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ORIGINAL RESEARCH

Evaluation of the effect of preoperative anxiety on intraoperative hemodynamic stability and drug consumption in patients who underwent BIS-guided total intravenous anesthesia (TIVA) for neurophysiological monitoring in spine surgery

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Abstract

In our study, the aim was to evaluate the effects of preoperative anxiety measured by Spielberger's State-Trait Anxiety Inventory-State (STAI-S) and State-Trait Inventory-Trait (STAI-T) scores on intraoperative hemodynamic stability, drug consumption and recovery in patients who underwent spinal surgery with neurophysiological monitoring and total intravenous anesthesia with bispectral index (BIS) monitoring, without the use of muscle relaxants. Eighty patients with planned spinal surgery and neurophysiological monitoring were included in this prospective observational study. Anxiety scores were recorded by applying Spielberger's STAI-T and STAI-S scoring questionnaires to all patients included in the study 1 hour before the operation. Age, gender and American Society of Anesthesiologists (ASA) scores of the patients who were taken to the operating table without premedication were recorded. Before anesthesia induction, standard monitoring including electrocardiography (ECG), noninvasive blood pressure, peripheral oxygen saturation (SpO_2), BIS was applied. The correlation between STAI-T and STAI-S scores with demographic characteristics of patients, preoperative, post-induction, 5th minute, 10th minute, 30th minute, 50th minute, 70th minute, 90th minute heart rate (HR), mean arterial pressure (MAP), SpO_2, operation time, recovery time, and total amount of propofol and remifentanil used during the operation were evaluated statistically. A significant negative correlation was observed between STAI-S anxiety scoring and age ($p < 0.05$). A significant positive correlation was found between the total amount of remifentanil and propofol used with the STAI-S score ($p < 0.05$). Significant positive correlations were observed between the STAI-S score and the HR value preoperatively, and in the 5th, 30th, 50th, 70th, and 90th minutes ($p < 0.05$). Our study showed that preoperative anxiety increases intraoperative drug consumption and heart rate. It is of great importance to keep the amount of intraoperative medication at optimal levels, to measure preoperative anxiety, and to eliminate it with multimodal treatments, especially for the accurate detection of neurological damage in patients with neurophysiological monitoring.

Keywords

Neurophysiological monitoring; Preoperative anxiety; Total intravenous anesthesia; BIS monitoring

1. Introduction

Anxiety is one of the most common psychological reactions in patients in the preoperative period and can be seen in 80% of patients scheduled for a high-risk surgical procedure [1]. It was proven that increased preoperative anxiety is associated with both negative psychological and somatic outcomes and affects the postoperative care, treatment and rehabilitation process. Preoperative anxiety is also accepted as an important risk factor for postoperative mortality [1].

Many factors such as fear of waking up during the operation, fear of not waking up after the operation, fear of pain, possibility of staying in the intensive care unit, fear of death, and distrust of the operation team or hospital conditions can be counted among the causes of preoperative anxiety [2]. Many "personal" factors that determine the level of preoperative

anxiety were listed. These include female gender, type of operation, previous operation experience, ASA classification and age of the patient [3].

The most widely used test in medicine for the measurement of anxiety is the State-Trait Anxiety Inventory (STAI) scale developed by Spielberger [4]. It was used to measure preoperative anxiety in more than three thousand studies [3, 5]. The first part of the STAI measures momentary, that is, state anxiety (STAI-S), while the second part evaluates trait anxiety (STAI-T). These different assessments are helpful in the diagnosis of depressive syndromes [3]. State anxiety expressions show people's momentary feelings (like I'm worried or nervous right now). Trait anxiety expressions, on the other hand, show the feelings of the patients in general (like "I worry too much about everything" or "I wish I could be happy with the little things"). Each section has 20 questions and scores range from 20 to 80, with high scores being associated with high levels of anxiety [6].

