

The effect of dexmedetomidine on cognitive function and anxiety in middle-ear surgery

Orta kulak cerrahisinde uygulanan deksmedetomidinin kognitif fonksiyonlar ve anksiyete üzerine etkisi

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Summary

Aim: Controlled hypotension has been used commonly during surgical procedures to reduce intraoperative hemorrhage. However, it can be detrimental to cognitive functions. This study is a prospective trial conducted to compare the effects of remifentanil alone and dexmedetomidine supplemented with remifentanil infusions on cognitive function and anxiety.

Materials and Methods: Forty patients scheduled for tympanoplasty were allocated randomly into groups to receive either remifentanil (1µg kg⁻¹ loading; maintenance, 0.25-0.5 µg kg⁻¹ min⁻¹) or dexmedetomidine combined with remifentanil infusion (1 µg kg⁻¹ dexmedetomidine loading; maintenance, 0.5 µg kg⁻¹ h⁻¹ dexmedetomidine and 0.25-0.5 µg kg⁻¹ min⁻¹ remifentanil). Hemodynamic changes, opioid requirement, bleeding, recovery time, cognitive functions and anxiety scores were recorded.

Results: Dexmedetomidine combined with remifentanil was found to have the same effect as remifentanil alone on hemodynamics. The remifentanil group was associated with significantly shorter recovery time. A mini-mental status test at 30 and 120 min and the Trieger dot test at 30 and 60 min in the remifentanil group were better than the other group whereas the Digit symbol substitution test and anxiety scores were similar in both postoperatively. The patients in the dexmedetomidine group had only lower anxiety scores postoperatively according to baseline values.

Conclusion: Remifentanil was more advantageous in middle ear surgery as it was associated with a shorter recovery time and earlier recovery of cognitive functions compared with the dexmedetomidine group.

Key Words: Controlled hypotension, remifentanil, dexmedetomidine, cognitive function, anxiety.

Özet

Amaç: Kontrollü hipotansiyon, intraoperatif kanamayı azaltmak amacıyla cerrahi operasyonlar sırasında sıklıkla kullanılır. Ancak, kontrollü hipotansiyon kognitif fonksiyonlar üzerine zararlı olabilir. Bu prospektif çalışma, sadece remifentanil infüzyonu ile deksmedetomidin ve remifentanilin birlikte infüzyonlarının kognitif fonksiyonlar ve anksiyete üzerine etkilerini karşılaştırmak amacıyla yapıldı.

Gereç ve Yöntem: Timpanoplasti uygulanacak 40 hasta, remifentanil (1µg kg⁻¹ yükleme; 0.25-0.5 µg kg⁻¹ dk⁻¹ infüzyon) ya da deksmedetomidin ile remifentanil infüzyonlarının birlikte uygulandığı (1 µg kg⁻¹ deksmedetomidin yükleme ve bunu takiben 0.5 µg kg⁻¹ sa⁻¹ deksmedetomidin ve 0.25-0.5 µg kg⁻¹ dk⁻¹ remifentanil infüzyonu) 2 gruptan birisine randomize edildi. Hastaların operasyon süresince hemodinamik değişimleri, opiyat gereksinimi, kanama, operasyon sonrası derlenme zamanı, kognitif fonksiyonlar ve anksiyete skorları kaydedildi.

Bulgular: Hemodinamik değişimler açısından deksmedetomidine ile remifentanil infüzyonu uygulanan grup ile sadece remifentanil infüzyonu uygulanan grupların benzer etkiye sahip oldukları bulundu. Derlenme zamanı remifentanil grubunda belirgin olarak kısaydı. Yine bu grup hastalarda operasyon sonrası 30 ve 120.dk da Mini-mental test, 30 ve 60.dk da ise Trieger dot testi sonuçları daha iyi bulunurken Digit symbol substitution testi ve anksiyete skorları açısından her iki grupta benzer sonuçlar elde edildi. Deksmedetomidin uygulanan hastaların anksiyete skorları sadece bazal değerlere göre daha düşüktü.

