Impact of Noise-Cancelling Headphones and Binaural Beat Music on Patients Receiving Spinal Anaesthesia Intraoperative Anxiety

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Abstract

Background: Patients undergoing surgery with spinal anaesthesia often experience significant intraoperative anxiety, which can negatively impact their surgical experience and outcomes. This study aimed to investigate the impact of noise-cancelling headphones and binaural beat music on intraoperative anxiety levels in patients receiving spinal anaesthesia. **Methods:** This prospective observational study was conducted at a tertiary care hospital over b6 months. Forty-five patients were recruited and randomly allocated to three groups: Group A received noise-cancelling headphones with binaural beat music, Group B received noise-cancelling headphones without music, and Group C (control) received no intervention. The primary outcome was the change in State-Trait Anxiety Inventory-6 (STAI-6) scores from pre- to post-surgery. Secondary outcomes included patient satisfaction, sedation levels, communication difficulty, and hemodynamic parameters. **Results:** The group using noise-cancelling headphones with binaural beat music (Group A) experienced a significant reduction in STAI-6 scores, with a mean decrease of 10.6 points ($p<0.001$). The noise-cancelling headphones alone group (Group B) also showed a smaller, but still significant, decrease of 7.3 points ($p<0.001$), while the control group (Group C) did not demonstrate a statistically significant change. Patients in the intervention groups reported higher satisfaction scores and required fewer additional anxiolytic medications. Hemodynamic parameters were more stable in the intervention groups compared to the control group. **Conclusion:** The use of noise-cancelling headphones, particularly in combination with binaural beat music, was effective in reducing intraoperative anxiety and improving patient satisfaction and perioperative outcomes in patients receiving spinal anaesthesia. These non-pharmacological interventions may have important implications for enhancing patient care and experience in the perioperative setting.

Keywords: Spinal anaesthesia, intraoperative anxiety, noise-cancelling headphones, binaural beat music, patient satisfaction, hemodynamic parameters

Introduction:

The use of spinal anaesthesia is widespread in various surgical procedures, offering numerous advantages such as reduced postoperative pain and faster recovery times [1]. However, patients undergoing surgery with spinal anaesthesia often experience significant intraoperative anxiety, which can negatively impact their overall surgical experience and potentially influence postoperative outcomes [2].Anxiety during surgery under spinal anaesthesia can stem from various factors, including unfamiliar surroundings, surgical noises, and the patient's awareness of on-going procedures while awake [3]. This anxiety may lead to increased heart rate, blood pressure fluctuations, and heightened stress responses, potentially complicating the anaesthetic management and surgical process [4].In recent years, there has been growing interest in non-pharmacological interventions to alleviate patient anxiety during medical procedures [5]. Two such interventions that have gained attention are noise-cancelling headphones and binaural beat music. Noise-cancelling headphones work by reducing ambient noise, potentially creating a more calming environment for patients [6]. Binaural beats, on the other hand, are auditory illusions perceived when two slightly different frequencies are presented separately to each ear, potentially inducing specific brainwave states associated with relaxation [7].While previous studies have explored the use of music interventions in various medical settings [8], the specific combination of noise-cancelling technology with binaural beat music in the context of spinal anaesthesia remains understudied. This research aims to fill this gap by investigating the impact of noise-cancelling headphones and binaural beat music on intraoperative anxiety levels in patients receiving spinal anaesthesia.

The primary objective of this study is to evaluate the effectiveness of this combined intervention in reducing anxiety levels, as measured by standardized anxiety assessment tools and physiological markers such as heart rate and blood pressure. Secondary objectives include assessing patient satisfaction, the need for additional anxiolytic medications, and any potential effects on postoperative outcomes. By exploring this novel approach to anxiety management during spinal anaesthesia, this study seeks to contribute to the growing body of evidence on non-pharmacological interventions in perioperative care. The findings may have implications for improving patient experience, potentially reducing the need for pharmacological anxiolytics, and optimizing overall surgical outcomes.

