Original research

Effect of tailored music therapy on post-procedural systolic blood pressure during invasive coronary angiography: the MUS.E I randomised clinical trial

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ABSTRACT

Background To date, no clinical study has specifically evaluated the effects of music therapy as a peri-procedural strategy to reduce stress-induced alterations in clinical and laboratory cardiovascular parameters during invasive coronary angiography, with or without ad hoc percutaneous coronary intervention (PCI).

Objectives This study sought to assess the effects of music therapy on clinical, laboratory and psychological stress parameters in patients undergoing invasive coronary angiography, with or without ad hoc PCI.

Methods In this randomised controlled trial, 100 patients undergoing invasive coronary angiography, with or without ad hoc PCI, were assigned in a 1:1:1 ratio to music therapy for 30 min before invasive coronary angiography (group A), music therapy for 30 min before and during invasive coronary angiography (group B) or standard care without music therapy (group C). Pre- and post-procedural assessments included systolic blood pressure (SBP), heart rate (HR), cardiac rhythm, oxygen saturation, cortisol, high-sensitivity troponin I (TnI) and brain natriuretic peptide. Individualised music playlists were created by a music therapist based on structured interviews and music preference testing. The primary endpoint was the absolute value of SBP after the intervention, between music therapy groups and control.

Results Baseline characteristics were comparable across groups. Group B demonstrated a significantly lower post-procedural SBP compared with group C (mean difference −13.4 mm Hg, 95% CI −22.1 to −4.6, p=0.003) and group A (mean difference −13.3 mm Hg, 95% CI −24.9 to −2.4, p=0.018). No significant SBP difference was observed between groups A and C. Music therapy administered before and during invasive coronary angiography was also associated with lower post-procedural HR and TnI levels.

Conclusions Music therapy reduced the primary endpoint of the absolute value of post-procedural SBP.

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ Music therapy has gained a precise role in several areas of medicine, including oncology, radiotherapy and psychiatry. Its role in cardiovascular medicine is still not clear.

WHAT THIS STUDY ADDS

⇒ Music therapy administered before and during percutaneous coronary intervention was associated with lower post-procedural blood pressure, heart rate and high-sensitivity troponin levels, compared with the control group and the group with music administered only before the intervention.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ Music therapy should be implemented in the catheterisation laboratory to render the intervention more acceptable to the patients and to reduce some typical stressors.

INTRODUCTION

Despite significant improvements in prevention and treatment, coronary artery disease remains the leading cause of mortality worldwide.[1] Invasive coronary angiography, with or without ad hoc percutaneous coronary intervention (PCI), is a cornerstone treatment, but despite its benefits, this intervention can trigger significant emotional and physiological stress that may worsen the outcomes. Anxiety during invasive coronary angiography stems from prior medical experiences, discomfort, uncertainty and the intense environment.[2] Such stress activates the sympathetic nervous system and hypothalamic–pituitary–adrenal axis, increasing catecholamines and cortisol, leading to higher blood pressure, heart rate (HR) and myocardial oxygen demand.[3] Proper and timely management of these reactions may enhance procedural safety, as high anxiety levels predict poorer prognosis in coronary heart disease.[4] Music therapy has gained attention as a non-pharmacological approach to reduce anxiety during several procedures and treatments. Defined as the systematic use of music by trained therapists, it leverages patient-preferred music to improve comfort and engagement. Such an approach should be tailored (live or recorded, with ad hoc genres and types) and applied before or during therapeutic procedures to reduce stress responses.[5] Music therapy can lower anxiety, activate parasympathetic tone, reduce cortisol and improve haemodynamics[6]; neuroimaging analyses demonstrated activation of limbic regions, supporting emotional regulation and distraction.[7]

However, studies specific to invasive coronary angiography, with or without ad hoc PCI, remain limited, often small in scale and focused on subjective anxiety and basic vitals, without assessment of biochemical stress or myocardial injury markers.[8] A few small studies have confirmed modest but significant benefits of music therapy, reporting a reduction in systolic blood pressure (SBP) and HR across PCI and cardiac surgery,[9] improved haemodynamic stability and reduced anxiety and pain.[10] In addition, previous trials during angioplasty also showed reduced stress with calming music.[11 12] Notably, none of these studies had a cardiovascular parameter as a primary endpoint and none examined biomarkers such as cortisol, high-sensitivity troponin or brain natriuretic peptide (BNP).

