Original Article

Effect of Music During General Anesthesia on Anesthetic Consumption During Vitrectomy Surgery

Ardeshir Tajbakhsh[1], Sohrab Salimi[1], Narsis Daftarian[2], Dariush Abtahi[1]

[1]Department of Anesthesiology, School of Medicine, Anesthesiology Research Center, Imam Hossein Hospital, Shahid Beheshti University of Medical Sciences, Tehran, Iran, [2]Ophthalmology and Vision Science, Shahid Beheshti University of Medical Sciences, Tehran, Iran

Abstract

Background: Controversy remains about the positive role of music during general anesthesia and postoperative recovery. We, therefore, tested the hypothesis that intraoperative exposure to classical music reduces the propofol necessary to maintain the bispectral index (BIS) close to 50 during vitrectomy surgery.

Materials and Methods: This double-blind clinical study is evaluating 50 patients undergoing vitrectomy surgery under general anesthesia. Patients were randomly assigned to music and white noise groups, and relevant sounds were played to patients after induction of anesthesia. The two groups were compared for the use of propofol as an anesthetic to maintain a BIS near 50 and for postoperative pain, anxiety, nausea, and vomiting.

Results: Propofol consumption to maintain the set BIS score was much lower in the music group than in the white noise group (78.72 ± 25.76 microgram/kg/min and 117.91 ± 36.78 microgram/kg/min, respectively, *P*-value = 0.000). Postoperative pain scores were also much lower in the music group than in the white noise group (*P*-value = 0.000) and anxiety levels between these two groups did not differ (*P*-value = 0.870). No patient in the music group had complaints of postoperative nausea and vomiting (PONV) compared to six patients in the white noise group (*P*-value = 0.011).

Conclusions: Listening to music during general anesthesia for vitrectomy surgery can reduce the use of anesthetics, postoperative pain, and PONV. Further, controlled studies are necessary to confirm our results.

Keywords: General anesthesia, music, pain management, vitrectomy

Address for correspondence: Dr. Dariush Abtahi, Department of Anesthesiology, Imam Hossein General Hospital, Shahid Madani Street, Tehran - 1617763141, Iran.
E-mail: drdariushabtahi@yahoo.com
Submitted: 29-Dec-2022; **Revised:** 31-Jan-2023; **Accepted:** 01-Feb-2023; **Published:** 21-Mar-2023

Introduction

Numerous studies have shown that anxious patients have concerns about their overall outcome and postoperative pain control during their planned surgery and anesthesia.[1,2] These can increase their stress markers and cause fluctuations in their hemodynamics that could adversely affect their postoperative recovery.[3] Pharmacological agents are commonly used to relieve patients' perioperative anxiety and pain, but patients can experience significant side effects that limit their use. Therefore, music can be a very desirable non-pharmacological alternative that is inexpensive and has almost no side effects.

Access this article online

Quick Response Code:

Website: www.advbiores.net

DOI: 10.4103/abr.abr_444_22

Vitrectomy is one of the most common eye surgeries worldwide[4] and most patients who undergo this surgery have various underlying conditions such as diabetes, hypertension, ischemic heart disease, or heart failure. Because of anesthetics' effects on vital organs such as the heart and respiratory system, performing general anesthesia under these conditions can be associated with complications in these systems. To reduce these risks, efforts are being made to use safer methods of anesthesia. Various anesthetic procedures have been proposed for this type of surgery, but to date, there has not been sufficient evidence of a suitable procedure.[4] One of these methods is the use of

How to cite this article: Tajbakhsh A, Salimi S, Daftarian N, Abtahi D. Effect of music during general anesthesia on anesthetic consumption during vitrectomy surgery. Adv Biomed Res 2023;12:59.

low doses of anesthetics, and using any method that reduces the use of these drugs can reduce the potential risks.

The development of psychoanalysis in the twentieth century introduces music therapy as a non-pharmacological, economical, and safe method. Current studies support music therapy as an effective way to reduce anxiety and pain.[5-7]

Evidence of memory and awareness during general anesthesia indicates that some cognitive functions are preserved in surgical patients who appear to be adequately anesthetized (i.e., unaware of what is happening in the operating room). This finding has important implications for both clinical studies and memory research.[8,9]

Music therapy during abdominal and cancer surgeries has been associated with hemodynamic stability and reduction of postoperative complications.[5] This modality is also used to facilitate the extubation procedure in the intensive care unit and to cause relaxation in spinal anesthesia.[10,11] Various studies suggested music therapy during or after surgical procedures, but this has not yet been implemented due to insufficient evidence and/or technical problems.

