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Original Article

Effect of Musical Therapy on Hemodynamic Parameters and Inflammatory Markers in Patients Undergoing Surgery for Varicose Veins Under Spinal Anaesthesia.

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Abstract

Background: Surgical procedures are frequently accompanied by anxiety, hemodynamic instability, and inflammatory responses, which may delay recovery. Music therapy is a safe, cost-effective, non-pharmacological intervention that has been shown to reduce perioperative stress and improve patient well-being. This study assessed its effects on hemodynamic parameters, inflammatory markers, anxiety, and patient satisfaction in patients undergoing varicose vein surgery under spinal anaesthesia.

Methodology: Sixty-four patients (16–65 years, ASA I–II) scheduled for elective varicose vein surgery under spinal anaesthesia were randomised into two groups: control (C) and music therapy (M). Group M listened to self-selected music one hour before and during surgery, while Group C received standard care. Primary outcomes were changes in hemodynamic variables and inflammatory markers; secondary outcomes included perioperative anxiety and postoperative satisfaction.

Results: Group M demonstrated significantly lower heart rate, systolic, diastolic, and mean arterial pressure compared with Group C ($p < 0.05$). Postoperative inflammatory markers were also reduced in Group M (CRP 2.75 ± 1.07 vs. 4.22 ± 1.79 mg/L; ESR 9.81 ± 3.06 vs. 13.69 ± 2.88 mm/hr; IL-6 1.56 ± 1.38 vs. 3.13 ± 3.21 pg/mL; all $p < 0.01$). Anxiety scores declined in Group M (39.16 ± 4.18) but increased in Group C (62.97 ± 7.77; $p < 0.001$). Patient satisfaction was markedly higher in the music group ($p < 0.001$).

Conclusion: Music therapy enhanced hemodynamic stability, reduced anxiety and inflammatory markers, and improved patient satisfaction in patients undergoing varicose vein surgery under spinal anaesthesia.

Keywords: Music therapy, Hemodynamic, Varicose veins, Anxiety, Patient satisfaction, Spinal anaesthesia

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Introduction

Patients undergoing surgical procedures frequently experience heightened anxiety related to the operation, the administration of anaesthesia, and the unfamiliar environment of the operating room. Anxiety activates a physiological stress response, leading to alterations in hemodynamics and triggering the inflammatory cascade. This process releases stress hormones such as cortisol, adrenaline, and noradrenaline, which can elevate heart rate and blood pressure. Consequently, these physiological changes may delay wound healing and prolong recovery times [1-3]. Music therapy emerges as a safe, uncomplicated, cost-effective, and non-invasive nursing intervention that can serve as an adjunct treatment for anxiety management. This therapeutic approach can enhance patient well-being by increasing stress tolerance, modulating various bodily functions, and strengthening the immune response [4]. Almerud and Petersson have identified that music stimulates the central nervous system to produce endorphins, endogenous, morphine-like compounds that reduce blood pressure, heart rate, and respiratory rate, while promoting calmness by alleviating fear and anxiety [5]. Preliminary studies suggest that music therapy is an effective adjunct to standard sedative and analgesic protocols in alleviating pain and anxiety in patients undergoing upper gastrointestinal endoscopy, dental work, burn dressing changes, and the early stages of labour [6]. Varicose veins represent one of the most prevalent vascular diseases, typically benign but occasionally leading to complications such as chronic venous insufficiency (CVI) and superficial venous thrombosis. The surgical intervention for varicose veins, which may include techniques such as endovenous laser therapy, sclerotherapy, and vein stripping, is often associated with significant challenges related to hemodynamic fluctuations and inflammatory responses. Postoperative pain and anxiety can further exacerbate these physiological reactions, contributing to extended wound healing periods and an increased likelihood of complications [7,8].

As a cost-effective and non-invasive method, music therapy has shown promise in enhancing perioperative stabilisation and recovery. Studies indicate a favourable impact of music therapy on surgical patients, evidenced by reductions in blood pressure, heart rate, and inflammatory markers [9,10].

