International Journal of
Anesthetics and Anesthesiology

CLINICAL STUDY

Comparison of the Effects of Target-Controlled Propofol Infusion and General Anesthesia with Desflurane on Postoperative Cognitive Functions in Controlled Hypotensive Anesthesia

Ayse Altun Gezgel[1], Fatih Dogu Geyik[1], Yucel Yuce[1], Ibrahim Gezgel[2], Banu Cevik[1] and Kemal Tolga Saracoglu[1]*

[1]*Department of Anesthesiology and Reanimation, University of Health Sciences Kartal Dr. Lutfi Kirdar Education and Research Hospital, Istanbul, Turkey*

[2]*Department of Anesthesiology and Reanimation, Karabuk University Education and Research Hospital, Karabuk, Turkey*

*Corresponding author: *Yucel Yuce, MD, Associate Professor, Department of Anaesthesiology and Reanimation, Kartal Dr. Lutfi Kirdar Education and Research Hospital, Kartal, Istanbul, Turkey, Tel: 00-90-216-458-30-00, Fax: 00-90-216-352-00-83*

Abstract

Background/aim: We evaluated anesthesia depth, cerebral oxygenation and postoperative cognitive functions with NIRS and BIS monitoring and Mini-Mental State Examination (MMSE) score.

Materials and methods: We studied 60 patients with American Anesthesiologists Association (ASA) I-II, over 18 years of age, with a preoperative MMSE test score of 23 and above. Hemodynamic parameters, BIS and bilateral NIRS values were recorded. The mean arterial pressure (MAP) value was kept between 55-65 mmHg. MMSE test was repeated 1 hour before and 24 hours postoperatively.

Results: The extubation time was shorter. Aldrete recovery score and NIRS values were was higher and blood pressure and heart rate values were lower in the desflurane group. There was a moderate positive correlation between blood pressure values and NIRS in a certain part of the operation in the desflurane group. In the propofol group, 5 patients had a more than 20% decrease in rSO_2. In MMSE test score, there was no decrease in both groups in the preoperative and postoperative period.

Conclusion: We think that, the desflurane group be preferred as a priority with less remifentanil expenditure, lower blood pressure values, higher rSO_2 values, no 20% decrease in rSO_2 values, faster extubation, and statistically significant early recovery.

Introduction

Controlled hypotension is frequently preferred in cases of otolaryngology by reducing bleeding, creating a quality surgical field, increasing operation success, and reducing surgical complications [1]. However, controlled hypotension can disrupt target organ perfusion, causing various side effects. Neurological complications and postoperative cognitive dysfunction (POCD) may occur as a result of developing cerebral hypoperfusion [2]. Although there is no definitive diagnosis of postoperative cognitive dysfunction, it can be diagnosed with various neuropsychiatric tests. In this study, the MMSE test [3] was performed in the preoperative and postoperative period and the development of POCD was evaluated. Cerebral hypoxia was monitored using NIRS monitoring in patients who underwent controlled hypotension with total intravenous anesthesia (TIVA) or balanced general anesthesia, and the effect of anesthesia

methods on postoperative cognitive function change was investigated.

Methods

The study was performed in Otorhinolaryngology operating rooms of Kartal Dr. Lutfi Kirdar Education and Research Hospital with the approval of the local Hospital Ethics Committee (Decision no: 2019/514/157/4 Date: 10.07.2019).

60 patients planned to undergo elective tympanoplasty, mastoidectomy, septoplasty, and functional endoscopic sinus surgery were informed and included in the written consent. ASA I-II patients aged 18 years and older were included in the study. Patients with hypertension disease, using anticoagulant drugs, pregnancy status, neurological or psychiatric disease, preoperative MMSE ≤ 23, BMI ≥ 35, literacy reaction to any anesthetic agent, drug addiction, and illiteracy were not included. The patients were randomly divided into two groups, Group D (desflurane) and Group P (propofol).

MMSE (Test 1) was performed 1 hour before the operation in patients without premedication. Peripheral vascular access was opened in the operating room and hydration was started with 5-10 ml/kg isotonic fluid. Electrocardiogram (ECG), peripheral oxygen saturation (SpO_2), noninvasive blood pressure monitoring were performed on the patients.

Again, NIRS probes were placed right and left on the forehead for right cerebral oxygen saturation follow-up (INVOS 5100C oximeter, Coivden 2-channel right-left). BIS monitoring (Covidien Medtronic) was performed before induction to monitor the depth of anesthesia and adjust the dose of anesthetic drugs. Preoxygenation was performed with 100% O_2 for 2 minutes before induction. All patients received 1 mg/kg lidocaine, 2 mg/kg propofol, 1.5 mcg/kg fentanyl, 0.6 mg/kg rocuronium i.v. Done. The patient was intubated and respiratory support was provided by mechanical ventilation (DraegerPerseus A500).

In the maintenance of anesthesia, ventilation was achieved with 50% O_2 + 50% air mixture, 2 L/min flow with 6-8 ml/kg tidal volume, and 10-14/min respiratory rate. End-tidal CO_2 values were kept between 30-35 mmHg.

Plasma concentration (Cp) in the range of 2-7 mcg/ml according to Marsh model with propofol infusion HCl device (Orchestra Base Primea, Fresenius Kabi) with an average arterial pressure between 55-65 mmHg; remifentanil was given with a manual perfusate (Aitecs 2016) in the dose range of 0.05-0.5 mcg/kg/min. In Group D, desflurane was given with 1-1.3 MAC and remifentanil with a manual perfusate in the dose range of 0.05-0.5 mcg/kg/min.

When the mean arterial pressure is above the target values for more than 5 minutes; In BIS control, remifentanil in 0.05 mcg/kg/min increments; Dose was increased in propofol increments of 0.5 mcg/ml, nitroglycerin 0.1 mg IV done. If OAB is more than 5 minutes below the desired value, the dose of anesthetic drugs was reduced with the same method under BIS control, IV bolus fluid was given, ephedrine 5 mg IV done. If the heart rate was below 45 beats/min for more than 2 minutes, bradycardia was considered and the dose of remifentanil was reduced, if the response was not sufficient, 0.5 mg of atropine IV done.

BIS values were tried to be kept between 40-60. The anesthetic dose was reduced at values below thirty, and the dose was increased at values above 60. In any period, the decrease in NIRS values by more than 20% of basal was considered as the deterioration of cerebral oxygenation and perfusion, and by reducing the dose of anesthetic agent, increasing the OAB value, increasing FiO_2, optimizing the end-tidal CO_2 value and increasing the NIRS values.

Before induction, after induction, after intubation, after extubation and for the first 30 minutes every 5 minutes; After 30 minutes, SAB, DAB, OAB, KTA, SpO_2, end-tidal CO_2, NIRS, BIS, FiO_2, propofol, desflurane, and remifentanil dose were recorded every 15 minutes. Operation time, anesthesia time, controlled hypotension time, extubation time were recorded. After the patient was extubated, the Aldrete score (Test-2) was calculated at 0, 5, and 30 minutes. The surgical field assessment was made by the surgeon using a six-degree Fromme scale (Test-3) with a 15-minute interval. Values of two and below were evaluated as the ideal surgical field.