A 2016 systematic review showed that music was effective in reducing anxiety, but pointed to the need for more detailed investigations.[12] On the other hand, some investigators rejected these concepts due to patients' passive listening and the staff's music choices.[5] It should also be noted whether the music is causing these effects or whether any frequency detected by the auditory cortex would have the same effect. To investigate this thesis, white noise was introduced.

One of the main disadvantages of some previous studies was the inappropriate determination of the control group. In the present study, white noise was used to create a standard group. White noise is a type of sound obtained by combining different sound frequencies. If you combine all conceivable tones that humans can hear, white noise is created. It is called "white" because the density function of its power spectrum is nearly constant at all frequencies. The adjective "white" is chosen here for the same reason it is used to describe white light. White noise is used in medicine to mask other sounds, like tinnitus. Because of its neutral nature, it is used to match control groups in music therapy studies.[11,13]

Due to limited and conflicting data on the role of music during surgery under general anesthesia, we hypothesize that the calming effects of classical music during general anesthesia may result in reducing the need for anesthetics during surgery. This study aimed to investigate the effect of classical music on the amount of anesthesia used during vitrectomy. In addition, pain, anxiety, and postoperative nausea and vomiting (PONV) were examined.

Materials and Methods

This randomized clinical study was conducted on patients with American Society of Anesthesiology (ASA) classification I and II undergoing vitrectomy surgery. After approval by institutional committee for ethics and clinical trial, and obtaining informed consent from the patients, all patients over 18 years of age who were referred to the operating room for vitrectomy surgery were included in this study. Patients with hearing impairments, mental health problems, prolonged use of tranquilizers or analgesics, and those with alcoholism or other illicit drug addictions were excluded from the study. None of the patients received anti-anxiety medication before surgery, and they were only taking medications related to their chronic conditions, such as diabetes and high blood pressure, on the day of surgery. Three patients were excluded from the study due to the use of hypnotics (benzodiazepines), two patients were excluded due to dissatisfaction, and finally, 50 patients were randomized into two equal groups of music (M) and white noise (W) [Figure 1].

As soon as the patients entered the operating room, they underwent standard monitoring with non-invasive blood pressure, electrocardiogram, and pulse oximetry. In addition, the bispectral index was used to monitor the depth of anesthesia and the BIS VISTA device (Aspect Medical Systems, Newton, MA USA) was used to monitor the depth of anesthesia.

General anesthesia was performed in all patients by the same method with intravenous injection of midazolam 0.02 mg/kg and fentanyl 2 micrograms/kg as premedication three minutes before induction. Intravenous injections of lidocaine 1 mg/kg, propofol 1.5 mg/kg, and atracurium 0.5 mg/kg were used for induction. The laryngeal mask was used for airway management in all patients and mechanical ventilation was initiated to maintain ETCO2 close to 30 mmHg. Propofol was used to maintain the BIS at about 50 throughout the procedure. After anesthesia induction, standard music player headphones (BT Trek, Stori Beat, and Move BT) were placed in the correct position for all patients, and the anesthesiologist blindly selected either the music files (M group) or white noise (W group) per random number from the table. Classical music was selected from a previous study. Kuan *et al*. suggested three unfamiliar relaxing music: Appalachian Spring: Ballet for Martha, by Copeland; Florida Suite: III Sunset-Near the

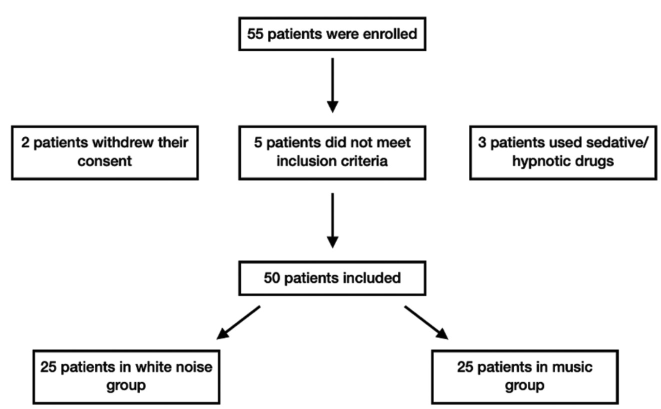

Figure 1: 50 patients were randomized into two equal groups of music (M) and white noise (W)