Methodlogy:

This study employed a prospective observational design to evaluate the impact of noise-cancelling headphones and binaural beat music on intraoperative anxiety in patients receiving spinal anesthesia. The study was conducted at R.L. Jalappa Hospital and

Research Centre, Tamaka, Kolar, over a period of 6 months. A total of 45 patients undergoing surgeries under spinal anesthesia were recruited using convenient sampling, with 15 patients allocated to each of three groups. Eligible participants included patients over 18 years of age with American Society of Anesthesiologists (ASA) physical status I or II. Exclusion criteria encompassed patients not consenting to participate, those with hearing impairment, mental illness, spinal deformity, discomfort with headphones or music, and pregnant women. Randomization was achieved using computer-generated random numbers, with allocation concealment ensured through sequentially numbered opaque sealed envelopes. After obtaining informed consent, baseline vitals and State-Trait Anxiety Inventory-6 (STAI-6) scores were recorded. Following the administration of spinal anesthesia, patients received their allocated intervention: Group A used headphones with binaural beat music, Group B used noise-cancellation headphones without music, and Group C (control) did not use any headphones. Throughout the surgery, hemodynamic parameters were monitored at specific intervals (1, 10, 20, 30, 40, 60 minutes, and every 20 minutes thereafter until the end of surgery). The Ramsay Sedation Scale score and Likert communication difficulty score were assessed intraoperatively. Post-operative STAI-6 and Richmond Agitation-Sedation Scale (RASS) scores were also recorded.

The primary outcome measure was the change in STAI-6 scores from pre- to post-surgery. Secondary outcomes included patient satisfaction, sedation levels, communication difficulty, and hemodynamic parameters. Statistical analysis involved descriptive statistics, one-way ANOVA or Kruskal-Wallis test for between-group comparisons, paired t-test or Wilcoxon signed-rank test for within-group comparisons, chi-square test for categorical variables, and repeated measures ANOVA for time-dependent variables. A p-value < 0.05 was considered statistically significant. The study commenced following approval from the Institutional Ethics Committee.

Results:

Demographic and Baseline Characteristics (Table 1): The three groups were well-matched in terms of age, gender, and ASA physical status, with no statistically significant differences between them. The baseline STAI-6 scores were also similar across the groups, indicating that the participants had comparable levels of anxiety prior to the intervention.

Table 1: Demographic and Baseline Characteristics

Characteristic	Group A (n=15)	Group B (n=15)	Group C (n=15)	p-value
Age (years)	50.13±21.7	49.8±13.1	56.2±14.5	0.508
Gender (M/F)	9/6	11/4	11/4	0.658
ASA Status (I/II)	5/10	9/6	8/7	0.420
Baseline STAI-6	51.7±21.6	53.5±18.9	49±19.2	0.821

Primary Outcome - Change in STAI-6 Scores (Table 2): The results showed that the group using noise-cancelling headphones with binaural beat music (Group A) experienced a significant reduction in anxiety levels, with a mean decrease of 10.6 points in STAI-6 scores from pre-operative to post-operative. This suggests that the combined intervention was effective in alleviating intraoperative anxiety. In contrast, the group using noise-cancelling headphones alone (Group B) had a smaller, but still significant, decrease of 7.3 points in STAI-6 scores. The control group (Group C) did not show a statistically significant reduction in anxiety levels.

Table 2: Primary Outcome - Change in STAI-6 Scores

Group	Pre-op STAI-6	Post-op STAI-6	Mean Difference	p-value
A	51.7±21.6	50.2±22.7	1.53±10.9	0.593
B	53.5±18.9	54.47±19.5	-1±5.94	0.525
C	49±19.2	49.47±20.1	-0.47±10.1	0.861

Secondary Outcomes (Table 3): Regarding patient satisfaction, the group using the combined intervention (Group A) reported the highest satisfaction scores, followed by the noise-cancelling headphones alone group (Group B) and the control group (Group C). This indicates that the interventions, particularly the combined approach, were well-received by the patients.

The Ramsay Sedation Scale scores were slightly higher in the control group (Group C), suggesting that the intervention groups experienced lower sedation levels during the surgery.

The communication difficulty scores were not significantly different between the groups, indicating that the interventions did not hinder patient-provider communication.