With the introduction of intraoperative neurophysiological monitoring, a very important method was developed to measure nerve damage that may occur especially in risky spinal surgery. In this way, the chance to avoid or reverse neurological damage that may develop during surgery has emerged. With the somatosensory evoked potentials (SEP), starting from the peripheral nerve, the dorsal and sensory pathways located in the lateral parts can be monitored. However, motor functionality cannot be evaluated. It has also been reported that there may be a delay of 4–30 minutes in the SEP data in case of any damage. Due to these deficiencies, it has been revealed that motor roads should also be monitored. Motor evoked potentials (MEP) provide information about the motor pathways in the ventral part of the spinal cord [7]. The anesthesia method significantly affects the quality and accuracy of neurophysiological data [8]. It is important to keep the depth of anesthesia at a constant level, since more or less all anesthetic drugs affect evoked potentials. High-dose intravenous bolus infusions or elevated minimum alveolar concentration (MAC) levels of inhalation agents cause inaccurate measurements. Steady-state alveolar and serum concentrations are required for accurate signal levels. In operations where intraoperative neurophysiological monitoring is applied, the gold standard for anesthesia was determined as total intravenous anesthesia without the use of neuromuscular blockers [9].

The amount of intraoperative drug consumption is even more important in patients undergoing neurophysiological monitoring. It was proven by randomized controlled studies that when the effect of muscle relaxants is removed, the depth of anesthesia decreases and the need for iv anesthetic drugs increases [10].

In our study, the aim was to evaluate the effects of preoperative anxiety measured by Spielberger's STAI-S and STAI-T scores on intraoperative hemodynamic stability, drug consumption and recovery in patients who underwent spinal surgery with neurophysiological monitoring and total intravenous anesthesia with BIS monitoring, without the use of muscle relaxants.

2. Material and method

This single-center study was conducted between 01 September 2019 and 01 September 2020, in the Brain Surgery operating room of Sultan 2. Abdulhamit Han Training and Research Hospital. The study was registered in Clinical Trials with the number NTC0469076. The study, which was designed as a prospective observational cross-sectional study, was planned for spinal surgery accompanied by neurophysiological monitoring and written consent was obtained for participation in the study. A total of 80 participants between the ages of 18–70, American Society of Anesthesiologists (ASA) physical status classification I, II and III, literate, without any psychiatric or neurological disease, taking psychiatric medication and chronic non-alcoholic patients with a body mass index (BMI) of 22–28 were included in the study (Fig. 1). Patients who did not agree to participate in the study, could not cooperate, used psychiatric drugs, had chronic drug habit and cases in which bleeding was recorded as the need for transfusion in the intraoperative process were excluded from the study. Anxiety scores were recorded by applying Spielberger State Anxiety Inventory (STAI-T and STAI-S) scoring questionnaires to all patients included in the study 1 hour before the operation. According to Spielberger, a STAI score of 20–37 indicates no or low anxiety, a score of 38–44 indicates moderate anxiety, and a score of 45 and above indicates high anxiety.

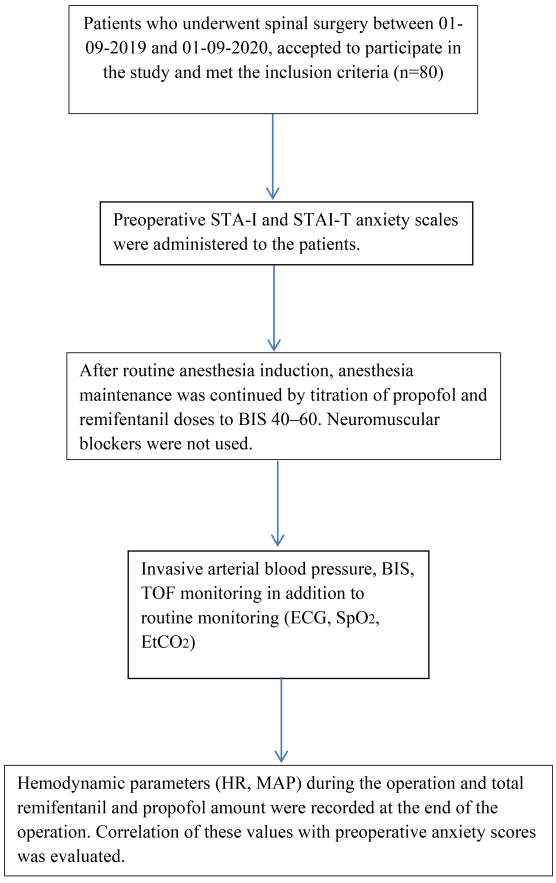

FIGURE 1. Flow chart of the study.