Sonuç: Orta kulak cerrahisinde, deksmedetomidin ile karşılaştırıldığında kısa derlenme zamanı ve kognitif fonksiyonların erken düzelmesi nedeniyle remifentanil daha avantajlı bulundu.

Anahtar Sözcükler: Kontrollü hipotansiyon, remifentanil, deksmedetomidin, kognitif fonksiyonlar, anksiyete.

Introduction

Controlled hypotension, which reduces bleeding, has been used for a long time to obtain better exposure during operations performed under microscope (1, 2). It is defined as a reduction of the systolic blood pressure to 80-90 mmHg, a reduction of mean arterial pressure (MAP) to 50-65 mmHg or a 30% reduction of baseline MAP (3). Several pharmacological agents, including beta-adrenergic receptor antagonists, calcium channel blockers, volatile anesthetics, esmolol, propofol, remifentanil and dexmedetomidine are used for controlled hypotension (1-4). Particularly, dexmedetomidine and remifentanil are rapidly acting drugs with a short duration of action that can be titrated to obtain a moment-to-moment control of arterial pressure (1).

Hypotension may cause cognitive deficits, and such changes have been used to investigate the role of cerebral perfusion (5). Cognitive functions are also affected after general anesthesia to a varying degree. The brain as a whole is not affected to the same degree by anesthetics, but those specific brain regions (and particular cognitive processes mediated by these regions) are more sensitive to anesthesia and sedation than others (6). Delayed physical and emotional rehabilitation may postpone hospital discharge and return to work (7). In ambulatory surgery, it is important to use drugs with short onset and duration of effect, resulting in quick recovery and the possibility of earlier discharge from the day surgical unit (8). Moreover, patients who await surgery usually suffer from varying degrees of fear and anxiety. This anxiety is influenced by the uncertainty of the impending anesthetic and surgical procedures, past experience, patient's personality, intra and postoperative pain. It also may adversely influence anesthetic induction and patient recovery, as well as decrease patient satisfaction with the perioperative experience (9). In this study, we also investigated patients' anxiety levels as well as cognitive and psychomotor functions since dexmedetomidine has an anxiety relieving effect.

In the literature, there are few studies in which dexmedetomidine is compared to remifentanil for controlled hypotension and the effects of these drugs on cognitive function are not evaluated (1,10,11). In our clinic, we routinely use remifentanil for providing hypotension during middle-ear surgery in order to benefit both from its analgesic effect and also from the middle ear blood flow decrease (3). While planning this study,

we determined that in studies using dexmedetomidine infusion for controlled hypotension in order to reach a target MAP level, the level was higher than ours (2), this drug was used in higher doses (1) or required additional opioid (2, 11). Therefore, our study protocol was intended to give the dexmedetomidine applied group easily titrated remifentanil infusion instead of bolus dosing for better hemodynamic stability. This study tested the hypothesis of whether dexmedetomidine or remifentanil, used as adjuncts for controlled hypotension, can affect cognitive function recovery characteristic and anxiety postoperatively.

Materials and Methods

After the ethics committee approval and informed consent, 40 healthy high-school-graduate male and female ASA physical status I and II patients, aged 18-55 years, scheduled to undergo elective tympanoplasty were included in this study. Exclusion criteria for potential subjects were a history of a significant cardiac, pulmonary, hepatic or renal disease, chronic drug or alcohol abuse, disabling neuropsychiatric disorders, morbid obesity, pregnancy, hypersensitivity to anesthetic drugs, hypertension (systolic blood pressure ≥ 150 mmHg) and bradycardia (heart rate < 50 beats min^{-1}).

The day before surgery, psychomotor state and cognitive function were evaluated with MMST (Mini-Mental State Test), DSST (Digit symbol substitution Test) and TDT (Trieger Dot Test). In addition, State-Trait Anxiety Inventory scale (STAI) was performed to measure the level of anxiety (12,13). The MMST is a screening test to quantitatively assess cognitive deterioration by questions on orientation, memory, attention, verbal recall and learning, visual-constructive ability (4). The DSST is the most sensitive of the tests for residual cortical depression by anesthetics, in particular, impairment of information processing performance and the ability to concentrate. The DSST is a timed test that presents the subject with a chart of eight rows of digits in random sequence. A key of the nine numerical digits and their corresponding symbols is provided. The subject's task is to replace the digit with its corresponding symbol. The number of correct substitutions within a 60s period is tallied. In the TDT, patients are asked to connect dots within 60s; missed dots and the distance line-dot (mm) are noted (13, 14). The STAI consists of 20 questions that determine how the respondents "feel right now". The score may vary from a minimum of 20 to a maximum of 80 (12).

