Full-length article

Effect of music therapy on propofol consumption in patients for laparoscopic cholecystectomy under TIVA (Total Intravenous Anaesthesia)

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Abstract
Traditionally, a combination of drugs and blocks have been used to provide balanced anaesthesia and make the perioperative experience satisfying for the patient. However, varying groups of anaesthetic agents have certain limitations. Music therapy has shown promising results in reducing perioperative stress thereby decreasing the requirement of anaesthetic agents needed. This research aims to study the effect of intraoperative music therapy on propofol consumption. A randomized controlled trial was conducted in patients undergoing laparoscopic cholecystectomy under TIVA (Total Intravenous Anaesthesia). Patients were randomly allocated to two groups (Music - M and Control - C) and specific selected music was played using noise cancelling headphones in group M. The primary outcome was to compare consumption of propofol (mg/kg/hr) required. The secondary objectives were to compare intra-operative hemodynamic parameters, additional intraoperative fentanyl required, quality of awakening, patient satisfaction, and change in serum cortisol levels in the two groups. Total propofol consumption was significantly reduced in group M. Group M also showed a significantly reduced fentanyl requirement, improved hemodynamic stability, a reduction in post operative serum cortisol levels and an improved quality of awakening. Intraoperative music therapy can be used as a simple, non-pharmacological method to reduce anaesthetic requirement and aid in reducing perioperative stress.

Keywords*:* anaesthesia, music therapy, total intravenous anaesthesia, laparoscopic cholecystectomy

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Introduction

In patients undergoing general anaesthesia for surgery, both pharmacological and non-pharmacological methods have been used to ease unpleasant experiences, provide optimum anaesthetic depth and adequate perioperative analgesia[1]. However, varied groups of anaesthetic agents have their own limitations like adverse intraoperative hemodynamic effects, delayed recovery, post operative nausea and vomiting, respiratory depression etc. Using a non-pharmacological method such as music therapy has shown promising results in reducing perioperative stress and thereby decreasing the requirement of sedatives or anaesthetic agents[2,3].

It has been suggested that auditory stimulus can be perceived even under general anaesthesia and therefore optimum activation of auditory pathways might be used to decrease the perception of pain[4,5]. Listening to music can reduce sympathetic nervous activity and decreases serum cortisol levels and also increase endogenous opioids and oxytocin[6,7]. Genres like classical music, smooth jazz, and instrumental pieces with calming sounds are frequently linked to relaxation; flute and piano are two instruments that show preference[8,9].

Hence, we conducted a study to assess the effect of intraoperative music therapy, with specific music- on total propofol consumption in patients undergoing laparoscopic cholecystectomy under general anaesthesia with Total Intravenous Anaesthesia(TIVA) using Target controlled Infusion (TCI) pump with the Schneider model and BIS monitoring.

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Dr. Tanvi Goel | Address: 403, BL Taneja Block, Department of Anaesthesiology & Intensive Care, Maulana Azad Medical College, New Delhi-110002, India | E-mail: tanvigoel1902@gmail.com | COI statement: The authors declared that no financial support was given for the writing of this article. The authors have no conflict of interest to declare.

Methods

The study was commenced after obtaining clearance from Institutional Ethics Committee (vide approval number: F.1/IEC/MAMC/MD/MS (92/04/2022/N0.243 dated August 29, 2022) and registration under Clinical Trials Registry- India (CTRI/2023/03/051132) dated March 28, 2023. The study was conducted from March 2023 to January 2024. Written informed consent from the patients was obtained for participation in the study and the use of study data for research and educational purposes. The study was conducted by the principles of the Declaration of Helsinki, 2013 and Good Clinical Practice guidelines.