Age, gender and ASA scores of the patients who were taken to the operating table without premedication were recorded. Before anesthesia induction, standard monitoring including

ECG, noninvasive blood pressure, peripheral oxygen saturation (SpO_2), bispectral index (BIS) and body temperature was applied. After anesthesia induction was provided with 2 mg kg^{-1} propofol, 1 μg kg^{-1} fentanyl, and 0.6 mg kg^{-1} rocuronium, the patients were endotracheally intubated. The placement and level of the endotracheal tube was confirmed with chest auscultation, then 6–8 mL/kg tidal volume, 10–12 respirations/minute frequency and end-tidal carbon dioxide ($EtCO_2$) values of 32–35 mmHg were set as mechanical ventilation parameters and positive pressure ventilation was provided.

Maintenance of anesthesia was titrated to a BIS range of 40–60, with 6–10 mg kg^{-1} h^{-1} propofol and 0.05–0.1μg kg^{-1} remifentanil infusion. A heart rate above 110 beats/minute or 20% above baseline was considered as tachycardia and remifentanil infusion was titrated accordingly. Neuromuscular blockers were not used during the operation. After intubation, radial artery cannulation was performed, invasive arterial monitoring was provided, urine output was monitored by inserting a urinary catheter, and neuromuscular blockade was monitored with Tofguard (neuromuscular transmission monitor) (TOF). During the operation, electrodes were placed on the *m.* tibialis anterior and *m.* abductor hallucis muscles in the lower extremity for motor evoked potential (MEP) monitoring and on the *n.* tibialis posterior and *n.* peronealis traces at the knee level for somatosensory evoked potential (SEP) monitoring. Cervical vertebrae and scalp were used for recording. After the electrodes were checked, the patient was placed in prone position for the operation. When the TOF value was 100%, the surgical team was informed that neurophysiological stimuli would be safe. Preoperative, post-induction, 5th, 10th, 30th, 50th, 70th, 90th minute HR, MAP, and SpO_2 levels were recorded by an anesthesia technician who did not know the anxiety scores measured preoperatively. When the skin incision was closed, remifentanil and propofol infusions used for total intravenous anesthesia were terminated. Then, 1 mg kg^{-1} Tramadol was administered intravenously for postoperative analgesia. The duration of the operation, recovery time and the total amount of propofol and remifentanil used during the operation were recorded. The patients who were routinely extubated after the operation were taken to the postoperative recovery unit. Aldrete's scoring system is a widely used scale to determine when patients undergoing surgery can be safely discharged from the post-anesthesia care unit to the ward. Evaluation is made between 1 and 15 points. When the Aldrete score is 12 points or higher, patients can be sent to the service from the recovery room [11]. In our study, patients with an Aldrete score of 12 were sent to their beds. Recovery time was evaluated as the time elapsed from the end of the surgery (last surgical suture) until the patients' Aldrete scores were 12 and above.

The correlation of the patients' preoperatively measured STAI-T and STAI-S scores with demographic characteristics, intraoperative drug consumption, hemodynamic parameters and recovery time were statistically evaluated.

The primary outcome of the study is to measure the correlation of preoperative anxiety measured by STA-I and STA-T with intraoperative total drug consumption in patients who underwent TIVA. The secondary outcome of the study is the evaluation of the effect of preoperative anxiety on hemodynamic parameters.

Statistical Package for Social Sciences (SPSS) 27.0 for Windows (IBM, Armonk, NY, USA) program was used for the analysis. For the descriptive statistics of the data, mean, standard deviation, median minimum, maximum, frequency and ratio values were used. The distribution of variables was measured with the Kolmogorov-Smirnov test, Kruskal-Wallis test, and Mann-Whitney U test were used in the analysis of quantitative independent data. Spearman correlation analysis was used for the correlation analysis. The results were evaluated at the 80% confidence interval and the significance level of $p < 0.05$.