Premedication was not prescribed to any patients. Prior to being transferred to the operation room, baseline MAP and heart rate (HR) were calculated as the mean of the three recordings in the ward. On arrival in the operating room, the patients' heart rate, blood pressure (systolic, diastolic and mean arterial blood pressure), and oxygen saturation were monitored by electrocardiography (ECG), non-invasive blood pressure monitor and pulse oximetry (Datex-Ohmeda, Helsinki, Finland), respectively. Using a computerized random generation program, patients were randomized to receive either remifentanyl (Group R, n=20) or dexmedetomidine combined with remifentanyl (Group RD, n=20). Lactated Ringer's solution, with a rate of $10 \text{ ml kg}^{-1}\text{h}^{-1}$, was started through an 18-gauge (G) intravenous (i.v.) cannula which was inserted in the right hand. The patients in Group R received an infusion of $1 \mu\text{g kg}^{-1}$ over 1 min before anesthesia induction followed by $0.25\text{-}0.5 \mu\text{g kg}^{-1}\text{min}^{-1}$ continuous infusion throughout the operation. Group RD received a loading dose of dexmedetomidine $1 \mu\text{g kg}^{-1}$ over 10 min before anesthesia induction followed by a continuous infusion at a rate of $0.5 \mu\text{g kg}^{-1}\text{hr}^{-1}$ dexmedetomidine and $0.25\text{-}0.5 \mu\text{g kg}^{-1}\text{min}^{-1}$ remifentanyl. Anesthesia was induced with propofol 2 mg kg^{-1} and atropine 0.01 mg kg^{-1} , and endotracheal intubation was facilitated with vecuronium 0.1 mg kg^{-1} and then maintained in both groups with sevoflurane at 0.5-1 MAC (end-tidal) in 50% oxygen/air. Patients were mechanically ventilated, adjusted to provide an end-tidal CO_2 (ETCO_2) pressure of 32-36 mmHg, while the body temperatures of the patients were maintained at 36-36.5°C. After anesthesia induction, arterial blood pressures of all the patients were continuously monitored invasively throughout the surgery due to controlled hypotension via a 20 G catheter inserted into the radial artery of the left hand. Lactate concentration was measured by arterial blood gas analyzer after induction, at 60 min and at the end of surgery. The remifentanyl infusion rates were then titrated to maintain mean arterial pressure of 55 to 65 mmHg during operation in both groups. Sevoflurane concentration and dexmedetomidine infusion rate were kept unchanged throughout the course. In both groups, signs of inadequate anesthesia (increase in MAP or $\text{HR}>20\%$) were treated by increasing remifentanyl infusion rate. Esmolol (bolus, i.v.) was planned to be administered if these target limits could not be achieved. A heart rate of less than $50 \text{ beats min}^{-1}$ was treated by decreasing the dosage of remifentanyl and administering atropine of $10 \mu\text{g kg}^{-1}$. If necessary, while a MAP of less than 55 mmHg was treated with intravenous fluids, decreasing the remifentanyl infusion and administering ephedrine 5 mg intravenously.