A randomized controlled trial was conducted over one year in 56 patients between 18 to 65 years of age with ASA status I and II undergoing laparoscopic cholecystectomy under TIVA. Any patient with hearing impairment, psychiatric disorder or BMI >=30 was excluded. The patients were asked to choose their preferred music from two prerecorded instrumental musical pieces instituted as the music therapy. We used non lyrical, soft, slow tempo, relaxing instrumental musical pieces of either flute [click here for audio] or piano [click here for audio] as the choices presented to the patient.

The musical pieces were selected based on their slow and meditative tempo (60-100 beats per minute), and only non - lyrical instrumental piano or flute based versions were chosen.

The flute version which was preferred by most patients was a combination of Raga Yaman and Raga Kirwani. Raga Yaman is bright and uplifting and Raga Kirwani is known for its soothing and calming effects. Combining these two Hindustani classical ragas provides musically uplifting qualities that could be helpful in reducing the stress associated with surgical procedures and control the hemodynamic responses to surgery. Noise cancelling headphones were used to play the instrumental pieces at 60db. The musical piece was played for the entire duration of the surgery on loop using blue tooth connectivity of the headphones with a mobile phone.

Since there was a paucity of literature, we conducted a pilot study for the calculation of sample size with 4 cases in the music group and 4 in the control group (no music). Mean propofol requirement in music therapy group was 4.32 ±0.86 mg/kg/hr in comparison to control group which was 5.68 ± 1.26 mg/kg/hr. At 95% confidence level and 90% power and assuming a 10% attrition rate, the sample size was calculated as 28 per group.

A detailed pre-anaesthetic check-up (PAC) and routine investigations as per institutional protocol was done. Patients were randomised using a computer-generated random number table into two groups in a 1:1 allocation ratio (https://www.randomizer.org/;Urbaniak GC, Plous S 2013, Lancaster, Pennsylvania, USA). On the day of surgery, one hour prior to induction, baseline sample for serum cortisol estimation was collected. In OT, all standard ASA monitors were attached to the patient along with BIS (Bispectral Index) monitor. Noise cancelling headphones were applied for blinding in both the groups. Inj. fentanyl 2mcg/kg and inj. midazolam 1mg was given intravenously as premedication. The recorded music was started in the music group (group M) through headphones at 60 decibels while no music intervention was given in the control group (group C). Induction was done with inj. propofol using TCI (Target Controlled Infusion) pump with effect site concentration set to 3 mcg/ml using Schneider regime and titrated to achieve a BIS of 40-60 and inj. atracurium 0.5mg/kg was given to achieve neuromuscular blockade. Airway was secured using I-gel of appropriate size and TIVA with propofol was continued maintaining BIS between 40-60. Intraoperative analgesia was maintained with intermittent dose of injection fentanyl 0.5 mcg/kg if the mean arterial pressure or heart rate increased by more than 20% of baseline values. The total intraoperative fentanyl consumed was recorded. At the end of the procedure, port sites were infiltrated with 10 ml of 0.25% bupivacaine and propofol infusion was stopped. The total amount of propofol consumed was recorded in both the groups. The residual neuromuscular blockade was reversed with injection neostigmine 50mcg/kg and injection glycopyrrolate 10mcg/kg intravenously. The I-gel was removed after patient became responsive and had adequate neuromuscular recovery. Subsequently, music therapy was stopped. Quality of awakening was assessed by RIKER SCALE and patient was shifted to PACU. Post operative pain score was assessed by the numerical rating scale. Blood sample for serum cortisol was taken one hour later and patient satisfaction score using the Likert scale was recorded 24 hours post-surgery.