3. Results

Demographic characteristics of the cases, STAI-T and STAI-S anxiety scores, amounts of propofol and remifentanil used, recovery times and preoperative, post-induction, and intraoperative minimum, maximum and median values of HR, MAP, and SpO_2 values measured at the 5th, 10th, 30th, 50th, 70th, and 90th minutes are shown in Table 1.

The STAI-S score did not differ significantly between the female and male genders ($p > 0.05$). In the comparison between ASA I, II, and III groups, the STAI-S score did not show a statistically significant difference ($p > 0.05$) (Table 2). The STAI-T score did not differ significantly between the female and male genders ($p > 0.05$). STAI-T score did not show a statistically significant difference in the comparison between ASA I, II, and III groups ($p > 0.05$) (Table 3).

A significant negative correlation was observed between STAI-S anxiety scores and age ($p < 0.05$). The STAI-S score increased with decreasing age.

In the correlation of the amounts of drugs used during TIVA with the STAI-S score, a significant positive correlation was found with the amounts of both propofol and remifentanil ($p < 0.05$). As the STAI-S score increased, the amount of both drugs used increased. No significant correlation was observed between the STAI-S score and recovery time ($p > 0.05$) (Table 4).

No significant correlation was observed between STAI-T anxiety score and age ($p > 0.05$). No significant correlation was observed between SATI-T score and the amount of propofol and remifentanil ($p > 0.05$). There was no significant ($p > 0.05$) correlation between STAI-T score and recovery time (Table 4).

Significant ($p < 0.05$) positive correlations were observed between the STAI-S score and the HR value preoperatively and in the 5th, 30th, 50th, 70th, and 90th minutes.

No significant ($p > 0.05$) positive correlation was observed between the HR value in the 10th minute after induction time with STAI-S score (Table 5).

No significant ($p > 0.05$) correlations were observed with STAI-S score for preoperative induction time, 5th minute, 10th minute, 30th minute, 50th minute, and 90th minute MAP values. A significant ($p < 0.05$) negative correlation was observed between the STAI-S score and the 70th minute MAP value.

No significant ($p > 0.05$) correlations were observed be-

TABLE 1. Demographic characteristics (Age, Gender, BMI, ASA) of the cases, STA-I and STA-S anxiety scores, amounts of propofol and remifentanil used, operation times, recovery times and HR, MAP, SpO_2 values (min–max, mean±).

	Min–Max	Median	Median ± SD/n-%	
Age/(year)	18.0–70.0	52.0	49.2 ± 16.8	
Gender				
Female			42	52.50%
Male			38	47.50%
ASA				
I			39	48.80%
II			35	43.80%
III			6	7.50%
STAI-S	28.0–57.0	43.0	43.3 ± 6.4	
STAI-T	20.0–51.0	37.0	36.5 ± 7.2	
Propofol Amount (mg)	600–16,000	2400	2668 ± 2314	
Remifentanil Amount (µgr)	800–6500	2000	2292 ± 1061	
Recovery Time (min)	0.0–35.0	20.0	17.0 ± 9.2	
BMI	22.0–28.0	25.5	25.4 ± 1.6	
Operation time (min)	120.0–166.0	138.0	138.9 ± 11.7	
Heart Rate (beats/min)				
Preoperative	50.0–110.0	88.0	87.1 ± 14.3	
Induction	56.0–108.0	84.0	82.6 ± 13.2	
5th min	50.0–126.0	83.5	82.7 ± 16.5	
10th min	48.0–115.0	80.0	80.7 ± 16.6	
30th min	48.0–97.0	70.0	71.0 ± 16.1	
50th min	45.0–98.0	65.0	69.2 ± 13.6	
70th min	48.0–89.0	65.5	67.6 ± 11.7	
90th min	47.0–105.0	68.0	69.1 ± 14.1	
MAP(mmHg)				
Preoperative	60.0–134.0	103.5	103.6 ± 15.1	
Induction	56.0–129.0	90.0	91.0 ± 16.1	
5th min	52.0–122.0	88.0	86.4 ± 16.8	
10th min	55.0–142.0	85.0	83.4 ± 16.1	
30th min	58.0–117.0	80.0	79.5 ± 12.7	
50th min	57.0–107.0	77.0	77.3 ± 12.0	
70th min	57.0–97.0	79.0	76.1 ± 10.2	
90th min	59.0–100.0	77.0	78.0 ± 10.3	
SpO_2 (%)				
Preoperative	97.0–100.0	99.0	98.6 ± 1.8	
Induction	95.0–100.0	99.0	99.3 ± 1.0	
5th min	96.0–100.0	99.0	99.1 ± 0.9	
10th min	96.0–100.0	99.0	99.1 ± 1.0	
30th min	96.0–100.0	100.0	99.4 ± 0.8	
50th min	95.0–100.0	100.0	99.3 ± 1.0	
70th min	95.0–100.0	100.0	99.4 ± 0.9	
90th min	97.0–100.0	100.0	99.5 ± 0.8	