Patient and surgical characteristics, remifentanyl and dexmedetomidine consumption were recorded at the end of surgery. HR and MAP were measured continually during surgery but were recorded before and after intubation and at 10-min intervals. The amount of bleeding during the operation was assessed by a 6-point scale (0=no bleeding, 1=mild bleeding-no need of blood aspiration, 2=mild bleeding-occasional aspiration necessary. Clear surgical field, 3=moderate bleeding-frequent aspiration necessary. Bleeding closes surgical field a few seconds following aspiration, 4=moderate bleeding-frequent aspiration necessary. Bleeding closes surgical field right after aspiration, 5= excessive bleeding-continuous aspiration necessary. Bleeding appears faster than aspiration. Surgical field is closed and surgery is not possible). Scores ≤ 2 were considered to be an optimal surgical condition (4). Dexmedetomidine and remifentanyl infusions were stopped 5-10 minutes before the end of surgery. Sevoflurane was discontinued before the completion of surgical suturing and patients were ventilated with 100% oxygen at 5 L min^{-1} . Following a spontaneous recovery, a combination of atropine 0.02 mg kg^{-1} and neostigmine 0.04 mg kg^{-1} was administered i.v. to reverse the neuromuscular block. Recovery time was evaluated with the Aldrete score (a scale of 0-10) in the operating room. Patients who scored ≥ 9 were discharged from the operating room to post-anesthesia care unit (PACU) (15). The patients were monitored in the PACU for 4 hours. All the patients were given 75 mg of intramuscular diclofenac sodium to serve as an analgesic drug. If the visual analogue pain score (VAS, 0-100 mm) was greater than 40 mm, 50 mg of i.v. meperidine was administered. Patients suffering from nausea or vomiting were treated with 4 mg of i.v. ondansetron.

MMS, DSST, TDT and STAI were repeated in the post anesthesia care unit (PACU) at 30th, 60th and 120th min after discontinuation of anesthesia. Before and after surgery, all of the tests related to cognitive and psychomotor performance and level of anxiety were performed by an anesthesiologist.

Statistical analysis

Statistical analyses were performed with the SPSS (SPSS for Windows Release 13.0) Statistical Package and data were shown as a mean and standard deviation (SD), or percentage. Age, weight, height, duration of anesthesia and surgery, time to complete recovery from anesthesia, lactate concentration in arterial blood, cognitive functions and anxiety scores were compared using the Student's *t*-test. The amount of blood, sex and bradycardia were compared in two groups using Chi-Square test and Fisher's exact test. Intraoperative opioid

consumption was compared using the Mann-Whitney U test. MAP and HR were compared using repeated-measures analysis of variance. All post hoc comparisons were performed using Bonferroni. $P < 0.05$ was considered statistically significant.

Results

There was no significant difference between the groups regarding age, weight, height and gender. Durations of anesthesia and operation were similar in both groups (Table-1). Group R patients received a total of $1692.9 \pm 357 \mu\text{g}$ of remifentanyl, whereas those in Group RD received $269.7 \pm 243.7 \mu\text{g}$ of remifentanyl and $131.3 \pm 31.1 \mu\text{g}$ of dexmedetomidine.

Table-1. Demographic data, duration of anesthesia and surgery

	Group RD (n:20)	Group R (n:20)	P values
Age (years)	36.5±10.8	37.6±9.3	0.7
Weight (kg)	70.8±13.9	70.7±10.9	0.9
Height (cm)	167.5±7.1	169±7.5	0.5
Duration of anesthesia (min)	109.2±22.8	109.7±22.9	0.9
Duration of surgery (min)	95.2±21.5	98±22.3	0.6
Gender (M/F)	11/9	12/8	0.7

Data are mean ±SD, M:male, F:female, RD:dexmedetomidine plus remifentanyl, R:remifentanyl, no statistically differences between groups

HR and MAP are presented in (Figure-1). Both HR and MAP were similar in baseline measurements between groups. In an intergroup comparison, HR was significantly lower in Group RD compared with Group R before intubation, after intubation and at 10th min. One patient in Group RD received atropine because of bradycardia. MAP was lower in Group RD than in Group R only before intubation while it was higher at 70th and 80th min ($p < 0.05$). No patients required ephedrine. In an intragroup comparison, HR and MAP significantly decreased in both groups at all time measurements when compared with baseline values, except for HR in Group R after and before intubation and for MAP in Group RD after intubation ($p < 0.05$). Hypotension was effectively obtained in the two groups with a bloodless surgical field, and there was no need for additional use of a potent hypotensive agent.