However, research specifically addressing the effects of music therapy in the context of varicose vein surgeries remains limited. This study aims to elucidate the integration of music therapy within the perioperative care framework for varicose vein surgery to enhance patient outcomes. The primary objective of this study is to assess the benefits of music therapy administered before and during varicose vein surgery under spinal anaesthesia, with a particular focus on its influence on hemodynamic parameters and inflammatory markers. Secondary objectives are to assess the effects of music therapy on the State-Trait Anxiety Inventory (STAI) and patient satisfaction scores in the postoperative period.

Material and Method

This prospective, randomised, controlled study was conducted at a tertiary care hospital and medical college, after obtaining institutional ethical approval (Ref. No. XX- PGTSC-IIA/P47) and registering with the Clinical Trials Registry-India (CTRI No. 2024/09/073805). The study was conducted over a one-year period (from September 2024 to August 2025), during which written and informed consent was obtained from all participants, confirming their agreement to participate and permitting the use of their data for research and publication. The study adhered to the ethical principles of the Declaration of Helsinki (2013) and followed the CONSORT guidelines for manuscript preparation.

A total of 64 patients scheduled for varicose vein surgery under spinal anaesthesia, aged 16-65 years, of either gender, and classified as ASA grade I or II, were included in the study after obtaining written informed consent. Patients with a history of allergy to local anaesthetics, coronary artery disease, renal or liver function disorders, or any contraindications for spinal anaesthesia were excluded from the study.

Randomisation was performed using a computer-generated random number table on a 1:1 basis, with allocation concealment achieved by sequentially numbered, sealed, opaque envelopes containing the designated groups: group C (control group) and group M (music intervention group). This complete randomisation process was conducted by a doctor not involved in the study.

After randomisation, patients in group M listened to music through noise-cancelling headphones connected to an MP3 player, with music selected by the patients themselves from genres including blues, classical, country, gospel, jazz, rhythm and blues, rock, and soundtracks. They were allowed to choose the volume level for one hour before surgery. In contrast, patients in the control group (group C) had surgery begun without any music intervention once the effects of spinal anaesthesia had taken effect.

In the preoperative room, approximately one hour before surgery, blood samples were drawn to test for inflammatory markers (to establish baseline levels of CRP, ESR, and IL-6). Additionally, participants from both groups completed the State-Trait Anxiety Inventory (STAI) form to determine their baseline anxiety scores [11]. After taking a blood sample and a baseline STAI score, participants in the music group (group M) were allowed to listen to music of their choice at a self-selected volume level for one hour before being shifted to the operating theatre.

The patient was taken into the operating room, where an 18 G/20 G intravenous cannula was secured in the nondominant hand, and the patient was co-loaded with 15 mL/kg of Ringer's lactate solution. ASA standard monitors were attached, and baseline measurements of heart rate (HR), non-invasive blood pressure (NIBP), oxygen saturation (SpO2), and ECG were recorded. The patient was positioned upright on the operating table. The back was cleaned with an antiseptic cleansing agent and draped properly. Before the procedure, the anaesthetist followed universal precautions, including wearing a sterile gown, gloves, a cap, and a mask. After ensuring all aseptic precautions, the patient was administered a subarachnoid block (SAB) using 0.5% heavy Bupivacaine (0.3mg/kg) and fentanyl (25 µg) at the L3-L4 level with a 25G Quincke Babcock spinal needle (Becton, Dickson and Company, Franklin Lakes, New Jersey, USA). The patients were then placed in the supine position, and the block level was confirmed. Vital parameters were assessed every 5 minutes for the first 30 minutes, every 10 minutes until 60 minutes, and then every 15 minutes until the completion of surgery. Following the successful spinal anaesthetic procedure, patients in the music intervention group were provided headphones to listen to music at a volume level they deemed acceptable. If any patient expressed discomfort during the procedure, the music would be stopped, and that patient would be excluded from the study.