Desflurane, propofol, and remifentanil infusions were discontinued at the end of the surgery, and extubation times were recorded. Patients were extubated by performing 0.01 mg/kg atropine and 0.03 mg/kg neostigmine intravenously for recurrence. As an analgesic, all patients received 1 mg/kg tramadol and 1gr parol intravenously. In the case of nausea and vomiting, metpamide 10 mg was given intravenously. All patients were transferred from the recovery unit to the service after the Aldrete score was 10. MMSE test was repeated 24 hours postoperatively, and 2 or more decreases in the test score were evaluated as POCD.

Demographic features and collected data of patients were entered into IBM® SPSS® (the Statistical PackagefortheSocialSciences) Statistics version 23.0. Student's t-test was used for comparisons between groups. Pearson chi-square test, if the group is small, Fisher exact test was used for the analysis of qualitative variables. Nonparametric continuous variables were compared using Mann-Whitney U tests.

In group comparisons, a two-way ANOVA test was used. For correlation analysis between parameters, the Pearson correlation coefficient was used, assuming

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Table 1: Demographic characteristics of the patients.

	Total	Group D (n = 30)	Group P (n = 30)	p value
Age (year)	37.8 ± 11.6	36.0 ± 11.4	39.7 ± 11.6	0.212
Gender				
Female	26	12	14	
Male	34	18	16	0.602
Length (cm)	168.4 ± 8.6	167.6 ± 8.5	169.2 ± 8.7	0.486
Weight (kg)	73.8 ± 13.0	73.2 ± 11.9	74.4 ± 14.2	0.718
BMI (kg/m²)	25.8 ± 3.6	25.9 ± 3.1	25.8 ± 4.1	0.933
ASA				
I	24	12	12	1.000
II	36	18	18	
Comorbidity (%)	60.0%	60.0%	60.0%	1.000
Educational status (n. %)				
Primary school	32 (53.3%)	17 (56.7%)	15 (50.0%)	
High school	23 (38.3%)	11 (36.7%)	12 (40.0%)	0.832
Graduate and post graduate	5 (8.4%)	2 (6.6%)	3 (10.0%)	
Surgery time (min)	87.5 ± 38.4	85.4 ± 36.0	89.7 ± 41.1	0.671
Those who have more than 90 minutes of operation (n. %)	29 (48.3%)	16 (53.3%)	13 (43.3%)	0.438
Anesthesia time (min)	106.2 ± 40.3	103.5 ± 39.3	109.0 ± 41.8	0.602
Controlled hypotension time (min)	91.8 ± 40.9	91.2 ± 39.1	92.5 ± 43.3	0.903
Controlled hypotension time more than 90 minutes (n. %)	30 (50.0%)	16 (53.3%)	14 (46.7%)	0.606
Surgery type				
Timpanoplasty	16	10	6	
FESS	14	5	9	0.444
Septoplasty	16	9	7	
Mastoidectomy	14	6	8	

D: desflurane. P: propofol

the data was normally distributed. If the correlation coefficient was negative, there was an adverse relationship between the two variables (an increase in one was associated with a decrease in another). Very weak relationship if coefficient value (r-value) < 0.2, weak relationship if between 0.2-0.4, medium severity relationship between 0.4-0.6, high if between 0.6-0.8 If the relationship is greater than 0.8, it is accepted that there is a very high relationship. P < 0.05 value was considered statistically significant. Also, if the p-value is between 0.05 and 0.099, this value was defined as a trend towards statistical significance (a trend toward).

Results

Of the 60 patients with an average age of 37.8 ± 11.6 years (mean 18-65), 34 were male and 26 were female. The general characteristics of the patients can be seen in Table 1. There was no difference between the groups in terms of demographic characteristics, duration of surgery, duration of anesthesia, duration of controlled hypotension, and type of surgery.

While the mean of preoperative MMSE test for all patients was 27.9 ± 1.3, this value was found to be 28.1 ± 1.4 on average. Preoperative and postoperative MMSE values were similar between the two groups (Preoperative; 27.9 ± 1.4 for the Desfluran group and 28.0 ± 1.2, p = 0.924 for the Propofol group) (Postoperative; 28.2 ± for the Desfluran group 1.4 and 28.1 ± 1.4 for the Propofol group, p = 0.661). When all patients were examined, it was determined that the postoperative MMSE change was -0.2 ± 1.2 (range -4 to +2) compared to the preoperative period. There was no significant difference in MMSE change between the groups (-0.3 ± 1.1 for the Desfluran group; -0.1 ± 1.3 p = 0.534 for the Propofol group). The proportion of patients whose MMSE value decreased by 2 or more was 5% (n = 3). These patients were seen to be in the Propofol group more frequently (16.7% versus 10.0%), but the difference was not significant (p = 0.706).

The mean extubation time for all patients was 8.5 ± 3.2 minutes. Extubation time was shorter in Desfluran group than Propofol group (7.9 ± 1.9 vs. 9.2 ± 4.1), but

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Table 2: Comparison of mean arterial pressure (MAP) differences with pre-induction status at all times.

MAP	Group D Mean ± SD	Group P Mean ± SD	p value
Before induction	91.8 ± 8.2	92.0 ± 11.4	0.935
After induction	73.6 ± 9.3	75.3 ± 9.4	0.487
After intubation	90.9 ± 11.0	89.6 ± 12.5	0.574
5. min	71.9 ± 9.7	68.3 ± 6.3	0.148
10. min	64.1 ± 6.1	64.5 ± 5.4	0.830
15. min	61.9 ± 6.1	61.9 ± 4.2	0.941
20. min	62.0 ± 5.7	62.5 ± 3.2	0.368
30. min	59.7 ± 4.5	62.3 ± 3.2	0.066[*]
45. min	60.2 ± 5.5	63.3 ± 5.6	**0.024**
60. min	59.7 ± 5.3	63.8 ± 3.5	**< 0.001**
75. min	60.5 ± 5.3	64.4 ± 4.8	**0.011**
90. min	61.4 ± 3.5	63.0 ± 2.9	0.189
After extubation	95.8 ± 13.4	90.5 ± 14.3	0.113
MAP	Group D Mean ± SD	Group P Mean ± SD	p value
Before induction - after induction	18.1 ± 10.0	16.7 ± 9.7	0.871
Before induction - after intubation	0.8 ± 12.1	2.4 ± 13.9	0.534
Before induction - 5. minutes	19.8 ± 12.3	23.7 ± 13.6	0.201
Before induction - 10. minutes	27.6 ± 9.6	27.4 ± 12.1	0.641
Before induction - 15. minutes	29.8 ± 9.4	30.1 ± 13.3	0.917
Before induction - 20. minutes	29.7 ± 9.1	29.5 ± 12.0	0.965
Before induction - 30. minutes	32.0 ± 9.0	29.7 ± 11.0	0.336
Before induction - 45. minutes	31.6 ± 8.6	28.6 ± 12.1	0.391
Before induction - 60. minutes	31.6 ± 7.1	28.5 ± 10.8	0.348
Before induction – 75. minutes	36.8 ± 20.8	27.0 ± 11.4	0.162
Before induction – 90. minutes	30.8 ± 9.8	26.3 ± 13.2	0.331
Before induction - after extubation	-4.0 ± 11.1	1.5 ± 12.9	0.143

[*]These values are close to statistical significance. Therefore. it is defined as there is a tendency towards meaningfulness.