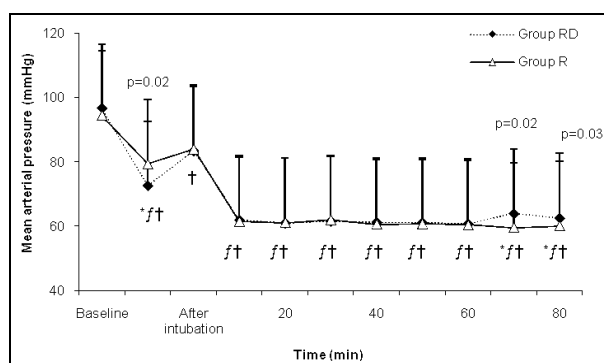
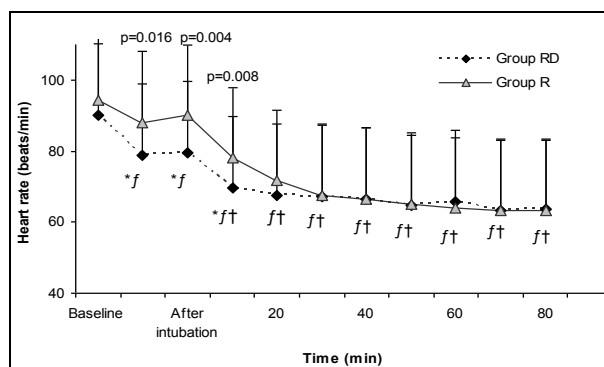


Figure-1. Changes of heart rate and mean arterial pressure in two groups.

RD: dexmedetomidine plus remifentanyl group, R:remifentanyl group, * $p < 0.05$ difference between groups, ^f $p < 0.05$ within Group RD versus baseline value and [†] $p < 0.05$ within Group R versus baseline value.

Table-2. Intraoperative lactate concentration in arterial blood.

	Group RD	Group R	P value
After induction	1.12±0.25	1.08±0.24	0.6
at 60 min	0.94±0.23	0.89±0.21	0.4
End of surgery	0.95±0.28	0.86±0.19	0.2

Data are mean ±SD, RD:dexmedetomidine plus remifentanyl, R:remifentanyl.

Lactate concentration in arterial blood (Table-2) and intraoperative bleeding were similar in both groups (Bleeding scores, Group RD:0.9±1.5, Group R:0.4±1, $p = 0.3$). The recovery time (Aldrete score ≥9) was faster in Group R than in Group RD (5.7 ± 1.2 versus 12.7 ± 1.7 , $p < 0.001$).

There were no differences in MMST, TDT, DSST and STAI before anesthesia between the groups. In postoperative period, the MMST scores at 30th and 120th min were statistically better in Group R than in Group RD. The mean STAI score was similar between the groups. However, the scores of patients in Group RD were statistically lower in all measurements compared with preoperative values. There was no difference between the groups for anxiety scores but all the values in Group RD decreased according to baseline (Figure-2)