Plantation, by Delius; The Birds: The Dove, by Respighi.[14] They are introduced as more relaxing than known music. So, we decided to use these three pieces and call them classical music. Loudness was verified using audio samples for patient comfort. To prevent possible hearing damage, the volume was turned up to a maximum of 85 dB by the recommendation of the World Health Organization. The headphones stayed in place until the end of the operation. At the end of the operation, the sound stopped and the headphones were removed. Blood pressure, heart rate, and BIS score were recorded at baseline and every 15 minutes during anesthesia. The amount of propofol used was recorded. Vital signs, pain intensity, the presence of nausea or vomiting, and restlessness were assessed in the recovery room. Pain intensity was measured on a 10-grade visual analog scale (VAS), from no pain (= 0) to maximal possible pain (= 10). Agitation was measured using the Riker Sedation-Agitation Scale [Table 1].[15]

Data analysis was performed using SPSS software version 17. Due to the normality of the statistical population distribution (confirmed by the Kolmogorov-Smirnov test), the Chi-square test was used to examine qualitative variables and the independent *t*-test was used to examine quantitative variables and the significance level was less than 0.05 in all cases.

Results

In this study, 50 patients were divided equally into two groups, music and white noise. Due to the normal statistical distribution of the population, an independent *t*-test was used to compare mean age and body mass index and there was no significant difference between the two groups. Using the Chi-square test, it was observed that there was no significant difference between the two groups in terms of the sex of the study participants. In both groups, the number of individuals of both sexes was equal.

The patients' hemodynamic status was assessed before and after anesthesia, including measurements of blood pressure and heart rate. Before anesthesia, systolic, diastolic, and mean blood pressures were insignificantly higher in the M group than in the W group (*P*-value was 0.77, 0.75, and 0.29, respectively). This difference between the two groups was reduced after surgery and in the recovery room, and was also not significant. The mean heart rate before surgery was significantly lower in the M group which was 80 ± 16 vs. 91 ± 15 in M and W groups, respectively (*P*-value = 0.02). This difference was reduced in the recovery room and became insignificant (*P*-value = 0.51) [Table 2].

Only six (24%) of the participants in the W group developed postoperative nausea in the recovery room, which was mild and required no medical treatment. No one in the M group experienced postoperative nausea or vomiting. No vomiting was reported in either group. There were significant differences between the two groups (*P*-value = 0.011). As propofol itself is an antiemetic, the low prevalence of nausea and vomiting in the study population was to be expected.

The postoperative pain intensity was evaluated by the standard VAS method, and it showed that the mean pain intensity in the M group was significantly lower than in the W group (*P*-value = 0.000). Moderate pain was reported in 3 (12%) in the M group and 18 (72%) in the W group.

Table 1: Riker Sedation-Agitation Scale

Score	Description	Explanation
7	Dangerous agitation	Tries to remove monitors and devices or climb out of bed; tosses and turns; lashes out at staff
6	Very agitated	Remains restless despite frequent verbal reassurance; bites endotracheal tube; requires restraint
5	Agitated	Anxious or restless; attempts to move; calms down with reassurance
4	Calm and cooperative	Calm; easy to arouse; able to follow instructions
3	Sedated	Difficult to awaken; responds to verbal prompts or gentle shaking but drifts off again
2	Very sedated	Incommunicative; responds to physical stimuli but not verbal instructions; may move spontaneously
1	Unarousable	Incommunicative; little or no response to painful stimuli

Table 2: Vital signs before and after anesthesia

Parameter	Music group		Wight noise group		*P*
	Mean	Std. Deviation	Mean	Std. Deviation	
SBP before anesthesia, mmHg	145.68	20.30	135.16	20.89	0.770
DBP before anesthesia, mmHg	85.24	13.79	84.00	13.742	0.752
MAP before anesthesia, mmHg	105.38	13.77	101.05	15.14	0.295
HR before anesthesia,/minute	80.92	16.75	91.20	15.36	0.028
SBP in the recovery room, mmHg	141.72	13.32	133.60	19.98	0.097
DBP in the recovery room, mmHg	86.72	9.17	84.04	9.84	0.324
MAP in the recovery room, mmHg	105.05	8.13	100.56	12.05	0.129
HR in the recovery room,/minute	75.76	11.88	86.48	24.04	0.51

SBP=Systolic blood pressure, DBP=Diastolic blood pressure, MAP=Mean arterial pressure, HR=Heart rate

Riker Sedation-Agitation Scale was used to evaluate the level of calmness of patients in the recovery room. Although it was lower in the M group, it wasn't statistically significant (*P*-value = 0.164) [Table 3].