P values marked with dark black are statistically significant.

D: desflurane. P: propofol

the difference was not significant (p = 0.125). Aldrete 5 minutes score was 9.4 ± 0.5 and Aldrete 30 minutes score was 9.9 ± 0.1. Aldrete 0 and 5 min scores were statistically significantly higher in the Desfluran group (p < 0.001). Aldrete 0.dk score was 8.7 ± 0.5 in Desfluran group, while 8.2 ± 0.5 in the Propofol group (p < 0.001), Aldrete 5.dk score was 9.8 ± 0.3 in the Desfluran group and 9.1 in the Propofol group It was ± 0.4 (p < 0.001). However, Aldrete 30.dk score was found to be similar in both groups (10.0 ± 0.0 in Desfluran group, 9.9 ± 0.1p = 0.321 in Propofol group).

It was observed that mean arterial pressure (MAP) was significantly different between groups between 45 minutes and 75 minutes (Table 2). In these time frames, OAB was significantly lower in Group D than Group P. There was no difference in other time periods (p > 0.05). In comparisons made with the situation before induction, it was seen that the decrease in OAB did not differ between the groups in all time periods (p > 0.05) (Table 2).

Heart rate (HR) was found to be significantly different between groups between 20 minutes and 90 minutes and even after extubation (Table 3). Between 20 minutes and 90 minutes of these time periods, HR was significantly lower than Group P in Group D, while it increased significantly after extubation. There was no difference in other time periods (p > 0.05). In comparisons made with the situation before induction, the decrease in HR in patients in Group D was found to be significantly higher than Group P at 20 minutes and 90 minutes (p < 0.05) (Table 3).

It was determined that saturation (SpO_2) was not different between groups in any time period. Comparison with pre-induction values was found to be similar among the groups. End-tidal CO_2 remained similar in the groups throughout the operation (p >

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Table 3: Comparison of heart peak (HR) differences with pre-induction status at all times.

HR	Group D Mean ± SD	Group P Mean ± SD	p value
Before induction	84.6 ± 16.8	83.0 ± 17.9	0.459
After induction	81.5 ± 11.9	76.7 ± 14.1	0.085*
After intubation	90.5 ± 12.8	86.3 ±16.5	0.198
5. min	81.1 ± 13.2	81.4 ± 16.8	0.807
10. min	73.9 ± 11.1	78.5 ± 13.6	0.201
15. min	71.1 ± 12.0	76.4 ± 12.4	0.110
20. min	67.9 ± 12.0	75.4 ± 13.1	**0.026**
30. min	62.8 ± 9.1	72.1 ± 13.1	**0.005**
45. min	61.1 ± 9.0	71.2 ± 12.3	**0.001**
60. min	59.0 ± 6.7	70.0 ± 12.8	**< 0.001**
75. min	60.0 ± 11.7	68.8 ± 12.2	**0.003**
90. min	59.8 ± 8.7	66.2 ± 11.0	**0.050**
After extubation	83.1 ± 16.4	75.2 ± 10.8	**0.049**
HR	Group D Mean ± SD	Group P Mean ± SD	p value
Before induction - after induction	3.1 ± 14.2	6.3 ± 12.1	0.424
Before induction - after intubation	-5.8 ± 14.6	-3.3 ± 14.6	0.424
Before induction – 5. minutes	3.4 ± 19.7	1.6 ± 16.9	0.579
Before induction – 10. minutes	10.7 ± 16.3	4.4 ± 16.4	0.162
Before induction – 15. minutes	13.5 ± 17.1	6.5 ± 15.2	0.063*
Before induction – 20. minutes	16.6 ± 18.2	7.6 ± 14.5	**0.016**
Before induction – 30. minutes	21.8 ± 16.9	10.8 ± 14.8	**0.012**
Before induction – 45. minutes	23.5 ± 16.7	11.8 ± 15.1	**0.009**
Before induction – 60. minutes	22.6 ± 14.0	14.3 ± 15.0	**0.040**
Before induction – 75. minutes	21.8 ± 17.0	12.3 ± 17.5	**0.035**
Before induction – 90. minutes	29.8 ± 24.6	14.5 ± 14.7	**0.046**
Before induction - after extubation	1.4 ± 14.9	7.7 ± 13.6	0.162

*These values are close to statistical significance. Therefore. it is defined as there is a tendency towards meaningfulness.

P values marked with dark black are statistically significant.

D: desflurane. P: propofol

Table 4: Comparison of bispectral index (BIS) differences with pre-induction status at all time.

BIS	Group D Mean ± SD	Group P Mean ± SD	p value
Before induction	96.8 ± 1.6	96.5 ± 1.5	0.413
After induction	35.2 ± 8.4	34.1 ± 5.1	0.880
After intubation	44.2 ± 8.4	44.5 ± 4.5	0.947
5. min	40.1 ± 8.0	37.0 ± 5.6	0.073*
10. min	40.0 ± 7.0	37.6 ± 5.6	0.157
15. min	37.5 ± 6.2	37.0 ± 5.0	0.976
20. min	37.4 ± 6.5	36.9 ± 5.7	0.795
30. min	36.7 ± 6.6	34.7 ± 5.1	0.285
45. min	37.1 ± 7.0	35.1 ± 5.1	0.296
60. min	36.9 ± 7.0	36.1 ± 5.7	0.852
75. min	36.6 ± 7.6	37.0 ± 3.4	0.351
90. min	35.0 ± 6.9	37.7 ± 3.8	0.097*
After extubation	82.8 ± 3.6	82.9 ± 5.0	0.835

*These values are close to statistical significance. Therefore. it is defined as there is a tendency towards meaningfulness.

P values marked with dark black are statistically significant.

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0.05). It was determined that the bispectral index (BIS) was not different between the groups in any time period (Table 4) and was similar in their changes.

While the pre-induction, post-induction, post-intubation cerebraloxymeter-left values (NIRS-left) were similar between the groups, it was observed to be statistically significantly higher in Group D from Group 5 to 90 minutes (Table 5). In the comparisons made with the situation before induction, the change in cerebraloxymeter-left values in patients in Group D was found to be significantly higher between the 10 minutes and 90 minutes compared to patients in Group P (p < 0.05) (Table 5).