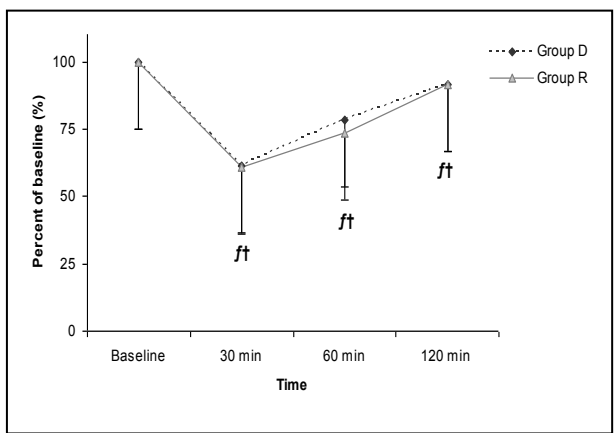
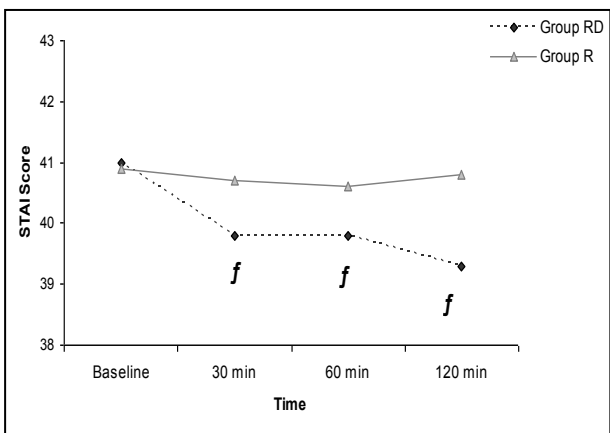
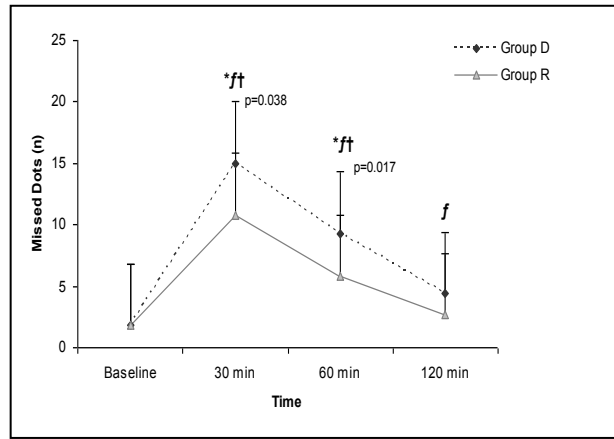
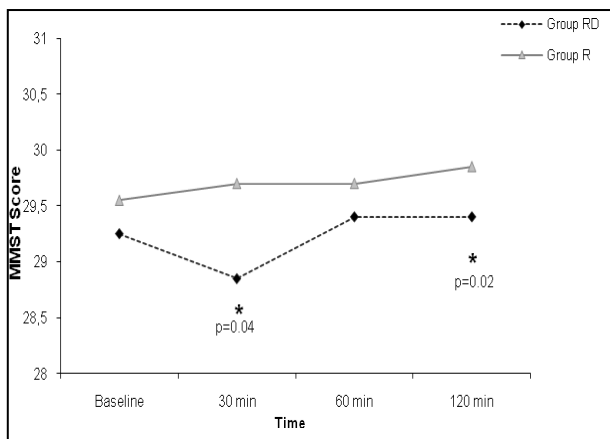


Figure-2. Changes of MMST and anxiety scores.

RD: dexmedetomidine plus remifentanyl, R:remifentanyl. * $p < 0.05$ difference between groups, ^f $p < 0.05$ within Group RD versus baseline value.

Figure-3. Psychomotor test results. Change in the TDT as number of missed dots and change in the DSST expressed according to percent of baseline.

RD:dexmedetomidine plus remifentanyl, R:remifentanyl, * $p < 0.05$ difference between groups, ^f $p < 0.05$ within Group RD versus baseline values and ^f $p < 0.05$ within Group R versus baseline.

In the TDT, a significantly lower error (missed dots) score was recorded in patients receiving remifentanyl alone compared with dexmedetomidin supplemented with remifentanyl at the 30th and 60th min postoperatively but there was no difference at the 120th min between two groups. When compared with the baseline values, TDT scores in Group R at the 30th and 60th min and all measurements in Group RD were significantly lower. The mean TDT score in Group R reached baseline value at the 120th min. For DSST, there were no differences between the groups and DSST scores at all time in both groups were low compared with baseline values (Figure-3).

There were no postoperative complications (respiratory or cardiovascular) in the first 24 hours. At no time did oxygen saturation decrease below 97% in any group in PACU. Two patients in each group complained of nausea and one patient in Group R suffered from vomiting. All five patients were successfully treated with ondansetron.

Discussion

The results of this study have shown that both groups provided controlled hypotension (target MAP) with a low rate of bleeding without the need for additional use of a potent hypotensive agent. However, recovery from anesthesia was significantly faster in the remifentanyl group compared with the dexmedetomidine group. In the postoperative period, MMST and TDT scores in the remifentanyl group were better than dexmedetomidine group; whereas, DSST and anxiety scores were similar.