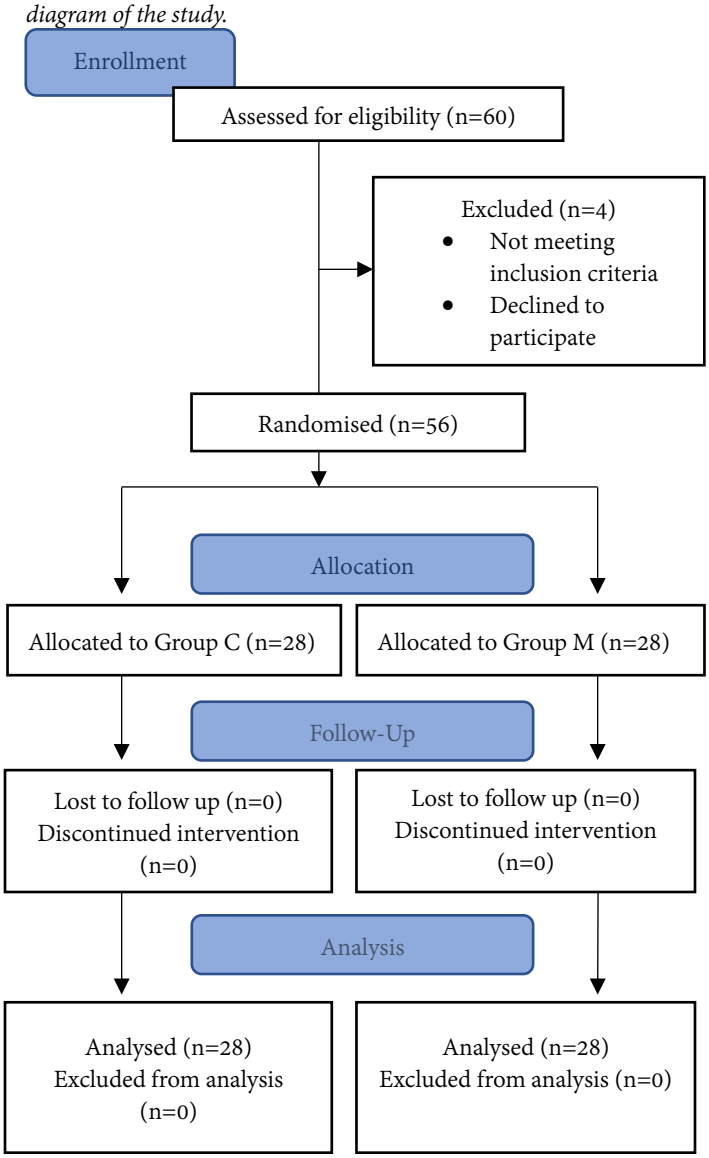
Figure 1. *Image showing patient with headphones and ongoing propofol infusion via the TCI pump.*

Statistical software SPSS version 25.0 was used in the analysis. Categorical variables were presented in number and percentage (%) and continuous variables were presented as mean ± SD. Statistical tests were applied with normality of data being checked by Kolmogrov Sminroff test. Qualitative variables were compared using Chi-Square test or Fisher's exact test. Quantitative variables were compared using Student 't' test. Pre-test and post-test comparison was done using Mann Whitney or Wilcoxon Signed Rank test. A P-value less than 0.05 was considered statistically significant.

Results

The CONSORT diagram elaborates on the flow of study participants. (Figure 2)

Figure 2. *Consolidated Standards Of Reporting Trials (CONSORT) diagram of the study.*



The baseline serum cortisol levels taken preoperatively for group C (249.93± 99.292 IU/ml) and group M (254.29± 128.546 IU/ml) were comparable (P=0.838). Serum cortisol levels were repeated after 1 hour postoperatively had risen in both the groups and mean values reported in group C were 536.18± 140.909 IU/ml and group M were 417.82±142.651 IU/ml. The rise in postoperative serum cortisol levels was found to be significantly higher in group C (P=0.004). (Figure 3)

Table 1. *Table showing demographic characteristics of both the groups.*

	Group C (n=28)	Group M (n=28)	P value
Age (years)	35.14±9.22	33.39±9.07	0.447
Gender (M/F)	4/24	4/24	1.000
Weight (kg)	58.11 ±7.748	57.82 ±7.087	0.886
ASA I & II	21 & 7	20 & 8	0.763

