



## The effects of music on anxiety and pain in patients during carotid endarterectomy under regional anesthesia: A randomized controlled trial

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### ABSTRACT

**Objective:** Music can be used as an alternative method to decrease anxiety in awake patients during surgical procedures. The aim of this study was to test the hypothesis that listening to music during carotid endarterectomy (CEA) under regional anesthesia decreases the patient's anxiety and pain.

**Design:** A multicenter, prospective, randomized controlled trial.

**Setting:** Patients undergoing carotid endarterectomy under cervical plexus block.

**Interventions:** Patients scheduled for carotid endarterectomy under cervical plexus block were randomized into two groups: Music Group and Control Group.

**Main Outcome Measures:** The primary endpoint of this study was the difference in intraoperative anxiety in patients with or without music during CEA under regional anesthesia, and the secondary endpoints were intraoperative and postoperative pain, use of additional local anesthetics, use of intravenous analgesics, patient and surgeon satisfaction and complications. Anxiety was assessed using State Trait Anxiety Inventory (STAI) and numeric rating scale (NRS). Visual analog scale (VAS) was used for pain assessment.

**Results:** The postoperative STAI scores were similar in both groups ( $p = 0.839$ ). The NRS scores measured immediately after the end of the surgery were statistically higher in Music Group ( $p = 0.001$ ). The intraoperative anxiety statistically increased in Music Group, when the scores of the intraoperative responses to the questions of "are you relaxed?" and "are you calm?" were compared. ( $p = 0.0001$  and  $p = 0.0001$ , respectively). There were no statistical differences in terms of the amount of intraoperative and postoperative analgesic used ( $p = 0.801$ ,  $p = 0.773$ , respectively). The intraoperative VAS scores, postoperative VAS scores, patient and surgeon satisfaction scores were similar in both groups ( $p = 0.586$ ,  $p = 0.185$ ,  $p = 0.302$  and  $p = 0.599$ , respectively). Systolic, diastolic and mean arterial blood pressure and heart rate were no different between Music Group and Control Group at any of all time points during the intraoperative period. Surgical side and contralateral side cerebral rSO<sub>2</sub> values are similar in both groups ( $p = 0.438$ ,  $p = 0.397$ , respectively).

**Conclusions:** Music use in CEA under regional anesthesia increased intraoperative patient anxiety, and had no effect on intraoperative and postoperative pain or patient satisfaction.

### 1. Introduction

Prior to surgery, patients often experience anxiety due to concerns about the risks of the procedure and possible discomfort and pain. It may be difficult for the patient to tolerate surgery especially under regional or local anesthesia because of this anxiety. Carotid

endarterectomy (CEA) can be performed under general or regional anesthesia, and although previous studies have not found the anesthesia modality to have any impact on postoperative outcomes,<sup>1</sup> many centers prefer regional anesthesia during CEA because of the ease of monitoring the neurological status with awake testing. Inadequate analgesia in CEA may result in increased patient anxiety. Both inadequate analgesia and

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increased anxiety can raise the stress response, leading to unwanted hemodynamic responses. Sedation may be administered to supplement regional block to avoid these statuses, but in CEA under regional anesthesia, sedation must be minimal, especially during cross-clamping, to allow neurological assessment.<sup>2</sup>

In addition to pharmacological methods, non-pharmacological methods such as music can be used as an alternative method to decrease anxiety in awake patients during surgical procedures.<sup>3–6</sup> The playing of music during surgical procedures has been previously shown to be associated with decreased sedative requirements.<sup>7,8</sup> A systematic review concluded that music might also affect blood pressure, heart rate, body temperature, oxygen saturation and respiratory rate, in addition to reducing pain and anxiety.<sup>9</sup>

The aim of this study was to test the hypothesis that listening to music during CEA under regional anesthesia decreases the patient's anxiety and pain.

## 2. Methods

### 2.1. Study design

This prospective randomized controlled study was carried out in accordance with the principles of the Declaration of Helsinki. Approval was granted by the Ethics Committee of Antalya Training and Research Hospital, Turkey (approval number 16/3). The trial was registered prior to patient enrollment at ClinicalTrials.gov (identifier: NCT03457181). Written informed consent was obtained from all trial participants. The study was conducted in Antalya Training and Research Hospital and Dr. Siyami Ersek Thoracic and Cardiovascular Surgery Training and Research Hospital; both of these academic institutions are associated with the University of Health Sciences, Turkey.

The primary endpoint of this study was the difference in intraoperative anxiety in patients with or without music during CEA under regional anesthesia, and the secondary endpoints were intraoperative and postoperative pain, use of additional local anesthetics, use of intravenous analgesics, patient and surgeon satisfaction and complications.

### 2.2. Participants

Patients undergoing CEA under cervical plexus block were enrolled the study. Exclusion criteria included the inability to communicate, or to comprehend the aim and objectives of the study and not provide informed written consent. Patients with contraindications for the block (local infection, coagulation disorders), hypersensitivity to the local anesthetics or refusal of regional anesthesia were also excluded.

### 2.3. Interventions

The night before the surgery, an anesthesiologist who was part of the study research team introduced and explained the study to the patients. Patients who were willing to participate in the study were randomly separated into 2 groups in a 1:1 ratio using a simple, non-stratified randomization scheme generated by software available online (<https://www.graphpad.com/quickcalcs/randMenu>): Music Group and Control Group. Randomization lists were carried out by an independent researcher. The researchers who involved in enrolling participants had no access to the randomization lists. Group allocation was concealed within numbered, sealed, opaque envelope. The envelope was opened by the non-blinded researcher who had no access to the randomization list prior to patient inclusion and was responsible to administer the assigned intervention to the patient in the operating room. The envelope was only opened after written informed consent of the included patient. The non-blinded researcher and participants knew the results of randomization but the outcome assessor was blinded. Also, non-blinded researcher asked for the participants to avoid comments about the

intervention due to guarantee the blindness of the outcome assessor. The randomization was conducted independently in the two centers.