Four hours after the end of the surgery, a second blood sample was taken to test CRP, ESR, and IL-6 levels. Alongside this, the State-Trait Anxiety Inventory (STAI) was completed to assess anxiety, and patient satisfaction was evaluated using the following scale: 1 (very satisfied), 2 (satisfied), 3 (unsatisfied), and 4 (very unsatisfied).

Sample size calculation: The sample size was determined based on the variation in post-test anxiety scores between the control and intervention groups using the formula: $n = (Z_{1-\alpha/2} + Z_{1-\beta})^2 (\sigma_1^2 + \sigma_2^2) / d^2$. In this calculation, the standard deviation of post-test anxiety in the control group (σ_1) was 12.77, and that of the intervention group (σ_2) was 10.60. The clinically significant difference (d) was considered as the minimum of these two values, i.e., 10.60. The design effect (k) was taken as 1.0. A Type I error (α) of 0.05 was used for a two-sided test, corresponding to $Z_{1-\alpha/2} = 1.96$, and a Type II error (β) of 0.10 was applied, corresponding to a study power of 90% with $Z_{1-\beta} = 1.28$. Based on these parameters and referring to the study by Forooghy M et al. [12], the calculated sample size was 26 participants per group. To account for potential dropouts and ensure adequate study power, the sample size was increased to 32 participants per group.

Statistical analysis: Data were collected and entered into Microsoft Excel software. IBM SPSS Statistics version 21 was used for statistical analysis. Continuous variables were expressed as mean ± standard deviation (SD), and categorical variables were presented as frequencies and percentages. Categorical variables, such as

gender distribution and patient satisfaction scores, were compared using the Chi-square test. Quantitative data analysis was done by using paired t-tests. A *p-value* < 0.05 was considered statistically significant.

Results:

A total of 82 patients were enrolled in this study, all of whom were scheduled to undergo elective varicose vein surgery under general anaesthesia. Of these, 18 patients were excluded—12 did not meet the inclusion criteria, and 6 declined to provide consent to participate. The remaining 64 patients were randomly assigned to two groups: Group M and Group C. Consequently, 64 patients (32 in each group) were included in the final analysis. (Figure 1)