TABLE 2. Comparison of STAI-S Scoring in terms of patients' gender and ASA scores.

	STAI-S			
	Min–Max	Median	Median ± SD	*p*
Gender				
Female	28–57	42.0	42.8 ± 6.9	0.246^{m}
Male	32–52	46.0	43.8 ± 5.8	
ASA				
I	32–51	43.0	43.5 ± 5.6	
II	28–57	42.0	42.9 ± 7.2	0.684^{K}
III	35–52	46.0	44.3 ± 7.7	

^{m} Mann-whitney U test; ^{K} Kruskal-wallis test.

TABLE 3. Comparison of STAI-T Scoring in terms of patients' gender and ASA scores.

	STAI-T			
	Min–Max	Median	Median ± SD	*p*
Gender				
Female	24–47	39.0	37.1 ± 6.8	0.306^{m}
Male	20–51	37.0	35.8 ± 7.7	
ASA				
I	20–46	37.0	35.3 ± 7.7	
II	27–51	40.0	37.5 ± 7.0	0.445^{K}
III	34–43	37.0	38.0 ± 4.1	

^{m} Mann-whitney U test; ^{K} Kruskal-wallis test.

TABLE 4. Correlation of STAI-S and STAI-T anxiety scores with age, total propofol amount and remifentanil amount, recovery time.

	Age	Propofol	Remifentayl	Recovery time
STAI-S				
r	−0.284	0.366	0.329	0.005
p	0.011*	0.001*	0.003*	0.964
STAI-T				
r	−0.042	−0.160	0.112	0.063
p	0.711	0.157	0.323	0.581

r values: (−0.25)–0.00 and 0.00–0.25 too weak, (−0.049)–(−0.26) and 0.26–0.49 weak, (−0.69)–(0.50) and 0.50–0.69 intermediate, (0.89)–(0.70) and (0.70)–0.89 high, (−1.00)–(−0.90) and 0.90–1.00 very high.
*Spearman Correlation test *p < 0.05.*

tween the STAI-T score with preoperative, induction time, 5th minute, 10th minute, 30th minute, 50th minute, 70th minute and 90th minute MAP values (Table 5).

No significant ($p > 0.05$) correlations were observed between the SATI-S score with the preoperative, 5th minute, 10th minute, 30th minute, 50th minute, and 90th minute SpO_2 values. Significant ($p < 0.05$) negative correlations were observed between the SATI-S score and the induction time and 70th minute SpO_2 value.

No significant ($p > 0.05$) correlations were observed between the STAI-T score with the preoperative, induction time, 5th minute, 10th minute, 30th minute, 50th minute, 70th minute and 90th minute SpO_2 values (Table 5).

No bleeding that would require blood transfusion and cause intraoperative hemodynamic instability occurred in the patients included in the study during the intraoperative period. None of the patients needed inotropic agent support during the operation.

4. Discussion

In spinal surgery, somatosensory evoked potentials (SEP) and motor evoked potentials (MEP) are monitored together. MEP is more sensitive for detecting motor damage [7]. In our study including spinal surgery cases, both types of monitoring were applied. A 50–80% reduction in MEP amplitude is the most common warning criterion for possible neurological damage. However, these stimuli criteria sometimes cause false positive alerts. False positive alerts in MEP amplitudes may be caused by insufficient depth of anesthesia and blood pressure [12].