The intraoperative heart rate in both the groups was comparable at all times (P>0.05). The systolic blood pressure was found to be significantly lower from time points 30 to 45 minutes in the group M (p<0.05). Similar results were found in diastolic blood pressure and mean arterial pressure at 30 minutes to 45 minutes time points during surgery (P<0.05). (See Table 2 at the appendix)

The duration of surgery was similar in both the groups and hence the duration of propofol administration was also comparable in both the groups (P=0.704). However, the mean propofol consumption in group M (6.7082± 0.96412 mg/kg/hr) was significantly lower in group M than in group C (7.8643± 1.43 mg/kg/hr) with a P value of 0.001. (Table 3)

Table 3. *Table showing mean propofol consumed via TCI pump in both the groups.*

	Group C (n=28)	Group M (n=28)	P value
Amount of propofol consumed (mg/kg/hr)	7.864 3± 1.43	6.7082± 0.96412	0.001

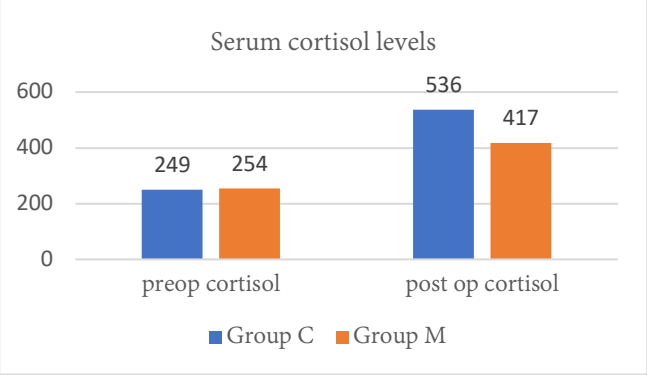
The additional intraoperative dose of fentanyl required was much lesser in group M and the difference was statistically significant. (P= 0.03). (Table 4)

Table 4. *Table showing additional doses of fentanyl required in both the groups.*

	Group C	Group M	P value
Additional fentanyl required	1.04± 0.637	0.64± 0.678	0.003

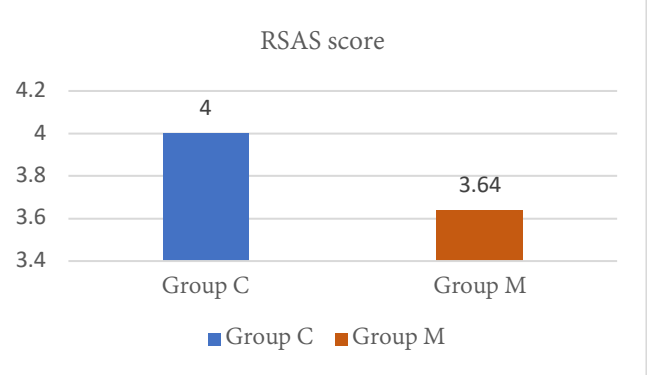
The baseline serum cortisol levels taken preoperatively for group C (249.93± 99.292 IU/ml) and group M (254.29± 128.546 IU/ml) were comparable (P=0.838). Serum cortisol levels were repeated after 1 hour postoperatively had risen in both the groups and mean values reported in group C were 536.18± 140.909 IU/ml and group M were 417.82±142.651 IU/ml. The rise in postoperative serum cortisol levels was found to be significantly higher in group C (P=0.004). (Figure 3)

Figure 3. *Preoperative and postoperative cortisol in both the groups.*



Quality of awakening assessed by RSAS immediately after extubation was found to be significantly better in the music group with a mean score of 3.64± 0.488 (P= 0.001). (Figure 4)

Figure 4. *RSAS scores in both the groups*



The mean patient satisfaction scores were assessed 24 hours post operatively using a Likert scale for satisfaction and found to be comparable in both the groups (P= 0.361). Post operatively mild pain was reported in both the groups, in group C (2.59±1.1) and in group M (2.12±0.94) which were comparable scores with a P value of 0.07, taken 1 hour post operatively.