#### 2.3.1. Music group

In Music Group, each patient was asked to choose one of the 4 different music genres with 60–80 beats per minute of Turkish folk music, Turkish classical music, Turkish popular music and Turkish art music according to his/her preference. These music genres were used in the study because these are the most popular music genres in Turkey. In Music Group, the selected music was delivered through an iPhone 6 and Music app (Apple Inc., USA) through the iPhone headphones.

#### 2.3.2. Control group

In Control Group, operation room (OR) noise was delivered through an iPhone and Microphone App (Free version, Von Bruno). This application allows the iPhone to be used as a live microphone. After the App was started, the bottom iPhone microphone was chosen as "iPhone microphone" and headphone out was chosen as "iPhone Headset" on the application menu. Thus, OR noise acquisition through the iPhone's microphone was simultaneously delivered to the patient via headphones.

#### 2.3.3. General management

On arrival in the operating room, a peripheral intravenous catheter was inserted. A 20-gauge cannula was inserted in the contralateral radial artery for invasive measurement of arterial blood pressure. Other monitoring included 3-lead electrocardiography, pulse oximetry, and frontal regional cerebral oxygen saturation. Combined (deep and superficial) cervical plexus blocks were performed as regional anesthetic technique. The deep part of the combined block was achieved with the three injection technique at C2, C3 and C4 as previously described by Moore.<sup>10</sup> The superficial part of the combined block was performed at the midpoint of the posterior border of the sternocleidomastoid muscle. 0.5% bupivacaine was injected along the posterior border of the sternocleidomastoid muscle, in the caudal and cranial directions. The total dose of 0.5% bupivacaine used was designed to be 1.4 mg/kg. All blocks were performed by the same two independent experienced anesthesiologists who were blinded to the study groups. In all patients, sensory loss in the C2-4 dermatome was confirmed with the pinprick test before the first incision of surgery. After the block was completed, a non-blinded researcher placed the headphones and started the Music App or Microphone App to deliver the assigned intervention (music or OR noise). The sound level was adjusted as 50–60 db after started the Apps and was maintained at the level the patient indicated as most comfortable. Then, the phone screen was turned off to assure blindness of the outcome assessor, so the screen only appeared black with the Apps continuing to run in the background. The Apps (Music App or Microphone App) were stopped using the button on the headset without any need to turn the phone screen on before each assessment and started again after the assessment.

All carotid endarterectomies were performed by the same 4 senior vascular surgeons, who were blinded to the study groups.

## 2.4. Outcomes

### 2.4.1. Anxiety assessment

Assessment of the anxiety level was made by the same two trained research assistants in the preoperative and postoperative period using the Turkish version of the State Trait Anxiety Inventory (STAI). The STAI was developed by Spielberger et al<sup>11</sup> to separately determine the state and trait anxiety levels of an individual, and the confidence coefficients have been found to be between 0.94 and 0.96. The inventory was tested for validity and reliability in Turkish by Oner et al<sup>12</sup> Internal consistency values were found to be 0.83 - 0.87, test-retest reliability 0.71 - 0.86, and item-by-item reliability 0.34 - 0.72.<sup>12–14</sup> The STAI questionnaire comprises 40 statements in 2 sections as the state

scale (STAI-S) and the trait scale (STAI-T). While STAI-S is used to determine the current level of anxiety, STAI-T is related to the general disposition of the respondent to anxiety. The STAI-S with 20 statements was used in the current study to evaluate the effect of music intervention on the patient's state anxiety. Each patient was instructed to rate his/her agreement for each statement using a scale from 1 to 4 (not at all, somewhat, moderately and very much, respectively). The total score on the scale ranges from 20 to 80 points and a higher score represents greater anxiety.

Intraoperative anxiety was assessed immediately before performing the block, immediately before the first incision, and at every 5 min after cross-clamping. In the intraoperative period, anxiety was assessed by asking the patient the 2 questions of "are you calm?" and "are you relaxed?". Responses were given on a scale of "1: not at all, 2: somewhat, 3: moderately, or 4: very much". These questions from the STAI were used because these questions have been previously shown to be correlated with the full STAI questionnaire.<sup>15–17</sup> Each patient was also asked to rate his/her intraoperative anxiety on a Numeric Rating Scale (NRS) from 0 (no anxiety) to 10 (worst feeling of anxiety possible) immediately after the end of the surgery.

#### 2.4.2. Pain assessment

Intraoperative pain was assessed using a visual analog scale (VAS) (from 0 = no pain to 10 = maximum possible pain) simultaneously with the intraoperative anxiety assessment during the procedure. If the patient was conscious and could reasonably answer the questions about anxiety and VAS, no further questions were asked to assess the mental state. At the same time, motor functions were evaluated by asking the patient to squeeze a stress-ball which was placed into the hand contralateral to the operated side. When intraoperative VAS was > 3, a 0.4 mg/kg bolus of supplemental 1% lidocaine was administered to the surgical area by the surgeon. If pain persisted despite a 2 mg/kg dose of lidocaine, then supplemental intravenous (IV) analgesia of 0.5 µg/kg of fentanyl up to a maximum dose of 200 µg was given. If this proved to be ineffective to complete the surgery, general anesthesia was induced.