Total intravenous anesthesia including propofol and an opioid is recommended for optimal recordings of MEP, but the suppressive effect of propofol anesthesia is also mentioned. At this point, measuring the depth of anesthesia is important in terms of determining the optimal propofol doses [13]. In patients undergoing neurophysiological monitoring in which the use of muscle relaxants is not recommended, monitoring the depth of anesthesia with BIS is of great importance to prevent unwanted problems such as the possibility of anesthesia awareness and incorrect neurophysiological monitoring values. In our study, the BIS values of the patients were kept between 40–60 and the depth of anesthesia was standardized.

An important point in determining the correct amplitude in neurophysiological monitoring is to ensure cerebral and spinal cord perfusion. Since there is no method that can directly measure the perfusion of these tissues, the measurement and regulation of blood pressure is of great importance. In a recent study, the depth of anesthesia and mean arterial pressure values were stated to affect the optimal measurements of MEP [14]. In our study, the target MAP values were determined as 55–110 mmHg. At values below 55 mmHg and above 110 mmHg, propofol and remifentanil titration were sufficient to keep the titration within the normal range. In our study, MAP values remained stable throughout the operation. The optimization of the drug amounts used with BIS contributes to the stabilization of the MAP values.

With MEP, evaluation of descending motor pathways is achieved by placing electrically stimulating electrodes in the motor regions required. The muscles to be stimulated vary according to the type of surgery performed and the level of the spinal cord [15].Opioids cause a small amplitude depression and a slight delay in cortical potentials in patients undergoing neurophysiological monitoring. It was stated that they are much more reliable than inhalation agents. Remifentanil administered as an infusion is safe, especially provided stable serum concentrations are maintained [16].

TABLE 5. Evaluation of the correlation preoperative, induction, 5th minute, 10th minute, 30th minute, 50th minute, 70th minute, 90th minute of HR, MAP, SpO_2 values and STAI-S and STAI-T scores.

		Preoperative	Induction	5th min	10th min	30th min	50th min	70th min	90th min
Heart Rate	STAI-S								
	r	0.297	0.214	0.235	0.188	0.448	0.351	0.328	0.240
	p	0.007*	0.057	0.036*	0.095	0.000*	0.001*	0.003*	0.032*
	STAI-T								
	r	0.066	0.201	−0.066	−0.063	−0.043	−0.051	0.031	0.004
	p	0.563	0.073	0.562	0.579	0.703	0.650	0.784	0.973
MAP	STAI-S								
	r	0.135	−0.012	−0.032	−0.011	−0.115	−0.126	−0.338	−0.140
	p	0.232	0.913	0.775	0.925	0.309	0.265	0.002*	0.214
	STAI-T								
	r	0.137	0.183	0.138	0.061	0.023	0.113	0.077	0.112
	p	0.227	0.105	0.221	0.594	0.843	0.318	0.495	0.324
SpO_2	STAI-S								
	r	0.058	−0.240	0.145	0.072	−0.143	−0.272	−0.178	0.046
	p	0.607	0.032*	0.198	0.524	0.206	0.015*	0.114	0.683
	STAI-T								
	r	−0.210	0.022	0.063	−0.070	−0.139	−0.200	0.159	−0.140
	p	0.061	0.844	0.579	0.539	0.219	0.076	0.160	0.216

r values: (−0.25)–0.00 and 0.00–0.25 too weak, (−0.049)–(−0.26) and 0.26–0.49 weak, (−0.69)–(0.50) and 0.50–0.69 intermediate, (0.89)–(0.70) and (0.70)–0.89 high, (−1.00)–(−0.90) and 0.90–1.00 very high.
*Spearman Correlation test *p < 0.05.*

The use of muscle relaxants is not recommended during neurophysiological monitoring. After use of a short- or intermediate-acting neuromuscular blocking agent to facilitate intubation during induction, either the drug must be left to wear off or reversed by an antagonist such as sugammadex. Determining the TOF value is 100% before the measurements reduces the possibility of false assessment of nerve damage [17]. In our study, rocuronium was applied during induction and it was determined that the TOF value was 100% before neurophysiological measurements. Sugammadex administration was not required in any of the cases.