Discussion

Music therapy has been used as a non-pharmacological intervention in various specialities to improve well-being of patients, reduce their anxiety, manage pain and improve patient outcomes[10,11]. Many cholecystectomies were conducted in India in the year 2022 out of which the majority were laparoscopic procedures[12]. Laparoscopic cholecystectomy is a minimally invasive surgery where the goals of perioperative care include providing optimum anaesthetic depth, adequate perioperative analgesia, easing the unpleasant experience of surgery and enhancing early post operative recovery; thereby facilitating an early discharge.

We decided to use patient selected receptive music therapy as a non- pharmacological tool to aid in the process of achieving these anaesthetic goals by ascertaining its effects on the intraoperative anaesthetic consumption[13-15], serum cortisol levels[16], quality of awakening[17], patient satisfaction score[10,11], and post operative pain scores[18]. The majority of patients in our study chose relaxing flute music (38 patients chose flute and 18 chose piano).

We found that the total intraoperative propofol consumption in the music group (group M - 6.7082 ± 0.96412 mg/kg/hr) was much lower than the control group (group C - 7.8643 ± 1.43 mg/kg/hr) with a P=0.001. Since the rest of the anaesthetic management was the same in the two groups, the decreased requirement of propofol in the music group may be attributed to the effect of intraoperative music in this set of patients. Our findings were similar to those found in the study conducted by Tajbakhsh et al on patients undergoing vitrectomy under general anaesthesia with propofol infusion. They compared music with white noise and found that mean propofol consumption was significantly lower in the music group (78.72 ± 25.76 micrograms/kg/min) than in the white noise group (117.91 ± 36.78 micrograms/kg/min) (P- 0.000)[13]. Similarly, Kar et al studied the effect of music in patients undergoing cardiopulmonary bypass using Indian Raga therapy. 34 patients undergoing bypass were included out of which 17 received music and 17 were the control group where a blank CD was played. They found that the intra operative mean propofol requirement was significantly less in the music group (22.94 ± 2.53 ml) in comparison to the control group (31.76 ± 5.847ml). ($P < 0.05$). These findings are in concordance to our findings as well, where the propofol consumption was found to be significantly reduced in the music group[14].

We found that patients in group M were more hemodynamically stable than the control group C with systolic, diastolic, and mean arterial blood pressure being significantly lower from time points 30 to 45 minutes in the

group M (P<0.05). Binns-Turner conducted a study in women diagnosed with breast cancer undergoing mastectomy[16] in which they compared the effect of music therapy on hemodynamic parameters and anxiety between the test group(music) and the control group. Results showed that the women in the music intervention group experienced a significant reduction in preoperative anxiety and reduction in MAP (Mean Arterial Pressure). Similar to our study they also concluded that the lesser hemodynamic variability observed could be due to the decreased release of epinephrine and nor epinephrine along with cortisol in the music therapy group.

We observed a significantly lower requirement of additional doses of fentanyl (as guided by hemodynamic parameters) in group M as compared to group C (P-0.03). This could also be attributed to the role of endogenous opioids that are released on listening to specific musical pieces, thereby decreasing the analgesic requirement and maintaining stable hemodynamics[17].

Preoperative serum cortisol levels were found to be comparable in all the patients in both the groups, indicating similar preoperative stress levels. On comparing the post operative values, serum cortisol increased from preoperative values in both the groups indicating that there is perioperative stress of surgery, but the rise in cortisol levels was significantly lesser in the music group as compared to the control group (group C- 536.18± 140.909 and group M-417.82±142.651, P<0.004). This signifies that music therapy could have a positive effect on reducing the surgical stress response. The results of our study were similar to that of Kar et al where cortisol levels were found to be significantly reduced in patients who received music therapy with Indian classical music undergoing cardiopulmonary bypass (P<0.001)[14].