After surgery, patients were transferred to the post-anesthesia care unit (PACU). Postoperative pain was assessed using VAS in the PACU. Postoperative VAS scores were recorded by independent staff in the PACU every 15 min until discharge to the surgical ward. The time to first requirement for analgesia in PACU was also recorded. When the postoperative VAS scores exceeded 3/10, 1 mg/kg dose of IV tramadol was administered.

#### 2.4.3. Hemodynamic variables

A researcher blinded to the groups documented systolic arterial blood pressure (SAP), diastolic arterial blood pressure (DAP), mean arterial blood pressure (MAP), heart rate (HR) and cerebral regional oxygen saturation (rSO<sub>2</sub>) values at every 5 min in the operating room.

#### 2.4.4. Patient and surgeon satisfaction

Postoperatively, patients and surgeons were asked by a blinded observer to rate their satisfaction using a 5-point Likert scale (ie, "1: very dissatisfied," "2: dissatisfied," "3: neutral," "4: satisfied," and "5: very satisfied").

### 2.5. Statistical analysis

#### 2.5.1. Sample size

G\*Power software version 3.1.9.2 was used to perform an a priori sample size calculation based on pilot data on NRS scores for intraoperative anxiety.<sup>18,19</sup> In a pilot study with 20 patients, the SD of intraoperative NRS scores was 2. A minimum of 27 patients per group was calculated to detect a difference of 2 points on the NRS scores with a power of 0.95 at  $\alpha = 0.05$ . Because a dropout rate of 20–25% was expected, a total of 70 patients with 35 patients in each group were included in the study.

#### 2.5.2. Data analysis

Statistical analysis was performed using SPSS version 24 statistical software (SPSS Inc., Chicago, IL, USA). Continuous variables were presented as mean  $\pm$  standard deviation (SD) and ordinal variables as median and interquartile range (IQR) values. Categorical variables were stated as the number (n) and percentage (%) of patients. Differences between the mean values for normally distributed variables were compared using the Student's *t*-test. Non-normally distributed variables were compared with the Mann-Whitney U-test and Wilcoxon rank sum test. The Chi-square test and Fisher Exact test were used for categorical data where appropriate. The Paired *t*-test was used to evaluate whether there were differences between pre- and post-operative STAI scores or physiological indices between the groups. The repeated analysis of variance (ANOVA) was implemented to examine the differences between various time-points. A value of  $p < 0.05$  was considered statistically significant.

### 3. Results

#### 3.1. Participant flow

A total of 76 patients were assessed for study eligibility and a total of 6 were excluded; 3 patients did not wish to participate in the study, 2 refused regional anesthesia and 1 declined the use of headphones due to previous ear surgery. Therefore, 70 patients were enrolled in the study. A further 2 patients in Music Group and 1 in Control Group were excluded from the analyses as these procedures were converted to general anesthesia because of loss of consciousness after cross-clamping. 1 patient in Music Group and 2 patients in Control Group reported severe pain although sensorial loss was confirmed before the incision and they were then excluded from the analyses because anxiety could not be correctly assessed in these patients. Finally, data from the remaining 64 patients were analyzed for the study (Fig. 1).

#### 3.2. Demographic data

There were no significant differences between the groups in terms of gender, age, body mass index, education level, ASA status and comorbidities. The characteristics of the patients are shown in Table 1. Turkish art music was the most commonly selected music genre (43.8%) among the music genres preferred by patients in Music Group.

#### 3.3. Perioperative data

No statistically significant differences were observed between the two groups in clamping time and duration of surgery ( $p = 0.217$ ,  $p = 0.127$ , respectively). The amount of intraoperative supplemental 1% lidocaine used and intraoperative IV analgesic used were similar in both groups ( $p = 0.552$ ,  $p = 0.801$ , respectively). The perioperative data are presented in Table 2.

Systolic, diastolic and mean arterial blood pressure and heart rate were no different between Music Group and Control Group at any of the time points during the intraoperative period (Fig. 2). Mean surgical-side cerebral rSO<sub>2</sub> values were  $60.8 \pm 9.9$  in Music Group and  $61.9 \pm 11.2$  in Control Group ( $p = 0.438$ ). Mean contralateral-side cerebral rSO<sub>2</sub> values were  $63.5 \pm 12$  in Music Group and  $64.7 \pm 13.4$  in Control Group ( $p = 0.397$ ).

There was no significant difference between the two groups in respect of complications (Table 2). All complications were fully resolved within 24 h after the surgery. No major neurological deficits or perioperative mortality were observed.

#### 3.4. Anxiety assessment

In the comparison of preoperative and postoperative STAI scores in Music Group, no statistically significant difference was determined