While the pre-induction, post-induction, and post-intubation cerebraloxymeter-right (NIRS-right) values were similar between the groups, it was observed to be statistically significantly higher in Group D from Group 5 to 90 minutes (Table 6). In the comparisons

made with the situation before induction, the change of cerebraloxymeter-right values in patients in Group D was found to be significantly higher in patients with Group P at 45 minutes and 90 minutes (p < 0.05) (Table 6).

In the Desfluran group; a statistically significant correlation was found between the differences of SAB measurements taken before and after induction and after 20 minutes and 90 minutes after the induction and cerebraloxymeter-left measurement differences. In the propofol group; A statistically significant relationship was found between the differences of SAB measurements taken before and after induction and 60 minutes after the operation and the differences between the cerebraloxymeter-left measurement (Table 7).

In the Desfluran group; a statistically significant relationship was found between the differences of DAB measurements taken before and after induction at the

Table 5: Comparison of regional cerebral oximetry (NIRS-left) differences measured by Near Infrared Spectroscopy (NIRS) with pre-induction status at all times.

NIRS-left	Group D Mean ± SD	Group P Mean ± SD	p value
Before induction	71.9 ± 6.2	68.3 ± 7.0	0.063*
After induction	75.9 ± 7.3	74.8 ± 7.8	0.468
After intubation	80.0 ± 7.3	76.1 ± 9.1	0.139
5. min	76.1 ± 7.3	69.8 ± 8.8	**0.008**
10. min	75.9 ± 7.5	68.1 ± 7.7	**0.001**
15. min	74.7 ± 7.5	67.0 ± 8.3	**0.001**
20. min	74.2 ± 7.5	67.0 ± 8.3	**< 0.001**
30. min	72.1 ± 7.7	65.8 ± 8.3	**< 0.001**
45. min	71.2 ± 7.8	62.7 ± 8.3	**< 0.001**
60. min	69.8 ± 8.3	61.6 ± 8.8	**0.004**
75. min	71.2 ± 9.2	62.9 ± 9.6	**0.014**
90. min	71.7 ± 9.1	61.9 ± 8.2	**0.002**
After extubation	73.3 ± 8.4	72.0 ± 10.6	0.711
NIRS-left	Group D Mean ± SD	Group P Mean ± SD	p value
Before induction - after induction	-4.0 ± 5.2	-6.5 ± 3.4	0.105
Before induction - after intubation	-8.0 ± 5.8	-7.8 ± 6.1	0.778
Before induction – 5. minutes	-4.2 ± 5.6	-1.4 ± 5.5	0.120
Before induction – 10. minutes	-4.0 ± 6.3	0.1 ± 5.6	**0.020**
Before induction – 15. minutes	-2.8 ± 7.1	1.3 ± 6.2	**0.049**
Before induction – 20. minutes	-2.3 ± 6.8	2.5 ± 6.1	**0.017**
Before induction – 30. minutes	-0.2 ± 7.0	4.4 ± 4.9	**0.013**
Before induction – 45. minutes	0.7 ± 7.1	5.5 ± 5.2	**0.009**
Before induction – 60. minutes	1.7 ± 6.9	6.5 ± 5.1	**0.024**
Before induction – 75. minutes	0.8 ± 7.6	6.3 ± 5.8	**0.047**
Before induction – 90. minutes	0.8 ± 7.6	6.5 ± 5.2	**0.037**
Before induction - after extubation	-1.4 ± 6.6	-3.7 ± 7.2	0.158

*These values are close to statistical significance. Therefore. it is defined as there is a tendency towards meaningfulness.

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Table 6: Comparison of regional cerebral oximetry (NIRS-right) differences measured by Near Infrared Spectroscopy (NIRS) with pre-induction status at all times.

NIRS-right	Group D	Group P	
	Mean ± SD	Mean ± SD	p value
Before induction	72.7 ± 7.9	68.6 ± 7.0	0.061*
After induction	76.3 ± 9.0	75.0 ± 9.2	0.871
After intubation	80.6 ± 9.0	76.3 ± 9.5	0.093*
5. min	76.6 ± 8.0	69.0 ± 8.9	**0.049**
10. min	76.1 ± 8.0	69.0 ± 8.9	**0.002**
15. min	74.7 ± 8.8	67.3 ± 8.6	**0.005**
20. min	73.9 ± 8.4	66.4 ± 9.1	**0.003**
30. min	72.1 ± 8.2	65.1 ± 8.6	**0.003**
45. min	71.4 ± 8.5	63.7 ± 9.5	**0.003**
60. min	71.2 ± 8.1	63.2 ± 8.9	**0.001**
75. min	72.9 ± 8.7	62.4 ± 6.2	**0.002**
90. min	72.9 ± 8.7	62.4 ± 6.2	**0.001**
After extubation	73.5 ± 8.5	71.7 ± 9.0	0.641
NIRS-right	Group D	Group P	
	Mean ± SD	Mean ± SD	p value
Before induction - after induction	-3.6 ± 5.4	-6.3 ± 4.3	0.023*
Before induction - after intubation	-7.9 ± 6.5	-7.6 ± 5.2	0.959
Before induction – 5. minutes	-3.9 ± 5.4	-0.3 ± 5.4	0.342
Before induction – 10. minutes	-3.4 ± 6.0	-0.3 ± 5.4	0.100
Before induction – 15. minutes	-2.0 ± 6.9	1.0 ± 5.7	0.137
Before induction – 20. minutes	-1.2 ± 7.2	2.2 ± 5.8	0.091*
Before induction – 30. minutes	0.5 ± 7.0	3.5 ± 4.7	0.116
Before induction – 45. minutes	1.2 ± 6.8	4.9 ± 5.3	**0.039**
Before induction – 60. minutes	1.5 ± 6.7	5.4 ± 5.4	0.064*
Before induction – 75. minutes	4.4 ± 17.6	5.7 ± 5.0	0.069*
Before induction – 90. minutes	1.0 ± 7.2	7.2 ± 4.0	**0.020**
Before induction - after extubation	-0.8 ± 7.0	-3.0 ± 4.9	0.059*

*These values are close to statistical significance. Therefore. it is defined as there is a tendency towards meaningfulness.

P values marked with dark black are statistically significant. D: desflurane. P: propofol

Table 7: Relationship (correlation) between SAP. DAP. MAP. HR and regional cerebral oximetry (NIRS-left) change levels measured by Near Infrared Spectroscopy (NIRS).