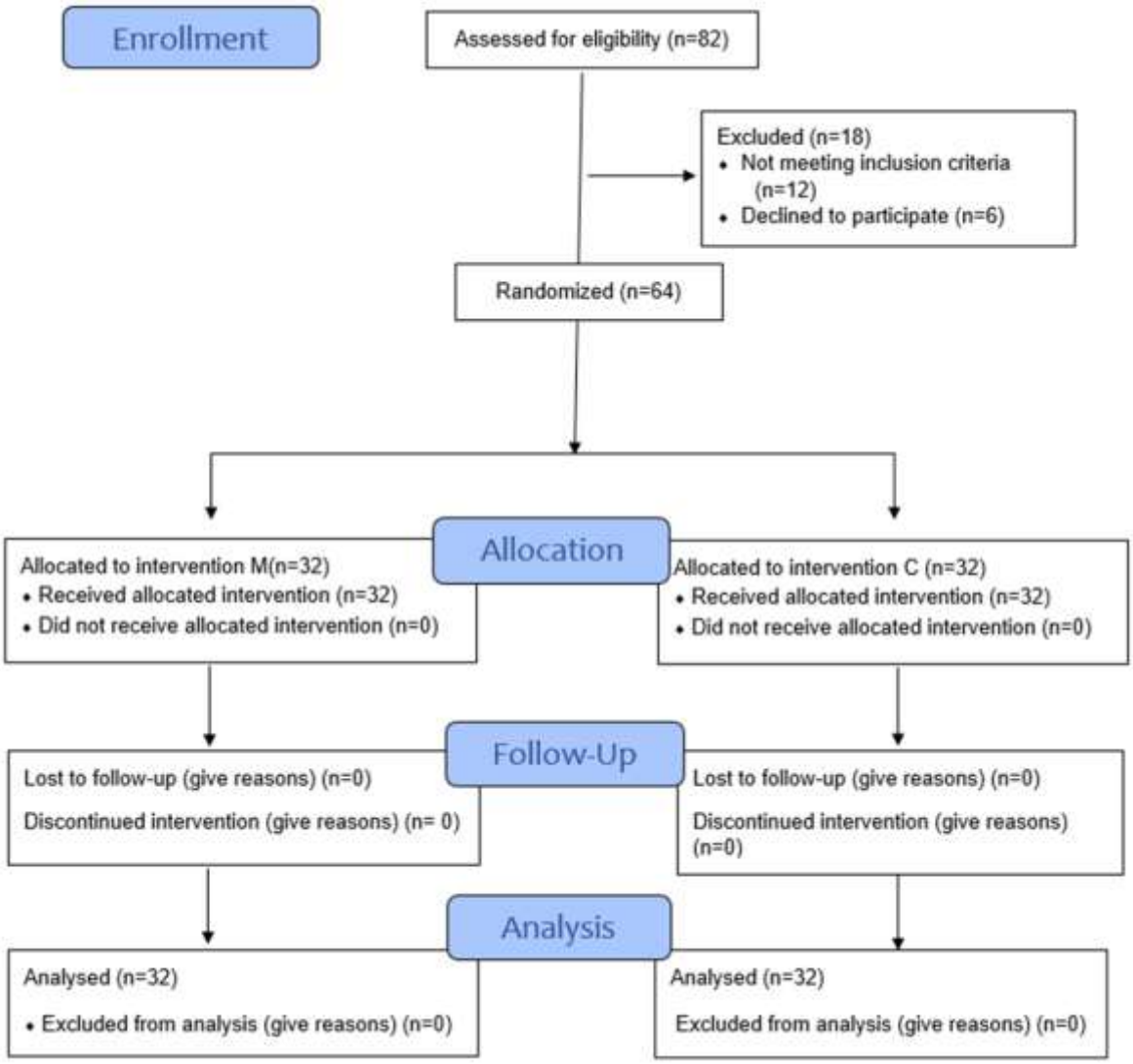

Figure 1: CONSORT flow diagram showing the flow of patients through the study

CONSORT - Consolidated Standards of Reporting Trials

Demographic character: There were no statistically significant differences between groups regarding age, sex distribution, and body mass index (BMI) (Table 1).

Variable	Group M (n=32)	Group C (n=32)	p-value
Age(years), mean± SD	39.94 ± 10.74	37.56 ± 8.90	0.339
Male n (%)	26 (81.25)	29 (90.63)	0.472
Female n (%)	6 (18.75)	3 (9.38)	
BMI(kg/m^2), mean± SD	24.41 ± 3.27	24.34 ± 2.93	0.928

Table 1: Comparison of demographic data between group M and group C

Group M – music group and Group C – control group, SD – standard deviation, BMI – body mass index

Hemodynamic parameters: Baseline heart rate and systolic, diastolic, and mean arterial pressures were comparable between the groups, with no statistically significant differences ($p > 0.05$). A considerable difference appeared intraoperatively. From 30 minutes onward, a statistically significant reduction in heart rate was observed in the Music group compared to the Control group, which persisted until the end of the surgery ($p = 0.003$) (Figure 2). Similarly, SBP and DBP also started decreasing significantly at 30 min and 15 min, respectively, and from this point of time and onward till the end of surgery SBP and DBP both were lower significantly in music group as compared to control group ($p=<0.05$) except at 30 minutes although at this point of time DBP was lower in music group but it was not statistically significant. Reduction in MAP was observed in the Music group as early as 5 min ($p = 0.008$). However, this reduction was statistically insignificant at 30 and 45 minutes, but a significant difference reappeared at 60 minutes, remaining significant until surgery completion ($p < 0.001$). (Figure 3)