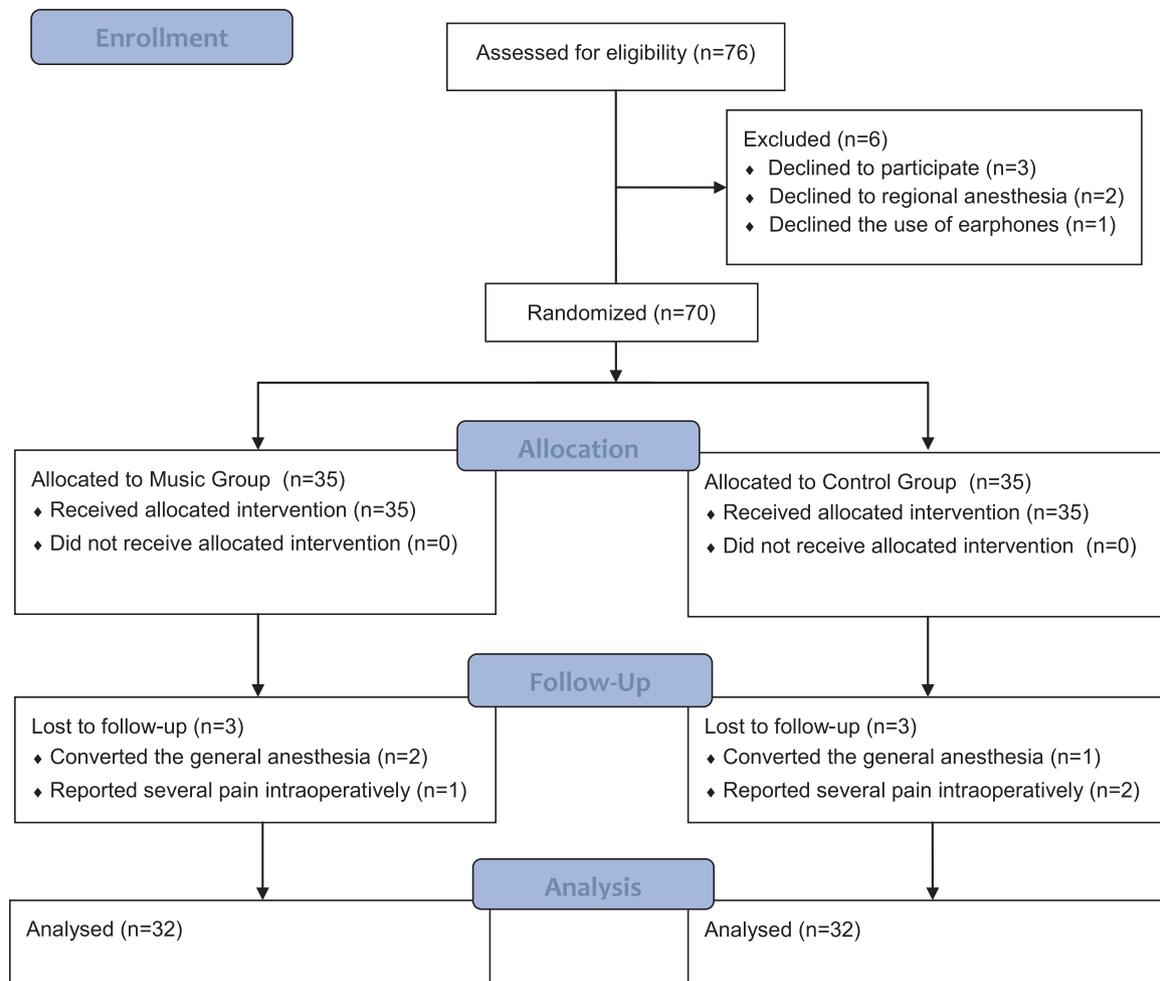


Fig. 1. Consort flow diagram.

Table 1

Patients' characteristics (Values are the mean  $\pm$  standard deviation or the number and percentage).

	Music Group (n = 32)	Control Group (n = 32)	P value
Age, years	68.5 $\pm$ 8.4	66.5 $\pm$ 9.7	0.384
BMI, kg/m <sup>2</sup>	25.4 $\pm$ 3.6	24.3 $\pm$ 4.8	0.615
<b>Gender</b>			
Male	22 (68.8)	22 (68.8)	1.000
Female	10 (31.2)	10 (31.2)	1.000
<b>Side of surgery</b>			
Left	14 (43.8)	16 (50)	0.616
Right	18 (56.2)	16 (50)	0.802
<b>Comorbidities</b>			
Arterial hypertension	24 (75)	27 (84.3)	0.351
Diabetes mellitus	18 (56.2)	13 (40.6)	0.211
COPD	4 (12.5)	2 (6.2)	0.391
CAD	4 (12.5)	5 (9.3)	0.719
<b>Education</b>			
Elementary	4 (12.5)	2 (6.2)	0.392
Junior high	12 (37.5)	12 (37.5)	
Senior high	12 (37.5)	12 (37.5)	
College or above	4 (12.5)	6 (18.8)	
<b>Music genre</b>			
Folk	4 (12.5)	–	–
Classic	6 (18.8)	–	–
Popular	8 (25)	–	–
Art	14 (43.8)	–	–

BMI, body mass index; CAD, coronary artery disease; COPD, chronic obstructive pulmonary disease.

(42.3  $\pm$  4.3 vs 40.6  $\pm$  4.6.  $p = 0.157$ ). The preoperative and postoperative STAI scores were similar in Control Group (42  $\pm$  4.4 vs 40.9  $\pm$  5.1.  $p = 0.203$ ). No statistically significant difference was observed between the two groups in the postoperative STAI scores ( $p = 0.839$ ). Both groups showed moderate anxiety in both the preoperative and postoperative period. The scores of the intraoperative responses to the questions of "are you relaxed?" and "are you calm?" were statistically lower in Music Group ( $p = 0.0001$  and  $p = 0.0001$ , respectively). The comparisons between the groups in respect of intraoperative responses to the questions of "are you relaxed?" and "are you calm?" are presented in Fig. 3A and B. Preoperative NRS scores were 5  $\pm$  1.4 in Music Group and 4.8  $\pm$  1.1 in Control Group. The NRS scores measured immediately after the end of the surgery were statistically higher in Music Group ( $p = 0.001$ ) (Table 3).