SAP/NIRS-left	Group D		Group P	
	R	p value	r	p value
Before induction - after induction	-0.123	0.519	-0.199	0.292
Before induction - after intubation	0.121	0.525	-0.130	0.492
Before induction – 5. minutes	0.093	0.626	0.091	0.631
Before induction – 10. minutes	0.258	0.168	0.139	0.463
Before induction – 15. minutes	0.287	0.125	0.100	0.600
Before induction – 20. minutes	0.433#	**0.017**	-0.002	0.991
Before induction – 30. minutes	0.332	0.073*	0.025	0.892
Before induction – 45. minutes	0.508#	**0.004**	-0.047	0.803
Before induction – 60. minutes	0.406#	0.060*	-0.382	**0.045**
Before induction – 75. minutes	0.416#	0.076*	-0.308	0.163
Before induction – 90. minutes	0.481#	**0.049**	-0.359	0.189
Before induction - after extubation	0.038	0.844	0.487#	**0.006**

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DAP/NIRS- left	Group D		Group P	
	R	p value	R	p value
Before induction - after induction	0.206	0.276	-0.031	0.871
Before induction - after intubation	0.181	0.339	-0.020	0.918
Before induction – 5. minutes	0.007	0.971	0.190	0.316
Before induction – 10. minutes	0.175	0.355	0.260	0.165
Before induction – 15. minutes	0.252	0.180	0.164	0.386
Before induction – 20. minutes	0.348	0.060*	0.252	0.180
Before induction – 30. minutes	0.425#	**0.019**	0.313	0.092*
Before induction – 45. minutes	0.477#	**0.008**	0.123	0.516
Before induction – 60. minutes	0.285	0.198	-0.001	0.997
Before induction – 75. minutes	0.617¥	**0.005**	-0.036	0.875
Before induction – 90. minutes	0.718¥	**0.001**	-0.035	0.902
Before induction - after extubation	0.097	0.610	0.424#	**0.020**
MAP/NIRS- left	Group D		Group P	
	R	p value	R	p value
Before induction - after induction	-0.164	0.387	-0.004	0.983
Before induction - after intubation	0.091	0.631	0.002	0.990
Before induction – 5. minutes	-0.043	0.820	0.290	0.121
Before induction – 10. minutes	0.252	0.179	0.253	0.177
Before induction – 15. minutes	0.301	0.106	0.179	0.343
Before induction – 20. minutes	0.362	**0.049**	0.153	0.419
Before induction – 30. minutes	0.401#	**0.028**	0.294	0.115
Before induction – 45. minutes	0.431#	**0.017**	0.135	0.476
Before induction – 60. minutes	0.572#	**0.006**	-0.035	0.861
Before induction – 75. minutes	0.609¥	**0.006**	-0.140	0.533
Before induction – 90. minutes	0.619¥	**0.008**	-0.197	0.482
Before induction - after extubation	-0.008	0.968	0.283	0.130
HR/NIRS- left	Group D		Group P	
	R	p value	R	p value
Before induction - after induction	-0.287	0.124	0.051	0.788
Before induction - after intubation	0.355	**0.049**	-0.073	0.701
Before induction – 5. minutes	0.406#	**0.026**	0.133	0.484
Before induction – 10. minutes	0.540#	**0.002**	0.017	0.930
Before induction – 15. minutes	0.548#	**0.002**	0.071	0.711
Before induction – 20. minutes	0.496#	**0.005**	0.017	0.930
Before induction – 30. minutes	0.330	0.075*	0.039	0.838
Before induction – 45. minutes	0.340	0.066*	0.014	0.940
Before induction – 60. minutes	0.243	0.275	0.100	0.611
Before induction – 75. minutes	0.454#	**0.049**	0.318	0.150
Before induction – 90. minutes	0.379	0.133	-0.098	0.729
Before induction - after extubation	0.274	0.143	0.336	0.069*

#These values show that there is a moderate relationship between SAP. MAP. DAP. HR and NIRS-left in the relevant time periods.

*These values are close to statistical significance. Therefore. it is defined as there is a tendency towards meaningfulness.

¥These values show that there is a high severity relationship between DAP. MAP and NIRS-left in the relevant time periods.

P values marked with dark black are statistically significant. D; desflurane. P; propofol

30th minute, 45th minute, 75th minute and 90th minute, and the cerebraloxymeter-left measurement differences. In the propofol group, a statistically significant correlation was found between the DAB measurements taken only before induction and after extubation and the differences between the cerebraloxymeter-left measurement (Table 7).

In the Desfluran group; a statistically significant

Table 8: Relationship (correlation) between SAP. DAP. MAP. HR and regional cerebral oximetry (NIRS-right) change levels measured by Near Infrared Spectroscopy (NIRS).

SAP/NIRS-right	Group D		Group P	
	R	p value	r	p value
Before induction - after induction	0.075	0.695	-0.268	0.152
Before induction - after intubation	0.052	0.793	0.022	0.910
Before induction – 5. minutes	0.108	0.571	0.041	0.830
Before induction – 10. minutes	0.288	0.122	-0.091	0.633
Before induction – 15. minutes	0.304	0.103	-0.209	0.268
Before induction – 20. minutes	0.315	0.090*	-0.140	0.462
Before induction – 30. minutes	0.099	0.604	-0.192	0.310
Before induction – 45. minutes	0.308	0.098*	-0.293	0.116
Before induction – 60. minutes	0.104	0.645	-0.479#	**0.010**
Before induction – 75. minutes	0.128	0.602	-0.459#	**0.032**
Before induction – 90. minutes	0.343	0.177	-0.706¥	**0.003**
Before induction - after extubation	-0.049	0.796	0.378	**0.039**
DAP/NIRS-right	**Group D**		**Group P**	
	R	p value	R	p value
Before induction - after induction	-0.038	0.843	-0.118	0.535
Before induction - after intubation	0.159	0.402	-0.014	0.940
Before induction – 5. minutes	0.250	0.183	0.039	0.837
Before induction – 10. minutes	0.078	0.680	-0.115	0.546
Before induction – 15. minutes	0.151	0.425	-0.093	0.626
Before induction – 20. minutes	0.258	0.169	-0.072	0.707
Before induction – 30. minutes	0.375	**0.041**	-0.009	0.962
Before induction – 45. minutes	0.326	0.078*	-0.030	0.874
Before induction – 60. minutes	0.051	0.823	-0.058	0.769
Before induction – 75. minutes	0.549#	**0.015**	-0.060	0.792
Before induction – 90. minutes	0.696¥	**0.002**	-0.224	0.422
Before induction - after extubation	0.106	0.577	0.215	0.254
MAP/NIRS-right	**Group D**		**Group P**	
	R	p value	R	p value
Before induction - after induction	-0.049	0.789	-0.113	0.551
Before induction - after intubation	0.108	0.570	-0.084	0.659
Before induction – 5. minutes	0.227	0.228	0.136	0.474
Before induction – 10. minutes	0.209	0.268	0.001	0.994
Before induction – 15. minutes	0.329	0.076*	-0.044	0.819
Before induction – 20. minutes	0.313	0.092*	-0.059	0.758
Before induction – 30. minutes	0.309	0.096*	-0.038	0.840
Before induction – 45. minutes	0.308	0.098*	-0.090	0.637
Before induction – 60. minutes	0.300	0.175	-0.246	0.206
Before induction – 75. minutes	0.841¥	**< 0.001**	-0.277	0.211
Before induction – 90. minutes	0.556#	**0.020**	-0.604¥	0.017
Before induction - after extubation	-0.062	0.745	0.091	0.631
HR/NIRS-right	**Group D**		**Group P**	
	R	p value	R	p value
Before induction - after induction	-0.228	0.225	-0.105	0.582
Before induction - after intubation	0.273	0.144	-0.066	0.730
Before induction – 5. minutes	0.294	0.115	-0.024	0.901
Before induction – 10. minutes	0.484#	**0.007**	-0.195	0.301