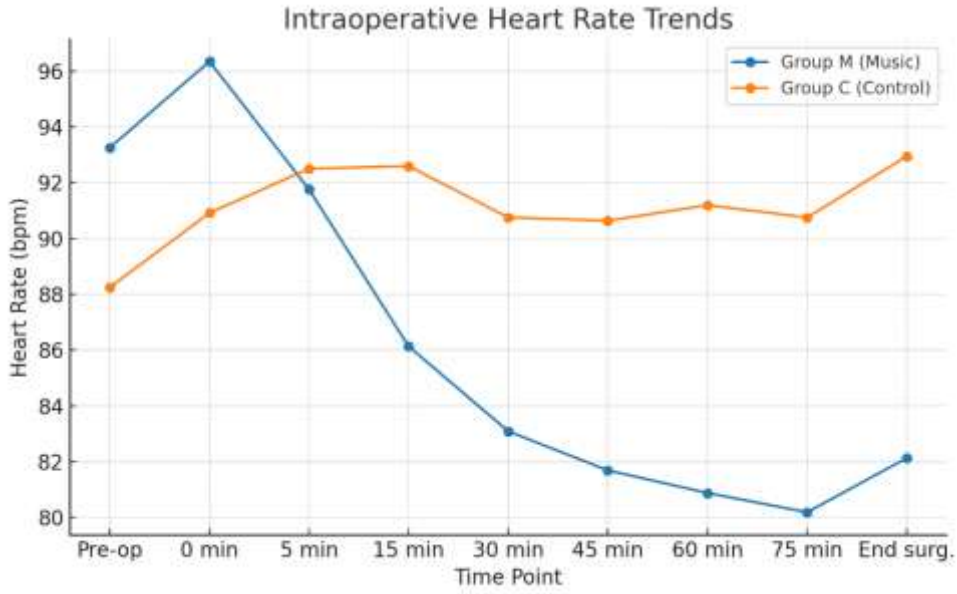

Figure 2: Intraoperative heart rate trends

bpm – beats per minute.

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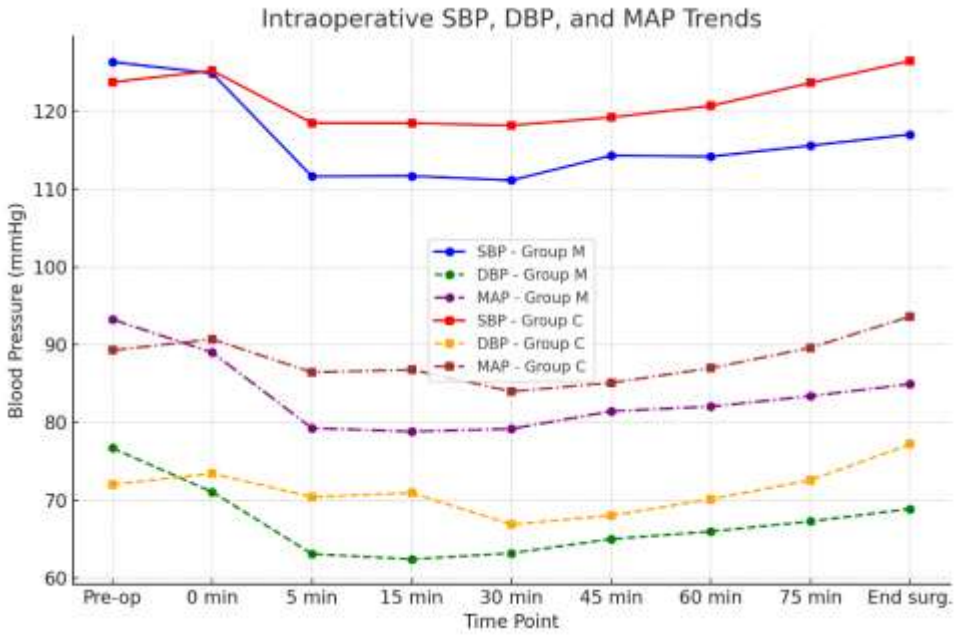