### 3.5. Pain assessment

The intraoperative and postoperative VAS scores were similar in both groups ( $p = 0.586$ ,  $p = 0.185$ , respectively) (Table 3).

### 3.6. Patient and surgeon satisfaction

There were no significant differences in terms of patient and surgeon satisfaction scores between the two groups ( $p = 0.302$  and  $p = 0.599$ , respectively) (Table 3).

**Table 2**  
 Perioperative data (Values are the mean  $\pm$  standard deviation or the number and percentage).

	Music Group (n = 32)	Control Group (n = 32)	P value
Carotid clamping time (min)	18 $\pm$ 6	21 $\pm$ 10	0.217
Duration of surgery (min)	67 $\pm$ 15	76 $\pm$ 32	0.127
Volume of supplemental lidocaine 1% (mL)	1.4 $\pm$ 2.5	1.8 $\pm$ 2.8	0.552
Number of patients requiring lidocaine 1% (n)	8 (25)	10 (31.2)	0.578
Intraoperative fentanyl used ( $\mu$ g)	9.3 $\pm$ 26.7	7.8 $\pm$ 22.3	0.801
Time of first analgesic requirement in PACU (min)	107 $\pm$ 22	116 $\pm$ 28	0.175
Postoperative tramadol consumption (mg)	17.1 $\pm$ 31.3	19.5 $\pm$ 33.4	0.773
Length of stay in PACU (min)	139 $\pm$ 20	149 $\pm$ 23	0.112
Hospital stay (day)	2.8 $\pm$ 0.7	3 $\pm$ 0.8	0.269
<b>Complications</b>			
Hoarseness	5 (15.6%)	6 (18.8%)	0.740
Cough	4 (12.5%)	5 (15.6%)	0.719
Horner's syndrome	0	1 (3.1%)	0.313

#### 4. Discussion

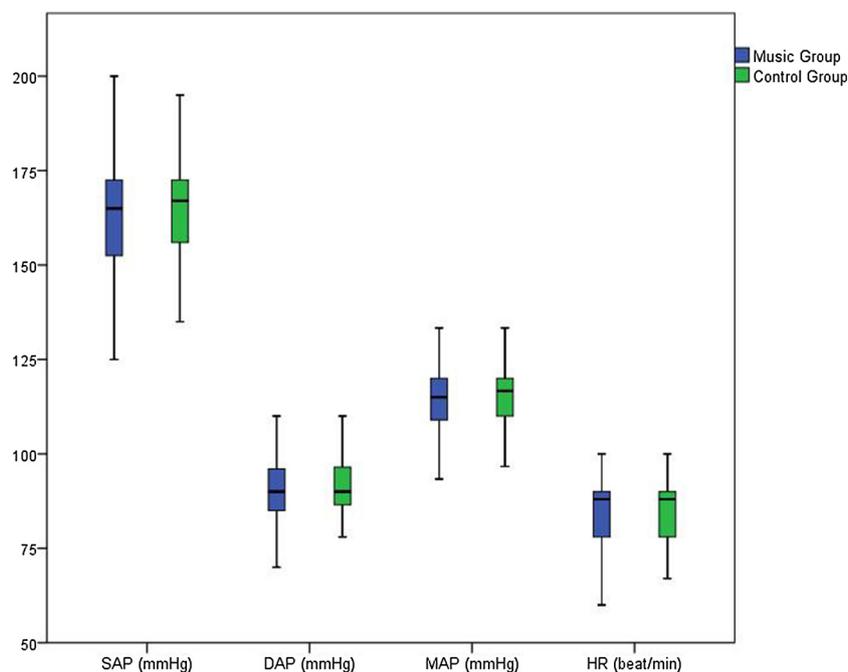
This randomized prospective study demonstrated that listening to music during CEA led to higher intraoperative anxiety than OR noise listening. Furthermore, music listening did not cause any change in pain scores, or patient and surgeon satisfaction scores.

The positive impacts of music on patients have led to its use in many fields of medicine. Music may cause pleasant feelings during a surgical procedure because it may divert the patient's attention away from negative stimuli. It has been demonstrated that music modulates the activity of multiple limbic and paralimbic brain structures, such as the ventral striatum, the dorsomedial midbrain, the amygdala, and the hippocampus. These structures have a role in the pathophysiology of pain and anxiety. These structures are also known to be densely populated by receptors of ligands related to pain and anxiety (endogenous opioids, GABA and dopamine).<sup>20</sup>