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Before induction – 15. minutes	0.497#	**0.005**	-0.138	0.473
Before induction – 20. minutes	0.458#	**0.011**	-0.080	0.673
Before induction – 30. minutes	0.340	0.066*	0.117	0.539
Before induction – 45. minutes	0.289	0.122	-0.195	0.301
Before induction – 60. minutes	0.315	0.153	-0.031	0.877
Before induction – 75. minutes	0.351	0.141	0.238	0.266
Before induction – 90. minutes	0.276	0.284	0.028	0.922
Before induction - after extubation	0.197	0.298	0.232	0.218

#These values show that there is a moderate relationship between SAP. and NIRS-right in the relevant time periods. However. this relationship is an opposite direction. In other words. while one value increases. the other decreases. Besides these values show that there is a moderate relationship between DAP . MAP. HR and NIRS-right in the relevant time periods.

¥These values show that there is a high severity relationship between SAP and NIRS-right in the relevant time periods. However. this relationship is an opposite direction. In other words. while one value increases. the other decreases. Besides these values show that there is a high severity relationship between DAP and NIRS-right in the relevant time periods. In addition. These values show that there is a high severity relationship between MAP and NIRS-right in the relevant time periods. However. in Group D. this relationship is positive while in Group P it is negative.

*These values are close to statistical significance. Therefore. it is defined as there is a tendency towards meaningfulness.

P values marked with dark black are statistically significant.

D; desflurane. P; propofol

correlation was found between the differences of OAB measurements taken before pre-induction and after 20-minute, 30-minute, 45-minute, 60-minute, 75-minute, and 90-minute post-induction. In the propofol group, there was no significant correlation between the differences of OAB measurements taken before and after induction and cerebraloxymeter-left measurement differences (Table 7).

In the Desfluran group; a statistically significant correlation was found between the differences of KTA measurements taken before pre-induction and after intubation, after 5-minute, 10-minute, 15-minute, 20-minute and 75-minute post-induction and cerebral oximeter-left measurement differences. In the propofol group, there was no significant relationship between KTA measurements differences and cerebraloxymeter-left measurement differences before and after induction (Table 8).

In both Desfluran group and Propofol group, there was no significant relationship between SpO$_2$ measurements differences before and before induction and cerebraloxymeter measurement-left differences.

In the Desfluran group; there was a statistically significant relationship between the differences in BIS measurements taken before and after the induction and the differences between the cerebraloximeter-left measurement, and there was no significant relationship in other time periods. In the propofol group, there was no significant correlation between BIS measurements differences and cerebraloxymeter-left measurement differences in any time period.

In the Desfluran group; there was no significant correlation between pre-induction and post-induction time difference between SAB measurements and cerebraloximeter-right measurement differences. In the propofol group, a statistically significant relationship was found between the differences of SAB measurements taken before and after induction after 60 minutes, 75 minutes, 90 minutes, and after extubation, and this relationship was moderately inverse (Table 8).

In the Desfluran group; while there was a statistically significant relationship between the differences of DAB measurements taken before the induction and after the 30th minute, 75 minutes and 90 minutes after the induction and the cerebelloxymeter-right measurement differences, the differences in the DAB measurements in the propofol group before the induction and after the induction There was no significant relationship between right measurement differences (Table 8).

In the Desfluran group; there was a statistically significant relationship between the differences of OAB measurements taken before and after the induction and at the end of the 75th and 90th minutes, and the cerebraloxymeter-right measurement differences. In the propofol group, there was no significant correlation between the differences of OAB measurements and the cerebraloxymeter-right measurement differences before and after induction (Table 8).

In the Desfluran group; while there was a statistically significant relationship between the differences of KTA measurements taken before and after induction at the 10th minute, 15th minute, and 20th minute, and between cerebroloximeter-right measurement differences, in the Propofol group, there were no differences in KTA measurements before and after induction. There was no significant relationship between right measurement differences (Table 8).

In both the Desfluran group and the Propofol group, there was no significant relationship between the differences in SpO$_2$ measurements and the

Table 9: Comparison of Fromme scale and Remifentanyl dosage between groups.

Fromme Scale	Group D Mean ± SD	Group P Mean±SD	p value
At the beginning	1.3 ± 0.8	1.6 ± 0.7	0.218
15.min	1.1 ± 0.7	1.1 ± 0.6	1.000
30.min	0.9 ± 0.8	1.0 ± 0.8	0.762
45.min	0.8 ± 0.7	1.0 ± 0.7	0.390
60.min	1.0 ± 0.7	0.8 ± 0.7	0.637
75.min	0.8 ± 0.6	1.2 ± 0.7	0.127
90.min	0.8 ± 0.7	1.2 ± 0.8	0.195
Remifentanil dosage	Group D Mean ± SD	Group P Mean ± SD	p value
After intubation	0.08 ± 0.02	0.08 ± 0.03	0.383
5. min	0.09 ± 0.03	0.10 ± 0.05	0.913
10. minutes	0.09 ± 0.02	0.11 ± 0.05	0.154
15. minutes	0.09 ± 0.03	0.12 ± 0.05	0.089*
20. minutes	0.10 ± 0.05	0.13 ± 0.07	**0.026**
30. minutes	0.10 ± 0.05	0.13 ± 0.07	0.094*
45. minutes	0.10 ± 0.65	0.14 ± 0.08	0.067*
60. minutes	0.09 ± 0.05	0.15 ± 0.07	**0.013**
75. minutes	0.10 ± 0.05	0.15 ± 0.07	**0.010**
90. minute	0.09 ± 0.03	0.15 ± 0.06	**0.012**

*These values are close to statistical significance. Therefore. it is defined as there is a tendency towards meaningfulness.

P values marked with dark black are statistically significant.

D; desflurane. P; propofol

cerebraloxymeter measurement-right differences in pre-induction and post-induction time interval.

While there was a statistically significant relationship between BIS measurements taken before induction and after extubation in the Desfluran group, and cerebral oximeter-right measurement differences; In the propofol group, there was a statistically significant correlation between the differences of BIS measurements taken before and after induction at the 20th minute and at the end of the 30th minute and the differences between cerebraloxymeter-right measurement.

When the image quality of the surgical area was examined, Fromme scale scores were not different between the groups (Table 9). Comparison of remifentanil dose by type of anesthesia can also be seen in Table 9.