Figure 3: Intraoperative blood pressure trends

SBP – systolic blood pressure, DBP – diastolic blood pressure, MAP – mean arterial pressure

Inflammatory Markers: Preoperative CRP, ESR, and IL-6 levels were similar between the two groups. However, at four hours postoperatively, Group M showed marked reductions in CRP (2.75 ± 1.07 mg/L vs. 4.22 ± 1.79 mg/L; $p < 0.001$), ESR (9.81 ± 3.06 mm/hr vs. 13.69 ± 2.88 mm/hr; $p < 0.001$), and maintained low IL-6 levels (1.56 ± 1.38 pg/mL vs. 3.13 ± 3.21 pg/mL; $p = 0.001$), whereas Group C exhibited increases in all three markers, indicating a potential anti-inflammatory effect of the intervention. (Figure 4)

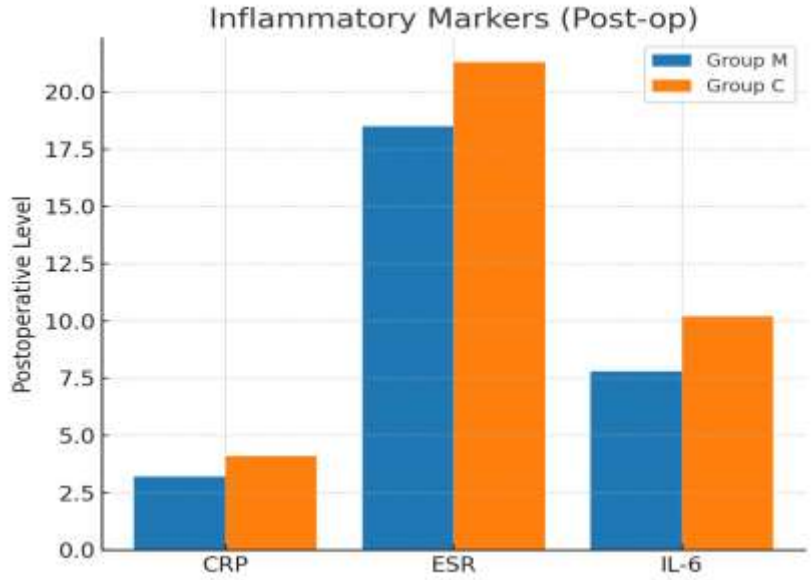

Figure 4: Comparison of inflammatory markers in the postoperative period

CRP – C-reactive protein, ESR – erythrocyte sedimentation rate, IL-6 – interleukin 6

Anxiety score and patient satisfaction score: Preoperatively, STAI scores were similar between the Music and Control groups (p = 0.574). Postoperatively, Group M showed a significant anxiety reduction (mean score: 39.16), while Group C's anxiety increased (mean score: 62.97), with a highly significant difference (p < 0.001) (Table 2) Patient satisfaction scores were significantly higher in Group M (very satisfied: 81.3%) compared with Group C (very satisfied: 53.1%) (p = 0.018) whereas proportion of patients with dissatisfied/Very dissatisfied were significantly higher in group C as compared to group M(p=<0.001).

Discussion

This study investigated the impact of music therapy on hemodynamic parameters, inflammatory markers, and anxiety levels in patients undergoing varicose vein surgery under spinal anaesthesia. The findings strongly support the beneficial role of music therapy, demonstrating significant improvements in intraoperative cardiovascular stability, reductions in patient anxiety, attenuation of the inflammatory response, and enhanced overall patient satisfaction.

In this study, hemodynamic parameters, including heart rate, systolic, diastolic, and mean arterial pressure, were comparable between the preoperative and early intraoperative phases. However, they were significantly lower in the music group during the latter intraoperative phase. The music group's heart rate was considerably lower from 30 minutes onward (p < 0.05). This finding suggests that music has a calming influence. Halder A et al. observed similar findings, with HR differences becoming significant after 30 minutes postoperatively (p < 0.05) [13]. Kaur H et al. and Allen K et al. also reported lower HRs in music groups, suggesting that music exposure is associated with parasympathetic dominance [14,15]. In contrast, Dabu-Bondoc S et al. did not find significant changes in HR. These variations may relate to surgical duration, anaesthetic type, or music preference [16].