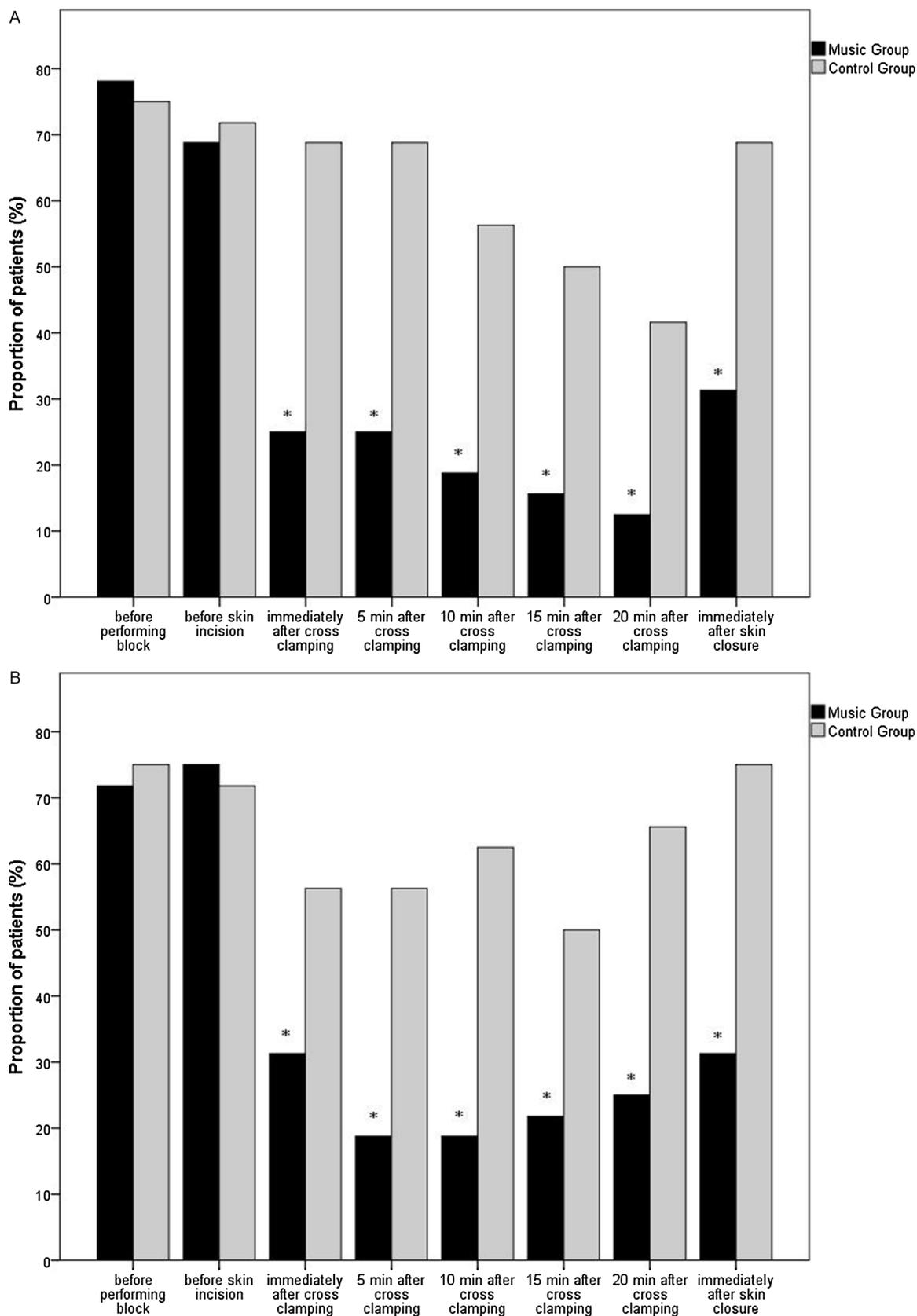
Many clinical trials and reviews investigating the effects of music on different procedures such as spinal surgery,<sup>3</sup> thoracic surgery,<sup>4</sup> labor,<sup>5</sup> awake craniotomy,<sup>6</sup> outpatient procedures,<sup>21</sup> and operations under spinal<sup>22</sup> or regional anesthesia<sup>23</sup> have reported that music intervention during these procedures was able to reduce patient anxiety. In contrast to these findings in previous studies, a surprising result from the current study was that the music intervention significantly increased

intraoperative anxiety. Similar findings to the results of the current study have been reported in a few clinical trials. Drzymalski et al reported that the use of music during epidural catheter placement in parturients in labour was associated with higher post-procedure anxiety.<sup>17</sup> There are also studies that have reported that music intervention has no effect on patient anxiety.<sup>24–27</sup> In a systematic review by Nilson, it was reported that musical interventions significantly reduced anxiety scores in only 50% of the outcomes of the reviewed studies.<sup>9</sup>

There could be various explanations for the outcomes of the current study. The close proximity of the drapes may be troublesome to some patients, causing a feeling of claustrophobia, which may then make it difficult for the patient to tolerate regional anesthesia during CEA. Moreover, a feeling of pressure in the neck area due to the retractions of the tissues during the operation may be troubling for some patients. It is inevitable that all these conditions increase patient anxiety throughout the operation. Although it has been reported that both the use of headphones and broadcast music have similar effects in reducing patient anxiety,<sup>28</sup> it may be easier for clinician–patient communication when the patient is not listening to music via headphones. Patients may want to monitor progress by listening to the surgery team talking. In this way, being aware of the progress in surgery can make them feel better. When listening to music on headphones, patients may be deprived of any information from the environment and this may further



**Fig. 2.** Comparison of hemodynamic parameters. Data were presented as box plots.



**Fig. 3.** A. Comparison of the "top-box" response of "very much relaxed". The responses such as "moderately", "somewhat" and "not at all" were considered negative (\*  $p < 0.05$ ). B. Comparison of the "top-box" response of "very much calm". The responses such as "moderately", "somewhat" and "not at all" were considered negative (\*  $p < 0.05$ ).

**Table 3**

Comparison between the both groups regarding anxiety, pain and satisfaction scores (Values are the mean  $\pm$  standard deviation or the median [interquartile range]).