When NIRS-left and NIRS-right were evaluated separately, it was observed that a decrease of 20% or more (significant decrease) in any time period compared to pre-induction values developed in only five patients (8.3%). All of these patients were found to be in the Propofol group, whereas in the Desfluran group there was no 20% or more reduction. Patients with a decline of 20% or more were found to be more in the Propofol group, and this difference was statistically significant (16.7% versus 0%, p = 0.02).

When the patients who had a significant decrease regardless of the anesthesia type and those who did not have a significant decrease were examined, MMSE was found to be similar in both preoperative and postoperative groups. Preoperative MMSE was 27.4 ± 1.8 in those with a decrease and 28.0 ± 1.8 in those without a drop (p = 0.359). While the postoperative MMSE was 28.6 ± 1.6 for those with a decrease, this value was 28.1 ± 1.4 for those without a decrease (p = 0.499). Preoperative-Postoperative MMSE change was also similar in those with a significant decrease and those with no significant decrease (1.2 ± 1.7 increase in those with a decrease, 0.1 ± 1.2 increase in those without a decline p = 0.193) (Table 10). Since there was no significant decrease in the desflurane group, in-group comparison could not be made.

When 5 patients with a decrease in propofol group and 25 patients without a decrease were compared, MMSE was found to be similar in those with and without preoperative and postoperative decreases. Preoperative MMSE was 27.4 ± 1.8 in those with a decrease, while 28.1 ± 1.1 in those without a decrease (p = 0.323). While the postoperative MMSE was 28.6 ± 1.6 for those with a decrease, this value was 28.0 ± 1.4 for those without a decrease (p = 0.448). Preoperative-postoperative MMSE change was also similar in those with significant decrease and those with no significant

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Table 10: Demographic and clinical comparison of patients with significant decrease (≥ 20.0%) and no significant decrease (< 20%).

	No significant decrease (n = 55)	Significant decrease (n = 5)	p value
Age (years)	37.7 ± 11.6	39.2 ± 12.3	0.716
Height (cm)	168.4 ± 8.8	167.8 ± 6.2	0.917
Weight (kg)	74.1 ± 12.7	70.8 ± 17.3	0.307
BMI (kg / m²)	25.9 ± 3.5	24.9 ± 4.8	0.418
Operation time (min)	83.3 ± 31.7	134.2 ± 72.3	**0.049**
Anesthesia time (min)	101.6 ± 33.7	157.0 ± 72.0	**0.037**
Controlled hypotension time (min)	87.2 ± 34.1	142.0 ± 74.3	0.056*
Preoperative MMSE	28.0 ± 1.2	27.4 ± 1.8	0.360
Postoperative MMSE	28.1 ± 1.4	28.6 ± 1.6	0.482
Anesthesia type			
Desflurane	30 (100%)	--	**0.020**
Propofol	25 (83.3%	5 (16.7%)	

*These values are close to statistical significance. Therefore. it is defined as there is a tendency towards meaningfulness.

P values marked with dark black are statistically significant.

decrease (1.2 ± 1.7 increase in those with a decrease, 0.08 ± 1.1 decrease in those without a decline p = 0.129).

The duration of surgery and the duration of anesthesia were significantly higher in patients with a 20% or more drop in any time period compared to the values before the induction (p = 0.04 and p = 0.03, respectively). The duration of controlled hypotension was also high in those with a significant decrease (p = 0.056) (Table 10).

In the propofol group, 3 patients needed nitroglycerin, 1 patient needed ephedrine, and 2 patients had bradycardia in the recovery room. It rose to normal values without medication. 4 patients in the Desfluran group needed ephedrine.

Discussion

In otorhinolaryngology surgery, especially in tympanoplasty, mastoidectomy, septoplasty, and FESS operations, the surgical area must be bloodless. It greatly affects the quality of the operation. For many years, various methods have been developed to improve the quality of the surgical field from the anesthetic point of view. One of the most important of these methods is controlled hypotension. Most studies have shown that controlled hypotension provides a quality surgical field [4,5].

In the meta-analysis conducted by Susie Lin, et al. [6] from 10 randomized controlled studies undergoing orthognathic surgery, controlled hypotension was compared with normotension, and the quality of the surgical field was found to be more successful in controlled hypotension.

In controlled hypotension applications, although it is argued that keeping the mean arterial pressure between 55-65 mmHg is safe, it may cause a delay in the recovery of the patients, cerebral hypoxia, deterioration of cognitive functions, blindness, renal, cardiac and hepatic side effects [7].

The rapid onset and rapid termination of the remifentanil effect have recently increased the frequency of use [8,9]. When used with desflurane and propofol, controlled hypotension is easier and recovery from anesthesia is faster than other opioid agents [9].

Although there was no significant difference in the systolic arterial pressure values during the operation compared to the propofol group in the desflurane group; there was a significant difference in diastolic arterial pressure and mean arterial pressure values for most of the operation. DAP and MAP were significantly low in the desflurane group for most of the operation. However, the dose of remifentanil spent in the desflurane group was also significantly lower than the propofol group in the majority of the operation.

Although controlled hypotension was achieved in both groups in our study, lower blood pressure values were obtained at the controlled hypotension limits by using less remifentanil in the desflurane group. In the Desfluran group, HR values remained significantly low in most of the operation. Although normally desflurane affects increasing the heart rate [10], we think that using remifentanil eliminates the stimulating effects.

Although blood pressure and heart rate were lower in the desflurane group, there was no statistically significant difference between the two groups during the operation in the Fromme scale, which we applied to evaluate the anemia of the surgical field, but the values were numerically lower in the desflurane group.

Again, the extubation time of the patients in the desflurane group was shorter, although it did not differ significantly from the propofol group. In our study, Aldrete scoring showing the compilation status of the

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patients was significantly higher in the desflurane group at 0 and 5 minutes; It was similar in the 30th minute evaluation.

In our study, we showed that the compilation was faster in the desflurane group. The low blood/gas partition coefficient of desflurane is associated with rapid awakening [11]. In the study, after the extubation, the HR increased significantly in the desflurane group compared to the propofol group, which we think is related to early recovery.

In the study of Mahli, et al. [12], with target-controlled infusion; Remifentanil, propofol and remifentanil, desflurane ear-nose and throat surgery were divided into two groups, anesthesia quality and recovery profile were examined, OAB and KTA were significantly lower in the desflurane group, and this decrease was seen as an advantage in the surgical field. No significant difference was observed in the early recovery period.

In the study of Tavlan, et al. [13] using remifentanil in FESS surgery, it was seen that hemodynamic response was similar in both groups but a compilation from desflurane was faster.

We used BIS in both groups to optimize the dose of anesthetic medication and to ensure rapid extubation and recovery by avoiding awareness and too deep anesthesia. BIS values remained similar between the groups during the operation. In this way, we believe that the comparison between the two groups is more reliable.