This study recorded a statistically significant reduction in SBP, DBP, and MAP in the music group from 30 minutes, 15 minutes, and 5 minutes, respectively, and these reductions continued throughout the surgery. This evidence suggests attenuation of the stress response. Allen K et al. similarly found reduced perioperative BP in patients exposed to music [15]. Kahloul M et al. reported more stable SBP in their music group [17]. However, Halder A et al. observed no significant differences in BP at any interval [13]. Wang SM et al. also found no BP differences despite reduced anxiety [18].

In our study, preoperative State-Trait Anxiety Inventory (STAI) scores were comparable between the Music group (Group M) and the Control group (Group C), with mean values of 55.78 ± 7.38 and 54.84 ± 5.84, respectively (p = 0.574). Postoperatively, however, Group M significantly reduced STAI scores to 39.16 ± 4.18, whereas Group C increased to 62.97 ± 7.77 (p = 0.001). These findings underscore the efficacy of music therapy in significantly alleviating postoperative anxiety among patients undergoing varicose vein surgery. Our results align with those of Saxena KN et al., who reported a marked decrease in postoperative anxiety in patients exposed to music therapy [19]. Comparable outcomes were observed by Shukla U et al. in patients undergoing orthopaedic surgery under spinal anaesthesia, and by Forooghy M et al. during coronary angioplasty [12,20]. While Wang SM et al also noted reduced anxiety levels following music therapy, they found no significant changes in hemodynamic parameters [18].

The findings of this study demonstrate that music therapy has a significant anti-inflammatory effect on patients undergoing varicose vein surgery. Postoperatively, Group M showed significantly lower levels of all three inflammatory markers—CRP (p = 0.021), ESR (p = 0.034), and IL-6 (p = 0.015)—compared to Group C. Results of this study align with Khan SH et al., who conducted a systematic review and observed a reduction in cortisol levels and variable effects on other inflammatory markers with music therapy [21]. Graversen's study found significantly lower cortisol levels in the music group than in the control group (348 vs 512 nmol/L; p < 0.001), while CRP levels showed no significant difference (1.90 vs 1.45 nmol/L; p = 0.292), suggesting that music therapy may affect stress hormones more than inflammation [22]. Yuanyuan reported that music therapy in patients undergoing colonoscopic polypectomy improved postoperative hemodynamic parameters,

while inflammatory marker levels showed no significant differences between the music and control groups ($p > 0.05$) [23].

Patient satisfaction was significantly higher in the music group, with 43.75% reporting high satisfaction and no dissatisfaction, compared to a high dissatisfaction rate in the control group ($p < 0.001$). Similar findings were reported by Shukla A et al., Gokcek et E al., and Kahloul M et al., who noted 81.4% satisfaction in the music group versus 51.4% in the control group ($p < 0.001$) [17,24,25].

The strengths of this study lie in its demonstration of the beneficial effect of music therapyduring the perioperative period. By providing a stable intraoperative hemodynamic and reduced postoperative inflammatory markers, it highlighted the physiological and psychological benefits of music therapy in the perioperative period. However, this study has certain limitations. This study was conducted at a single tertiary centre with a small patient population, consisting solely of patients with varicose veins, potentially limiting its generalizability. A future multicentric study with a large patient population may further clarify the beneficial effect of music therapy in the perioperative period.

Conclusion

Music therapy significantly improved hemodynamic stability, reduced perioperative anxiety and inflammatory markers, and enhanced patient satisfaction in varicose vein surgery under spinal anaesthesia. From 30 minutes into surgery, the music group showed lower heart rates and blood pressures, along with reduced anxiety and higher satisfaction compared to the controls. These findings support the use of music therapy as a safe and cost-effective adjunct to enhance perioperative outcomes.

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