Although it was reported that high bolus doses of propofol may cause a decrease in MEP amplitude, it is considered to be the most appropriate intravenous anesthetic agent in patients undergoing neurophysiological monitoring at controllable infusion doses [17]. In operations where muscle relaxants are not used, it may be necessary to increase the amounts of intravenous agents used to ensure sufficient depth of anesthesia. Considering that preoperative anxiety also increases drug doses, stimuli decreasing MEP or SEP amplitude may be caused by anxiety. Therefore, the elimination of preoperative anxiety becomes even more important in patients undergoing neurophysiological monitoring. In our study, anesthesia was maintained with total intravenous anesthesia, and propofol and remifentanil doses were titrated to values between BIS 40–60 and administered as intravenous infusion. The amounts of propofol and remifentanil used were determined to be higher in patients with high preoperative anxiety scores.

The STAI-S and STAI-T scales used in our study are considered the gold standard compared to many tests used for the evaluation of preoperative anxiety. It is an advantage that they have been translated into many languages and used in many studies [18]. It was stated that preoperative anxiety increases the need for intravenous anesthetic during both maintenance and induction, and doses should be adjusted considering the preoperative anxiety levels of the patients [18].

Unlike other studies, the amounts of anesthetic agents applied for the purpose of TIVA gained greater importance in our study, which did not use intraoperative muscle relaxants due to neurophysiological monitoring. In statistical analysis, a positive correlation was found between the STAI-S scores, which measure momentary anxiety, and the amounts of propofol and remifentanil used in total intravenous anesthesia. In addition, a positive correlation was found between the HR values measured at the preoperative, 5th, 10th, 30th, 50th, and 90th minutes in patients with high STAI-S score. This positive correlation may be associated with preoperative sympathetic stimulation in patients with high anxiety scores. It has also been found to be compatible with studies on the subject in the literature [19]. The same correlation was not observed for MAP values. Monitoring the depth of anesthesia with BIS monitoring and titration of anesthetic agents accordingly are effective in hemodynamic stabilization.

Studies showed that age is one of the factors affecting preoperative anxiety [20]. In our study, a negative correlation was found between age and STAI-S score, and preoperative

anxiety was found to be higher in young patients. This seems to be consistent with the literature. In our study, no difference was found between male and female gender in terms of preoperative anxiety. In similar studies, it was stated that preoperative anxiety is more common in the female gender [21, 22]. ASA scoring has also been found to be associated with preoperative anxiety in studies [22]. In our study, no difference was found between patients with different ASA scores in terms of preoperative anxiety.

However, there is no standardization in terms of the type of operation in these studies. In our study, it can be said that the result is more reliable because there is no variety of operations.

In our study, only correlation analysis and the absence of a control group involving randomization are important limitations. We hope that our study will guide further controlled studies on the subject.

5. Conclusions

In our study, preoperative anxiety increased intraoperative drug consumption and affected heart rate. In surgical cases undergoing neurophysiological monitoring, the increase in intravenous drug use and hemodynamic instability caused by preoperative anxiety may cause false amplitude responses. This results in neurological damage in patients. Especially in patients undergoing neurophysiological monitoring, preoperative anxiety should be measured and eliminated with multimodal treatments.

AUTHOR CONTRIBUTIONS

AE, BBG, TE—coordinated the acquisition of subjects, data collection, and processing. ACC—performed the initial statistical analyses. AE—wrote the first draft of the manuscript and performed the additional analyses and adjustments during the revision process. NTA and IE—aided in interpreting the results. All authors have read and approved the final manuscript.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

Ethical approval was obtained from the ethical committee of Okmeydani Training and Research Hospital, Clinical Research Ethics Committee the dated 27-08-2019 and numbered 1423 and study was completed at University of Health Sciences Sultan 2. Abdülhamid Han Training and Research Hospital, Department of Anesthesiology and İntensive Care. The study was carried out in accordance with the rules of the Declaration of Helsinki. Consent for the study was obtained from all patients.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

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