In a study by Luginbühl, et al. [14] anesthesia applied with desflurane or propofol was divided into groups with and without BIS; In the groups where both desflurane and propofol were monitored with BIS, the drug dose given similar to the study was found to be lower, patient satisfaction, extubation, and recovery were faster.

In a study by Triem, et al. [15], hemodynamic effects, extubation time, and recovery were similar to manual infusion, while propofol consumption was less in the HCI group. In the study of Breslin, et al. [16]; especially, it was determined that more propofol was spent with HCI in the initial period of anesthesia and BIS values were lower in this period.

In cases where controlled hypotension monitoring of cerebral oxygen saturation has been applied, the frequency of NIRS use has increased in recent years to show the cerebral perfusion disorder that may be caused by hypotension and to protect postoperative cognitive functions by intervening during the case.

Cerebral oxygen saturation is not only from hypotension; it is also affected by conditions such as hypoxia, end-tidal CO_2 drop, cerebral ischemia, and anemia. In both groups, SpO_2 and end-tidal CO_2 values were within normal limits and similar during the operation. Bilateral regional cerebral oxygen saturation values were significantly higher in the desflurane group than in the propofol group in similar BIS values in most of the operation. In the propofol group, more than 20% decrease was observed in 5 patients.

Besides, in the desflurane group, rSO_2 values were significantly higher in the comparisons made with the values before induction. Desflurane decreases cerebral oxygen consumption rate ($CMRO_2$) and increases cerebral blood flow [17]. Propofol reduces both $CMRO_2$ and cerebral blood flow. We think that this situation might explain the higher course of rSO_2 values in the desflurane group.

In the study conducted by Ruzman, et al. [18] in laparoscopic cholecystectomy cases, rSO_2 values in the sevoflurane group were significantly higher than propofol. The number of cases with a critical decrease in regional cerebral oxygen saturation values was significantly higher in propofol.

A decrease in cerebral oxygenation values may occur during controlled hypotension. In our study, a significant relationship was found between SAB, OAB, and DAB and rSO_2 (especially left) in the desflurane group. There was a moderate positive correlation between the decrease in blood pressure values and the decrease in rSO_2 values. No significant relationship was found in the propofol group.

In the study performed by Sang, et al. [19] in cases of shoulder arthroscopy, controlled hypotension was applied, OAB was kept at around 60 mmHg, and a decrease in rSO_2 values. The relationship between blood pressure and a drop in cerebral oximetry was found statistically significant.

In our study, although no relation was found between BIS and NIRS in both groups; studies are showing that using BIS and NIRS monitoring together is more effective in showing cerebral hypoperfusion. They found that the BIS values of Hayashida, et al. [20] decreased acutely during acute hypotension, suppression occurred in EEG, and a decrease in rSO_2 values was observed at the same time. They evaluated this suppression in EEG as cerebral hypoperfusion.

Postoperative cognitive dysfunction is a condition that is usually short-term and temporary after surgery but maybe long-term in some patients, with a deficiency in memory and concentration. In elderly patients, cardiac surgery and major orthopedic surgery are more likely to occur in conditions that impair cerebral perfusions, such as hypoxia and hypotension. In the study, the MMSE test, which was translated into Turkish by Erdem AF, et al. [21] and standardized to the Turkish community in 2002, was applied 2 hours before the preoperative and 24 hours after the postoperative period. Preoperative and postoperative MMSE values were similar in both groups. There was also no significant difference in MMSE exchange between the groups.

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In a study conducted by Niazi, et al. [22] with 60 patients in septoplasty cases, the group who underwent controlled hypotension and the group who did not undergo controlled hypotension, but aimed to reduce bleeding at the operative site with a local vasoconstrictor, was evaluated in terms of postoperative cognitive functions and MMSE performed at postoperative 30 and 60 minutes. The test showed a significant decrease in the hypotensive group, and at 24 hours there was no cognitive dysfunction in either group.

In the study conducted by Salazar, et al. [23] in 50 patients who planned to have shoulder arthroscopy, rSO_2 was followed and a drop of more than 20% was considered as cerebral desaturation at any period. The preoperative and postoperative 3rd day neuropsychiatric test battery was applied and cerebral desaturation developed in 9 patients. Patients with and without desaturation were compared with the test battery in terms of postoperative cognitive dysfunction and no cognitive dysfunction was detected in either group.

In our study, cerebral desaturation was observed in 5 patients in the propofol group. Preoperative and postoperative MMSE test results were similar in patients with and without desaturation, and there was no significant decrease. In our study, we link the absence of cognitive function impairment despite cerebral desaturation to the positive effect of monitoring with NIRS. NIRS monitoring enabled rapid recognition and treatment of cerebral hypoperfusion.

One of the limitations of our study; we used only one of the neuropsychiatric tests. Although MMSE is an important test in showing cognitive functions, studies have shown that multiple tests strengthen the evaluation and are more valuable in the interpretation of different cognitive areas [24]. Also, repeating the test only at the 24th hour in the postoperative period can be considered as the limitations of the study.

The effects of anesthetic agents used in studies comparing inhalation anesthetics with intravenous anesthetics on POCD development are still unclear. In a study conducted by Geng, et al. [25] in cholecystectomy operations, propofol, sevoflurane, and isoflurane were compared and it was shown that the POCD rate was significantly lower in the propofol group on the 1st and 3rd days. In another study, the cognitive functions at the 1st, 2nd and 4th hours of propofol and sevoflurane were compared; while POCD was higher in the propofol group at the first hour, there was no significant difference at 2 and 4 hours, and sevoflurane was recommended in daily surgery [26].

In our study, no significant difference was found in the propofol and desflurane groups in terms of POCD. Based on all these studies, we think that the effects of anesthetic agents used on POCD development are still not clear and larger studies should be conducted.

Conclusion

As a conclusion, we think that desflurane and propofol can be used safely in controlled hypotension. Desflurane, despite the lower remifentanil dose, compared to propofol; we recommend that it is preferred as a priority in cases where controlled hypotension will be applied due to lower, more stable blood pressure and heart rate values, faster extubation and early recovery, and higher cerebral oxygen values.

We think that our study is one of the few studies in which propofol and desflurane are divided into two groups as TIVA and balanced general anesthesia, four different types of surgery are included in otorhinolaryngology surgery, BIS and NIRS monitoring are used together and postoperative cognitive functions are investigated.

Highlights

- Controlled hypotension is frequently preferred in cases of otolaryngology by reducing bleeding, creating a quality surgical field, increasing operation success, and reducing surgical complications.

- Controlled hypotension can disrupt target organ perfusion, causing various side effects.

- Desflurane and propofol can be used safely in controlled hypotension.

- Our study is one of the few studies in which propofol and desflurane are divided into two groups as TIVA and balanced general anesthesia, four different types of surgery are included in otorhinolaryngology surgery.

Funding

Availability of Data and Materials

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

Ethics Approval and Consent to Participate

The study was approved by the institutional review board. All the patients' information was kept confidential.

Competing Interests

The authors declare that they have no competing interests.

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