The Riker sedation agitation scale (RSAS-Revised Sedation Agitation Scale) score ranges from 1 to 7 where 1 is unarousable, 2 is very sedated, 3 is sedated, 4 is calm and cooperative, 5 is agitated, 6 is very agitated and 7 is dangerous agitation. The majority of our patients (98.2%) included in our study had scores between 3 and 4. The mean score for group C was 4.00± 0.272 and for group M was 3.64± 0.488. This difference was found to be statistically significant (p=0.001) however both groups had similar clinical recovery profile. Kahloul et al had assessed quality of recovery of patients using the Riker scale in a study conducted on 70 patients undergoing abdominal surgery under general anaesthesia and played patient selected music from an Mp3 player for 35 patients[18]. Contrary to our findings, they found a calm recovery in 60.7% of the patients most of the whom were from the music group (P<0.001). While 98.2% of all patients in our study had a score of either 3 or 4 signifying a calm recovery. This may be attributed to the difference in anaesthetic drugs used in the two studies.

Conclusion

In our study, we observed that music therapy reduced the total propofol consumption and decreased the stress response to surgery as assessed by serum cortisol levels. Patients in the music therapy group had a calm recovery and a decrease in the intraoperative fentanyl requirement. Hence, we can conclude that patient selected receptive music therapy may be used as a safe and effective, non-pharmacological aid to reduce intraoperative anaesthetic requirements and improve overall patient outcome with no adverse effects.

Recommendations

- It may be suggested that further clinical trials may be conducted using music therapy in the perioperative period to assess its role and to ensure that it receives due recognition.
- Prospective clinical trials with larger patient cohorts, conducted across multiple centres, employing double-blind, randomized, and controlled methodologies, along with relevant serum markers and other blood investigations, are essential to advance our comprehension in this area.

Limitations

- It was a single centre study on patients undergoing laparoscopic cholecystectomy. The patients were introduced to the pieces of music for a brief period in the PAC giving less time for choice selection.

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APPENDIX

Table 2. *Table showing P values of HR, SBP, DBP and MAP (mmHg) in both the groups.*

Heart Rate (Time in mins)	P value	Systolic Blood pressure (SBP)	P value	Diastolic blood pressure (DBP)	P value	Mean Arterial Pressure (MAP)	P value
HR PREOP	0.288	SBP PREOP	0.129	DBP PREOP	0.089	MAP PREOP	0.108
HR POST INDUCTION	0.243	SBP POST INDUCTION	0.643	DBP POST INDUCTION	0.720	MAP POST INDUCTION	0.779
HR5	0.461	SBP5	0.305	DBP5	0.529	MAP5	0.744
HR10	0.550	SBP10	0.516	DBP10	0.562	MAP10	0.628
HR15	0.530	SBP15	0.117	DBP15	0.129	MAP15	0.057
HR20	0.574	SBP20	0.143	DBP20	0.188	MAP20	0.041
HR25	0.556	SBP25	0.059	DBP25	0.073	MAP25	0.110
HR30	0.955	SBP30	0.001	DBP30	0.032	MAP30	0.019
HR35	0.772	SBP35	0.003	DBP35	0.006	MAP35	0.000
HR40	0.765	SBP40	0.022	DBP40	0.035	MAP40	0.008
HR45	0.636	SBP45	0.006	DBP45	0.040	MAP45	0.009
HR50	0.537	SBP50	0.033	DBP50	0.134	MAP50	0.202
HR55	0.887	SBP55	0.125	DBP55	0.128	MAP55	0.043
HR60	0.912	SBP60	0.146	DBP60	0.246	MAP60	0.027
HR65	0.374	SBP65	0.133	DBP65	0.075	MAP65	0.101
HR70	0.227	SBP70	0.907	DBP70	0.773	MAP70	0.688
HR75	0.044	SBP75	0.773	DBP75	0.197	MAP75	0.112
HR80	0.003	SBP80	0.608	DBP80	0.585	MAP80	0.338