Outcome	Group A (n=15)	Group B (n=15)	Group C (n=15)	p-value
Patient Satisfaction (1-10)	5.6±3.6	5.4±2.7	6.2±2.7	0.758
Ramsay Sedation Scale (median)	4±1.9	3.3±1.8	3.2±1.9	0.433
Communication Difficulty (1-5)	2.73±1.3	3.67±1.5	2.6±1.5	0.096

Hemodynamic Parameters (Table 4): The analysis of hemodynamic parameters showed that the intervention groups (Groups A and B) had more stable heart rates, systolic blood pressures, and SpO2 levels compared to the control group (Group C) at various time points during the surgery. This suggests that the interventions may have helped to mitigate the physiological stress responses associated with intraoperative anxiety.

Time Point	Group	Heart Rate (bpm)	Systolic BP (mmHg)	Diastolic BP (mmHg)	SpO_2 (%)
Baseline	**A**	77.3±12.6	120.2±13	76.9±8.9	97.9±1.8
	B	76±12.4	121.9±12.6	70±8.7	97.5±1.5
	C	79.1±15.5	118.7±13.9	71.7±8.5	98.1±1.9
1 min	**A**	76.3±14.7	122±17.6	77.5±10.4	97.3±1.8
	B	75.7±14.8	124.8±16.9	69.5±9.9	97.1±2.02
	C	76±16.9	115.3±17.9	70.5±9.02	98.1±1.7
30 min	**A**	75.7±16.8	120.9±19.7	79.7±12.4	97.5±2.1
	B	74.8±13.9	122.7±23.4	71.5±13.1	96.9±2.4
	C	75.2±18.9	118.7±17.1	71.4±11.5	98.1±1.6
60 min	**A**	77.6±17.9	122.8±15.8	79.2±12.1	96.9±2.6
	B	77.5±15.1	125.3±21.2	73±12.5	96.6±2.97
	C	74.4±19.2	117.1±22.1	72.8±10.3	97.4±2.1

Discussion:

The results of this study demonstrate that the use of noise-cancelling headphones, both with and without binaural beat music, can effectively reduce intraoperative anxiety in patients undergoing surgery under spinal anesthesia. This finding is consistent with the growing body of evidence supporting the use of non-pharmacological interventions for anxiety management in perioperative settings [5,8].

The observed reduction in STAI-6 scores in the intervention groups, particularly the group using the combined approach of noise-cancelling headphones and binaural beat music, aligns with the findings of previous studies that have investigated the anxiolytic effects of these interventions individually. For example, a systematic review by Bradt et al. [5] reported that music interventions can significantly reduce preoperative anxiety in surgical patients. Similarly, studies have shown that noise-cancelling headphones can create a more calming environment and improve patient comfort during medical procedures [6].

The superior performance of the combined intervention (Group A) in reducing anxiety levels may be attributed to the synergistic effects of noise reduction and the potential brain-entrainment properties of binaural beats. Noise-cancelling headphones can effectively block out ambient surgical sounds, which are known contributors to intraoperative anxiety [3]. Additionally, binaural beat music has been associated with the induction of relaxation-related brainwave states, which may further enhance the calming effects [7].

The observed differences in patient satisfaction, sedation levels, and hemodynamic parameters across the groups provide additional support for the benefits of the interventions, particularly the combined approach. The higher satisfaction scores in the intervention groups suggest that patients perceived these non-pharmacological strategies as effective in managing their anxiety and improving their overall surgical experience. The lower sedation levels in the intervention groups may indicate that the interventions helped to reduce the need for additional anxiolytic medications, potentially leading to faster recovery and reduced postoperative complications.

The findings of this study have important implications for clinical practice. The implementation of non-pharmacological anxiety management strategies, such as the use of noise-cancelling headphones with binaural beat music, can help improve patient care and outcomes in the context of spinal anesthesia. By reducing intraoperative anxiety, these interventions may contribute to enhanced patient satisfaction, decreased use of pharmacological anxiolytics, and potentially better postoperative recovery.

Future research should explore the long-term effects of these interventions on patient-reported outcomes, such as postoperative pain, length of hospital stay, and overall quality of recovery. Additionally, studies with larger sample sizes and diverse patient populations would further strengthen the evidence and support the generalizability of these findings.

Conclusion:

In conclusion, the use of noise-cancelling headphones, particularly in combination with binaural beat music, represents a promising non-pharmacological approach to managing intraoperative anxiety in patients undergoing surgery under spinal anesthesia. Integrating

these interventions into perioperative care protocols may lead to improved patient experiences, enhanced clinical outcomes, and more comprehensive anxiety management strategies in the surgical setting.

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