The duration of anesthesia was longer in the M group and the difference between the two groups was not significant (*P*-value = 0.962). For standardization, we calculated propofol consumption based on patient weight and duration of anesthesia. Mean propofol consumption was significantly lower in the music group (78.72 ± 25.76 and 117.91 ± 36.78 micrograms/kg/min in M and W groups, respectively) (*P*-value = 0.000).

Discussion

Postoperative recovery has focused on pharmacological interventions to minimize pain, nausea, and vomiting, and agitation during the postoperative period. Our results tentatively suggest a role for non-pharmacological interventions. We propose that the use of music during general anesthesia may positively impact postoperative recovery after vitrectomy.

There have been mixed reports of the benefits of music in reducing perioperative anxiety, anesthetics or sedatives, and pain. Music is relatively ineffective when a pain stimulus is severe.[16] A review article by Matsota *et al*. concluded that music's effectiveness depends on the patient's individual disposition.[17]

Previous studies have measured the effect of music on patients' anxiety before and after surgery. A study by Ajorpaz *et al*. in 2011 showed that listening to music in the waiting room before surgery reduced patients' anxiety.[18] Koch *et al*. showed the positive effect of this method on reducing anxiety during spinal anesthesia.[19] A study by Al-Jubouri *et al*. in 2021 showed that music reduces anxiety before chemotherapy.[20] Binns-Turner *et al*. and Kahloul *et al*. showed a reduction in postoperative anxiety in the music therapy group.[21,22] We used the Riker Sedation-Agitation Scale to assess patients' level of calmness in the recovery room and found no significant association (*P*-value = 0.164).

In a crossover clinical trial conducted by Choi *et al.*, there was a significant effect of music on reducing pain experienced by patients during cataract surgery.[23] Koch *et al*. also showed reduced pain from intraoperative music in patients undergoing lithotripsy treatment who received patient-controlled intravenous opioid analgesia.[19]

In the above studies, the effect of auditory interventions was on conscience patients. But, in a study by Ikedo *et al*. in 2007, people undergoing general anesthesia for heart surgery were divided into three groups: the first group by hearing sounds of prayer, the second group by hearing a soothing sound using the Hemi-Sync technique, which is said to coordinate the two brain hemispheres, and the third group without hearing intervention. In contrast to our study, this study showed no difference between the groups regarding general complications after the operation.[24] Nikandish *et al*. in 2007 showed that the use of Spanish music during general anesthesia for cesarean section did not affect postoperative anxiety and nausea compared to the control group. In their study, no auditory intervention was carried out in the control group either.[25] In the 2016 Kahloul study, music therapy under general anesthesia during abdominal surgery showed favorable outcomes, and control of systolic blood pressure, arousal quality, and postoperative pain intensity were better than in the control group. Again, their control group had no auditory intervention.[22] Szmuk showed that the end-tidal concentration of sevoflurane required to maintain the BIS near 50 during laparoscopic cholecystectomy was virtually identical in patients exposed to music or not.[26] In the present

Table 3: Gender, PONV, pain, and sedation/agitation results in the music and white noise groups

Parameter	Music group		White noise group		*P*
	Numbers	%	Numbers	%	
Gender					
Male	11	44.0	12	48.0	0.571
Female	14	56.0	13	52.0	
PONV					
None	25	100.0	19	76.0	0.011
Mild	0	00.0	6	24.0	
Severe	0	00.0	0	00.0	
Pain					
Mild	22	88.0	7	28.0	0.000
Moderate	3	12.0	18	72.0	
Severe	0	00.0	0	00.0	
Sedation/Agitation (based on the Riker Sedation-Agitation Scale					
Sedate	12	48.0	12	48.0	0.870
Calm	12	48.0	7	28.0	
Agitate	1	4.0	6	24.0	

PONV=Postoperative nausea and vomiting

study, it was shown that listening to music during general anesthesia could reduce the dose of propofol without losing adequate anesthetic depth. Using fewer anesthetics during surgery reduces the likelihood of hemodynamic changes during surgery. This also helps to better awaken after the anesthesia. We tried to consider a fixed BIS number for individuals to measure the total dose of propofol during surgery. This method results in less propofol consumption, thereby reducing the possible side effects.