Hemodynamic Effects and Recovery time

It has been reported that for tympanoplasty, a bloodless surgical field would occur with a MAP of 50±5.1 mmHg (4). However, a previous study reported that hypotension with a mean arterial pressure (MAP) between 50-60 mmHg affects cognition (4,16,17). Therefore, we tried to maintain MAP values of about 60 mmHg in both groups even though the target MAP was between 55 and 65 mmHg in our study protocol. The dexmedetomidine group required an additional dose of 292.5±325.7 µg

remifentanil intraoperatively in order to reach target MAP level. Richa's pilot study is the first to compare the efficacy of dexmedetomidine and remifentanil in providing controlled hypotension during tympanoplasty (1). In this study, although they used a higher dose of continuous infusion dexmedetomidine than ours, remifentanil was found to be more effective on MAP and HR. Furthermore, Celebi et al. (4) found remifentanil to be more effective than esmolol in reaching ideal MAP values and in ensuring good surgical conditions. Durmus et al (2) showed that dexmedetomidine, compared with a placebo, was associated with more stable hemodynamic responses for controlled hypotension in middle-ear surgery. However, they maintained a mean arterial pressure between 60-80 mmHg with the need for fentanyl. In another study, dexmedetomidine was used along with remifentanil to maintain MAP at 50-65 mmHg for spine surgery (11). In our study as well, we provided controlled hypotension (target MAP) by dexmedetomidine supplemented with remifentanil infusion at a small dose. Only in this way, an additional use of a potent hypotensive agent was not required in the dexmedetomidine group. After surgery, the remifentanil alone group was associated with shorter recovery time compared with the other group. Faster recovery time in the remifentanil group most probably was caused by a more rapid elimination of the drug compared with that of dexmedetomidine (13).

Cognitive functions and anxiolytic effects

Under normal conditions, the limits within which cerebral blood flow is assumed to be constant are approximately between a MAP of 60 and 150 mmHg. If blood pressure is below the lower limit, cerebral blood flow falls. Slight reductions of blood pressure can be compensated by autoregulation, but if this compensation fails, brain damage becomes irreversible (17). Postoperative mental changes were caused by the physiological effects of the anesthetic, such as hyperventilation, hypotension or hypoxia, alone or in combination. Hypotension may cause cognitive deficits, and such changes have been used by several groups to investigate the role of cerebral perfusion (5). Newman et al (18) reported that hypotension (MAP<50 mmHg) and rapid rewarming contributed to cognitive deficit in elderly patients after cardiac surgery. However, Eckenhoff et al. (19) tested perception and short-term memory in a group of younger patients and found no difference in the hypotensive group. Furthermore, Jacobi et al (20) showed that three hours after surgery, cognitive function was still impaired in both the hypotensive (MAP of 65 mmHg to 75 mmHg) and normotensive groups without any significant difference between the groups. They reported that controlled hypotension did not cause any cerebral

perfusion deficit and neurological deficits due to a disturbed cerebral autoregulation. Celebi et al (4) demonstrated that MAP between 55-65 mmHg had no effect on cognitive function in the study where esmolol and remifentanil were compared. Although they found statistically significant differences in MMST scores within both groups, the results were similar between the groups. In our study, the decrease observed in MMST scores in dexmedetomidine compared with the remifentanil group can be associated with continuing sedative effects of dexmedetomidine postoperatively. In a study in which remifentanil-propofol, desflurane-N₂O and sevoflurane-N₂O were compared, it was demonstrated that there was a significant delay in recovery of cognitive function during the first hour after anesthesia administration compared with baseline values in all patients, with no difference among the groups in the TDT (13). Remifentanil patients showed a tendency of fewer error responses on the TDT than patients after desflurane and sevoflurane anesthesia administration. At 30 min after termination of anesthesia, significantly more patients in the remifentanil and in the desflurane groups gave correct responses on the DSST than in the sevoflurane group, whereas at 60 min, this was only the case for remifentanil patients. 90 min after anesthesia administration, no difference could be demonstrated on this test among the three groups. Wilhelm et al (21), remifentanil-desflurane compared with fentanyl-desflurane, reported that both tests (DSST and TDT) showed an initial decrease from baseline values as in ours. Even though our dexmedetomidine-treated patients could be easily awakened to perform the testing, their performance was impaired as in the remifentanil group. Arain et al. (22) studied the effects of dexmedetomidine and propofol on the psychomotor performance with DSST and found no differences between groups just as we did. The performance on the DSST at 15 min into the recovery was slightly and significantly decreased from the baseline in both groups. In this study, patients were easily aroused to perform the psychomotor testing (DSST), and their performance was not importantly impaired compared with the propofol treated patients. These authors related this with one of the more interesting characteristics of dexmedetomidine, which is its ability to achieve sedation but preserve patient arousability. We found no difference between the dexmedetomidine and remifentanil groups in DSST scores although the dexmedetomidine group had longer recovery time.