	Music Group (n = 32)	Control Group (n = 32)	Differences (95% CI)	P value
Postoperative STAI score	40.6 $\pm$ 4.6	40.9 $\pm$ 5.1	-0.2 (-2.7 to 2.2)	0.839
NRS score for intraoperative anxiety	5.5 $\pm$ 1.9	3.4 $\pm$ 1.3	2.0 (1.1 to 2.8)	0.001*
NRS of the intraoperative response to question of "are you relaxed"	2 [2–4]	4 [3–4]	-0.8 (-1 to -0.6)	0.0001*
Score of the intraoperative response to question of "are you calm"	2 [2-3.75]	4 [3–4]	-0.7(-0.9 to -0.5)	0.0001*
VAS score for intraoperative pain	2.4 $\pm$ 0.8	2.5 $\pm$ 1	-0.1 (-0.5 to 0.3)	0.586
VAS score for postoperative pain	2.5 $\pm$ 1	2.3 $\pm$ 1	0.1 (-0.1 to 0.4)	0.185
Patient satisfaction score	3 [3–4]	3 [3–4]	-0.2(-0.5 to -0.1)	0.302
Surgeon satisfaction score	4 [4–5]	4 [3.2-5]	0.1 (-0.2 to 0.4)	0.599

CI, Confidence interval; STAI, State-Trait Anxiety Inventory; NRS, Numeric Rating Scale; VAS, visual analog scale.

increase patient anxiety.

In the current study, although participants were asked to choose from the 4 most popular music genres in Turkey, they could not choose their favorite songs in these music genres. Although the patients enjoy these genres of music, their preference might have been for different songs in these genres. This could have increased patient anxiety in the music group. Previous studies have reported that when patients made their own selection of music, anxiety was significantly reduced.<sup>29,30</sup> However, systematic reviews have not shown whether there is any difference in the effects on anxiety of researcher-selected music compared with patient-selected music, whereas the decline in pain intensity has been shown to be similar in studies in which patients selected the type of music and in those in which patients did not choose the type of music.<sup>9,31</sup>

Another finding of the current study was that listening to music had no effect on intraoperative and postoperative pain. During painful procedures, music may reduce both analgesic requirements and pain perception depending on the severity of stimuli.<sup>32</sup> Capeda et al reported that music reduced the level of pain intensity and opioid requirements but because the benefits were minimal, the clinical importance of listening to music was unclear.<sup>31</sup> A meta-analysis indicated that there was a moderate effect of music interventions on pain reduction.<sup>33</sup> Nilsson et al concluded that music intervention was effective in reducing pain in 59% of 22 trials.<sup>9</sup> However, a few studies have also reported that music had no effect on pain.<sup>17,34,35</sup> Graversen et al reported that music did not reduce pain 3 h after laparoscopic cholecystectomy.<sup>34</sup> Drzymalski et al also reported that music use during epidural catheter placement in parturients in labour had no effect on pain.<sup>17</sup> Reza et al also showed that intraoperative music was not effective in reducing postoperative pain after cesarean section.<sup>35</sup>

There were several limitations to the current study. First is that there was no evaluation of how interested the patients were in music in their daily lives, and therefore it was not possible to evaluate whether or not there was a greater effect on patients who were more interested in music. Secondly, as the participants were aware of the music, they were not blinded to their assigned group, which may have caused bias. Finally, the patients in this study were relatively elderly and so the findings cannot be generalized to other age groups.

## 5. Conclusion

The results of the current study demonstrated that listening to music during CEA under regional anesthesia increased intraoperative patient anxiety, and had no effect on intraoperative and postoperative pain or patient satisfaction. A well-controlled operating room environment, continuous sensible discussion between the operating team and providing rational answers or positive feedback to the patient may be more advantageous than listening to music. Further studies with a larger sample size are required to confirm the results of this study.

## Conflict of interest

All of authors of this manuscript have no conflict of interest to declare.

## Funding

Departmental resources were used for the study.

## Authors' contributions

A.S.K. conceived and designed the study, coordinated the trial, prepared the first draft of the manuscript, and was responsible for the final manuscript. A.S.K., N.K.O., H.Y.A. developed the protocol. A.S.K., N.K.O., H.Y.A., T.K. recruited the patients and acquired the data, and were responsible for protocol adherence and managing the trial at each of the sites. A.S.K., H.Y.A., T.K. and N.Y. analyzed and interpreted the data. All authors revised manuscript drafts, approved the final manuscript, and contributed intellectually important content.

## Presentation

The preliminary results of this study were presented as an oral presentation at the 24th Annual Congress of Society for Thoracic & Cardiovascular Anesthesiology and Intensive Care, May 04, 2018, Izmir, Turkey.

## References

1. Group GTC, Lewis SC, Warlow CP, et al. General anaesthesia versus local anaesthesia for carotid surgery (GALA): a multicentre, randomised controlled trial. *Lancet*. 2008;372:2132–2142.
2. Stoneham MD, Stamou D, Mason J. Regional anaesthesia for carotid endarterectomy. *Br J Anaesth*. 2015;114:372–383.
3. Lin PC, Lin ML, Huang LC, et al. Music therapy for patients receiving spine surgery. *J Clin Nurs*. 2011;20:960–968.
4. Liu Y, Petrini MA. Effects of music therapy on pain, anxiety, and vital signs in patients after thoracic surgery. *Complement Ther Med*. 2015;23:714–718.
5. Simavli S, Gumus I, Kaygusuz I, et al. Effect of music on labor pain relief, anxiety level and postpartum analgesic requirement: a randomized controlled clinical trial. *Gynecol Obstet Invest*. 2014;78:244–250.
6. Wu PY, Huang ML, Lee WP, et al. Effects of music listening on anxiety and physiological responses in patients undergoing awake craniotomy. *Complement Ther Med*. 2017;32:56–60.
7. Zhang XW, Fan Y, Manyande A, et al. Effects of music on target-controlled infusion of propofol requirements during combined spinal-epidural anaesthesia. *Anaesthesia*. 2005;60:990–994.
8. Ayoub CM, Rizk LB, Yaacoub CI, et al. Music and ambient operating room noise in patients undergoing spinal anesthesia. *Anesth Analg*. 2005;100:1316–1319.
9. Nilsson U. The anxiety- and pain-reducing effects of music interventions: A systematic review. *AORN J*. 2008;87:780–807.
10. Moore DC. *Regional block: A handbook for use in the clinical practice of medicine and surgery*. 4th. Springfield, Illinois: Charles C Thomas; 1978:112–122.
11. Spielberger CD, Gorsuch RL, Lushene RE. *Manual for state-trait anxiety inventory (Self-Evaluation questionnaire)*. Palo Alto, CA: Consulting Psychologists Press; 1970.
12. Oner N, Le Compte A. *State and trait anxiety inventory - manual (Turkish)*. İstanbul: Bogazici University Press; 1993.
13. Civan A, Özdemir I, Tas I, et al. Comparison of state and trait anxiety levels of

