $VAS_{75}$ scale, and more severe nausea occurred in patients in the remifentanil group compared to the patients in the dexmedetomidine group. In another study supporting our study, perioperative dexmedetomidine infusion and remifentanil infusion were compared in terms of postoperative nausea and vomiting in patients who underwent thyroidectomy surgery, and more nausea and vomiting were detected in patients in the remifentanil group.[25] A recent meta-analysis supports our results, it was stated that opioid-used anesthesia management was associated with higher nausea-vomiting rates than opioid-free anesthesia management.[26]

When the groups were compared in terms of surgeon satisfaction, higher satisfaction scores were obtained in patients who received dexmedetomidine infusion than patients who received remifentanil infusion. When the reason for this was questioned, it was established that the presence of deep sedation in patients who received dexmedetomidine infusion, the presence of cooperation, the absence of respiratory depression, and the hemodynamic stability of the patients were determinative for surgeon satisfaction. In another study supporting our study, propofol infusion and dexmedetomidine infusion used for sedation in patients undergoing ocular surgery were compared, and it was found that patients who received dexmedetomidine had higher surgeon satisfaction.[27]

In our study, the postoperative VAS scores evaluating pain intensity in the postoperative period were compared between the two groups. Patients who received remifentanil infusion had greater VAS scores and a higher need for analgesia than patients who received dexmedetomidine. In another study supporting the results of our study, dexmedetomidine infusion decreased VAS scores more than remifentanil infusion and further reduced the need for postoperative analgesia.[25] In another study, intraoperative dexmedetomidine infusion has been shown to reduce the need for postoperative analgesia in patients undergoing abdominal surgery.[28] However, in another study, it was shown that the effect of perioperative dexmedetomidine on postoperative analgesic consumption and postop-

erative recovery in patients underwent lateral thoracotomy for esophageal cancer was unsuccessful.[29]

In another study, it was thought that the possible mechanism of postoperative pain reduction with dexmedetomidine infusion was to inhibit the release of substance-P due to the activation of $\alpha_2$ adrenoceptors.[30] However, Cortinez et al.[31] claimed that dexmedetomidine was not actually a good analgesic as remifentanil and that the low VAS scores measured in the postoperative period in patients receiving dexmedetomidine were due to a different mechanism.

The limitation of our study was that the anesthesiologist was not blinded to the drugs during the study since the duration of action of dexmedetomidine and remifentanil was different from each other. However, all data were collected by an anesthesia technician who was blinded to the drugs and study groups.

As a result of our study, dexmedetomidine was found to be superior to remifentanil in terms of sedation quality, hemodynamic stability, surgeon satisfaction, and low complication rate in geriatric patients undergoing an outpatient surgical procedure. We believe that dexmedetomidine is an effective and safe alternative drug that can be used for sedation in elderly patients in terms of patient safety and surgeon and anesthesiologist satisfaction.

**Author contributions**

Conceiving and designing the study; collecting the data; analyzing and interpreting the data: 'CK, NOC, SD, OO; writing the manuscript or providing critical revisions that are important for the intellectual content; CK, NOC, OO; approving the final version of the manuscript; NOC, OC, OO.

**Conflicts of interest**

The authors declare that they have no conflict of interests. There is no financial sponsor or financial disclosure. Dr. Cem Kaya was presented as a thesis at the Hacettepe University Faculty of Medicine, Department of Anesthesiology and Reanimation.



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