The 2001 Nilsson reported no beneficial effect of listening to music during surgery in reducing PONV.[27] Nikandish also failed to demonstrate the benefit of music in reducing PONV.[25] In the present study in the music group, there was no case of postoperative nausea or vomiting. Twenty-four percent of the control group suffered from mild nausea in the recovery room. Although this effect was statistically confirmed in our study (P-value = 0.011), a larger study is recommended to investigate this effect due to the small number of cases.

Cepeda *et al*. found that several nonpharmacological therapies had a minimal impact when a painful stimulus was moderate-to-severe.[16] A 2010 study by Whitaker *et al*. showed a significant reduction in postoperative pain by music[28] and Schneider and Kahloul confirmed similar effects.[22,29] In the present study, increasing average pain intensity in the W group was seen and differences between the two groups were significant (P-value = 0.000). Again, this secondary consequence may require increasing the sample size to show a significant impact. Our results differ from several studies and this discrepancy could be related to the type of music played.

Conclusion

Technological advancements help people to easily listen to music and access a variety of music genres. In our study, the effect of listening to music during surgery on reducing the need for anesthesia and, nausea and vomiting after vitrectomy was confirmed, and because of its easily administered, low cost, and safety as a non-pharmacological method, it can be used during surgery with better control of vital functions, reduction of postoperative complications, and costs. Our study had limitations such as differences in patients' psychological backgrounds and their possible responses to listening to music in the operating room. In addition, the prevalence of COVID-19 disease prevented us from conducting the study in large numbers and the study was conducted with an acceptable minimum number. For a more detailed study of the effect of listening to music, it is recommended to use a larger sample size and a variety of different operations.

Acknowledgment

The authors would like to thank the staff of the operating room personnel at Imam Hossein Hospital.

Financial support and sponsorship

This project was funded entirely by intramural departmental sources dedicated to the research project. The authors received no other specific grant for the study from the public, commercial, or not-for-profit sectors.

Conflicts of interest

There are no conflicts of interest.

References

1. Maranets I, Kain ZN. Preoperative anxiety and intraoperative anesthetic requirements. Anesth Analg 1999;89:1346.
2. Kain ZN, Sevarino F, Alexander GM, Pincus S, Mayes LC. Preoperative anxiety and postoperative pain in women undergoing hysterectomy. A repeated-measures design. J Psychosom Res 2000;49:417-22.
3. Bradt J, Dileo C, Shim M. Music interventions for preoperative anxiety. Cochrane Database Syst Rev 2013;6:CD006908.
4. Licina A, Sidhu S, Xie J, Wan C. Local versus general anaesthesia for adults undergoing pars plana vitrectomy surgery. Cochrane Database Syst Rev 2016;9:CD009936.
5. Palmer JB, Lane D, Mayo D, Schluchter M, Leeming R. Effects of music therapy on anesthesia requirements and anxiety in women undergoing ambulatory breast surgery for cancer diagnosis and treatment: A randomized controlled trial. J Clin Oncol 2015;33:3162-8.
6. Masuda T, Miyamoto K, Shimizu K. Effects of music listening on elderly orthopaedic patients during postoperative bed rest. http://dx.doi.org/101080/08098130509478121 [Internet]. 2009;14:4-14. Available from: https://www.tandfonline.com/doi/abs/100.1080/08098130509478121. [Last accessed on 2022 Dec 01].
7. Martin-Saavedra JS, Ruiz-Sternberg AM. The effects of music listening on the management of pain in primary dysmenorrhea: A randomized controlled clinical trial. https://doi.org/101080/0809813120201761867 [Internet]. 2020 Oct 19 [cited 2022 Dec 1];29(5):398–415. Available from: https://www.tandfonline.com/doi/abs/100.1080/08098131.2020.1761867.
8. Dowd NP, Cheng DC, Karski JM, Wong DT, Munro JA, Sandler AN. Intraoperative awareness in fast-track cardiac anesthesia. Anesthesiology 1998;89:1068-73.
9. Bonebakker AE, Jelicic M, Passchier J, Bonke B. Memory during general anesthesia: Practical and methodological aspects. Conscious Cogn 1996;5:542-61.
10. Riker RR, Fraser GL, Simmons LE, Wilkins ML. Validating the sedation-agitation scale with the bispectral index and visual analog scale in adult ICU patients after cardiac surgery. Intensive Care Med 2001;27:853-8.
11. Ilkkaya NK, Ustun FE, Sener EB, Kaya C, Ustun YB, Koksal E, *et al*. The effects of music, white noise, and ambient noise on sedation and anxiety in patients under spinal anesthesia during surgery. J Perianesth Nurs 2014;29:418-26.
12. do Amaral MAS, Neto MG, de Queiroz JG, Martins-Filho PRS, Saquetto MB, Oliveira Carvalho V. Effect of music therapy on blood pressure of individuals with hypertension: A systematic review and Meta-analysis. Int J Cardiol 2016;214:461-4.
13. Son SM, Kwag SW. Effects of white noise in walking on walking time, state anxiety, and fear of falling among the elderly with mild dementia. Brain Behav 2020;10:e01874.
14. Kuan G, Morris T, Terry P. Effects of music on arousal during imagery in elite shooters: A pilot study. PLoS One 2017;12:e0175022.
15. Riker RR, Fraser GL. Monitoring sedation, agitation, analgesia, neuromuscular blockade, and delirium in adult ICU patients. Semin Respir Crit Care Med 2001;22:189-98.
16. Cepeda MS, Diaz JE, Hernandez V, Daza E, Carr DB. Music does not reduce alfentanil requirement during patient-controlled analgesia (PCA) use in extracorporeal shock wave lithotripsy for renal stones. J Pain Symptom Manage 1998;16:382-7.
17. Matsota P, Christodoulopoulou T, Smyrnioti ME, Pandazi A, Kanellopoulos I, Koursoumi E, *et al*. Music's use for anesthesia and analgesia. J Altern Complement Med 2013;19:298-307.
18. Mirbagher Ajorpaz N, Aghajani M, Shahshahani M. The effects of music and Holy Quran on patient's anxiety and vital signs before abdominal surgery. Evidence Based Care 2011;1:63-76.