- handicapped and non-handicapped tennis sportsmen. *Selçuk Univ J Phys Educ Sport Sci*. 2012;14:83–87.
14. Parlar Kilic S, Karadag G, Oyucu S, et al. Effect of music on pain, anxiety, and patient satisfaction in patients who present to the emergency department in Turkey. *Jpn J Nurs Sci*. 2015;12:44–53.
  15. Marteau TM, Bekker H. The development of a six-item short-form of the state scale of the Spielberger State-Trait Anxiety Inventory (STAI). *Br J Clin Psychol*. 1992;31(Pt 3):301–306.
  16. Bergua V, Meillon C, Potvin O, et al. Short STAI-Y anxiety scales: Validation and normative data for elderly subjects. *Aging Ment Health*. 2016;20:987–995.
  17. Drzymalski DM, Tsen LC, Palanisamy A, et al. A randomized controlled trial of music use during epidural catheter placement on laboring parturient anxiety, pain, and satisfaction. *Anesth Analg*. 2017;124:542–547.
  18. Faul F, Erdfelder E, Lang AG, et al. G\*Power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behav Res Methods*. 2007;39:175–191.
  19. Faul F, Erdfelder E, Buchner A, et al. Statistical power analyses using G\*Power 3.1: Tests for correlation and regression analyses. *Behav Res Methods*. 2009;41:1149–1160.
  20. Archie P, Bruera E, Cohen L. Music-based interventions in palliative cancer care: A review of quantitative studies and neurobiological literature. *Support Care Cancer*. 2013;21:2609–2624.
  21. Daniel E. Music used as anti-anxiety intervention for patients during outpatient procedures: a review of the literature. *Complement Ther Clin Pract*. 2016;22:21–23.
  22. Wang Y, Dong Y, Li Y. Perioperative psychological and music interventions in elderly patients undergoing spinal anesthesia: Effect on anxiety, heart rate variability, and postoperative pain. *Yonsei Med J*. 2014;55:1101–1105.
  23. Bae I, Lim HM, Hur MH, et al. Intra-operative music listening for anxiety, the BIS index, and the vital signs of patients undergoing regional anesthesia. *Complement Ther Med*. 2014;22:251–257.
  24. Hudson BF, Ogden J, Whiteley MS. Randomized controlled trial to compare the effect of simple distraction interventions on pain and anxiety experienced during conscious surgery. *Eur J Pain*. 2015;19:1447–1455.
  25. Chantawong N, Charoenkwan K. Effects of music listening during loop electro-surgical excision procedure on pain and anxiety: a randomized trial. *J Low Genit Tract Dis*. 2017;21:307–310.
  26. Danhauer SC, Vishnevsky T, Campbell CR, et al. Music for patients with hematological malignancies undergoing bone marrow biopsy: a randomized controlled study of anxiety, perceived pain, and patient satisfaction. *J Soc Integr Oncol*. 2010;8:140–147.
  27. Jeppesen E, Pedersen CM, Larsen KR, et al. Music does not alter anxiety in patients with suspected lung cancer undergoing bronchoscopy: a randomised controlled trial. *Eur Clin Respir J*. 2016;3:33472.
  28. Lee KC, Chao YH, Yiin JJ, et al. Effectiveness of different music-playing devices for reducing preoperative anxiety: a clinical control study. *Int J Nurs Stud*. 2011;48:1180–1187.
  29. Lee D, Henderson A, Shum D. The effect of music on preprocedure anxiety in Hong Kong Chinese day patients. *J Clin Nurs*. 2004;13:297–303.
  30. Salamon E, Bernstein SR, Kim SA, et al. The effects of auditory perception and musical preference on anxiety in naive human subjects. *Med Sci Monit*. 2003;9:CR396–399.
  31. Cepeda MS, Carr DB, Lau J, et al. Music for pain relief. *Cochrane Database Syst Rev*. 2006;CD004843.
  32. Matsota P, Christodouloupoulou T, Smyrnioti ME, et al. Music's use for anesthesia and analgesia. *J Altern Complement Med*. 2013;19:298–307.
  33. Kuhlmann AYR, de Rooij A, Kroese LF, et al. Meta-analysis evaluating music interventions for anxiety and pain in surgery. *Br J Surg*. 2018;105:773–783.
  34. Graversen M, Sommer T. Perioperative music may reduce pain and fatigue in patients undergoing laparoscopic cholecystectomy. *Acta Anaesthesiol Scand*. 2013;57:1010–1016.
  35. Reza N, Ali SM, Saeed K, et al. The impact of music on postoperative pain and anxiety following cesarean section. *Middle East J Anaesthesiol*. 2007;19:573–586.