Psychomotor testing was included in our protocol because it provides a more sensitive index of patient recovery than clinical assessment alone (23). The Trieger's dot test is used widely for the assessment of intermediate and late recovery of cognitive and

psychomotor functions after anesthesia (24). A previous study reported the use of dexmedetomidine versus propofol for intraoperative sedation (22). Patients were easily aroused to perform the psychomotor testing (DSST), and their performance was not importantly impaired compared with the propofol-treated patients. This is consistent with one of the more interesting characteristics of dexmedetomidine, which is its ability to achieve sedation but preserve patient arousability.

Patients who received remifentanyl alone performed significantly better in MMTS and TDT than the dexmedetomidine-treated patients, which suggest that patients anesthetized with remifentanyl were likely to be more coordinated and alert after surgery. The quality and speed of recovery with remifentanyl, as assessed by these tests, must be regarded as a consequence of its rapid metabolism (terminal elimination half-life less than 10 minutes) compared with dexmedetomidine, which is eliminated predominantly through hepatic metabolism, with a terminal half-life of 1.2-1.9 hours (25). In addition, our patients in both groups demonstrated a significant delay in recovery of psychomotor function during the first two hours, except for at the 120th min TDT in the remifentanyl group, after anesthesia administration compared with baseline values.

Anxiety has been described as a subjective feeling of tension, apprehension, nervousness and worry and by activation or arousal of the autonomic nervous system (12). Previous studies concluded that VAS and more complex scales such as state-trait anxiety inventory or the hospital anxiety and depression scale are equivalent in their assessment of anxiety before surgery (26, 27). Scores on the state anxiety scale increase in response to physical danger and psychological stress and decrease as a result of relaxation training. Our study demonstrated that patients in the dexmedetomidine group had better anxiety scores postoperatively according to preanesthesia values. However, as we

found no difference between the groups, we believe that merely intraoperative dexmedetomidine infusion failed to prevent anxiety.

There are few limitations in this study. Firstly, we did not use Bispectral Index (BIS) monitoring for the level of anesthesia due to the use of remifentanyl or dexmedetomidine infusions intraoperatively. Secondly, it has been reported that the postoperative analgesic regimen is important in the cognitive performance. In the early postoperative phase; pain, sleep deprivation and residual effects of analgesics or hypnotics and physical limitations can also affect the performance. Accordingly, neuropsychological testing is not recommended if the patient is having pain necessitating administration of opioids (28). Therefore, we applied a non-steroidal anti-inflammatory drug to all of the patients in the study for analgesia and we did not give opioid to any patients who had a low VAS score. Only patients with VAS \geq 40 were treated with opioids. Although the VAS of the patients in both groups was evaluated, we did not record the patients' VAS scores and analgesic drug requirement postoperatively. Finally, the frequency of side-effects (nausea, vomiting, bradycardia etc.) and sedation scores were not recorded. Future studies taking account of these issues might be needed.

In this study, the dose of remifentanyl can be ignored since a small dose remifentanyl is used in the dexmedetomidine group. We found that the recovery of cognitive and psychomotor functions was faster in the remifentanyl group. However, in the between the groups, cognitive function tests were not clinically significant. Rapid postoperative awakening and quicker recovery suggest that remifentanyl infusion alone is more suitable than dexmedetomidine and we believe that dexmedetomidine is not more beneficial or advantageous than remifentanyl alone for controlled hypotension in middle ear-surgery.

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