19. Koch ME, Kain ZN, Ayoub C, Rosenbaum SH. The sedative and analgesic sparing effect of music. Anesthesiology 1998;89:300-6.
20. Al-Jubouri MBA, Isam SR, Hussein SM, Machuca-Contreras F. Recitation of quran and music to reduce chemotherapy-induced anxiety among adult patients with cancer: A clinical trial. Nurs Open 2021;8:1606-14.
21. Binns-Turner PG, Wilson LL, Pryor ER, Boyd GL, Prickett CA. Perioperative music and its effects on anxiety, hemodynamics, and pain in women undergoing mastectomy. AANA J 2011;79 (4 Suppl):S21-7.
22. Kahloul M, Mhamdi S, Nakhli MS, Sfeyhi AN, Azzaza M, Chaouch A, *et al*. Effects of music therapy under general anesthesia in patients undergoing abdominal surgery. Libyan J Med 2017;12:1260886.
23. Choi S, Park SG, Bellan L, Lee HH, Chung SK. Crossover clinical trial of pain relief in cataract surgery. Int Ophthalmol 2018;38:1027-33.
24. Ikedo F, Gangahar DM, Quader MA, Smith LM. The effects of prayer, relaxation technique during general anesthesia on recovery outcomes following cardiac surgery. Complement Ther Clin Pract 2007;13:85-94.
25. Reza N, Ali SM, Saeed K, Abul-Qasim A, Reza TH. The impact of music on postoperative pain and anxiety following cesarean section. Middle East J Anaesthesiol 2007;19:573-86.
26. Szmuk P, Aroyo N, Ezri T, Muzikant G, Weisenberg M, Sessler DI. Listening to music during anesthesia does not reduce the sevoflurane concentration needed to maintain a constant bispectral index. Anesth Analg 2008;107:77-80.
27. Nilsson U, Rawal N, Unest•hl LE, Zetterberg C, Unosson M. Improved recovery after music and therapeutic suggestions during general anaesthesia: A double-blind randomised controlled trial. Acta Anaesthesiol Scand 2001;45:812-7.
28. Whitaker MH. Sounds soothing: Music therapy for postoperative pain. Nursing 2010;40:53-4.
29. Schneider MA. The effect of listening to music on postoperative pain in adult orthopedic patients. J Holist Nurs 2018;36:23-32.