The MUS.E I trial was designed to fill this gap by evaluating personalised music therapy during invasive coronary angiography, with or without ad hoc PCI. By assessing blood pressure, HR and biomarkers of stress and myocardial injury, this study aimed to provide evidence for integrating music therapy as a safe, easily affordable adjunct to enhance patient care in interventional cardiology.

METHODS

Study design and population

MUS.E I was a single-centre, randomised controlled trial conducted at Grand Hospital de I'Est Francilien in Paris, France between November 2024 and March 2025 to evaluate the effects of music therapy on cardiovascular parameters and stress levels in patients undergoing invasive coronary angiography, with or without ad hoc PCI. The protocol was designed in accordance with the Declaration of Helsinki and the Good Clinical Practice guidelines. The local ethical committee of the Grand Hôpital de l'Est Francilien, Marne la Vallée, France approved the protocol (n. 7942/2025). All participants provided prior written informed consent to be enrolled into the study.

Eligible participants were adults aged 18 years or older who were scheduled for invasive coronary angiography, with or without ad hoc PCI, and were cooperative and able to communicate effectively. The exclusion criteria were: necessity for emergent coronary interventions, including any myocardial infarction; history of hearing impairment (eg, deafness); uncooperative behaviour that would interfere with the music therapy protocol; necessity for deep sedation; haemodynamic instability; and a psychiatric disorder that would have been triggered by music, according to the judgement of the psychologist.

Primary and secondary endpoints

The study primary endpoint was the absolute value of SBP after the intervention, comparing it between patients treated with music therapy and the control group.

Secondary endpoints included pre- and post-intervention measurements of HR, oxygen saturation (SpO_2), diastolic blood pressure (DBP), BNP, cortisol and high-sensitivity troponin I (TnI). In addition, continuous cardiac rhythm monitoring was performed to assess the incidence of premature ventricular contractions and new onset arrhythmias.

Sample size and statistical analysis

The study hypothesis was that music therapy was superior to standard of care in reducing immediate post-procedural systolic arterial pressure. Accordingly, the power calculation of the MUS.E I trial was based on the assumption of an average blood pressure lower by 8 mm Hg in the experimental groups, resulting in an expected post-procedural systolic pressure of 132±10 mm Hg in music therapy participants compared with 140±10 mm Hg in the control group. With an α level of 0.05 and 90% power, a total sample size of 100 patients was calculated to achieve statistical significance.

Sedation practice

The sedation protocol adopted at the institution where all patients were recruited did not involve routine sedative medications given upfront. In case of an express request by the patient, a commonly used regimen consisted of midazolam 0.5–1 mg intravenously (IV) and fentanyl 25 µg IV, administered in small incremental doses according to the clinical effect. Lower initial doses were considered for elderly, frail, hypotensive or respiratory-compromised patients. Adequate local, puncture-site, anaesthesia with lidocaine or bupivacaine was always provided to all the patients.

Study overview

Each patient enrolled first viewed a tutorial video explaining the study purposes and provided informed consent. Patients were then randomised 1:1:1 via a dedicated web-based system into one of three groups: group A received music therapy for 30 min before the procedure only; group B received music therapy for 30 min before and during the procedure; group C received standard of care without music therapy (control group) (central illustration; figure 1). The music selection process was personalised and guided by a professional music therapist. Patients completed a pre-procedural music preference questionnaire and a music preference test by listening to brief excerpts from 10 different songs representing various genres (including classical, pop and rock) and rating each on a scale of 1 to 5. The music therapist individualised playlists aligned with both patient preferences and therapeutic recommendations. A baseline psychological stress assessment using the State-Trait Anxiety Inventory (STAI) was conducted by a psychologist. Baseline blood samples were collected to measure cortisol, BNP and high-sensitivity TnI. During the intervention, we continuously monitored HR, blood pressure and peripheral SpO_2. Following the procedure, a second round of blood samples was collected, and patients completed a post-intervention STAI assessment along with a structured evaluation of their music listening experience.

Statistical analysis

The presentation of continuous variables included either mean and SD or median and IQR, depending on the nature of the data. Categorical variables were displayed as absolute counts and corresponding percentages. The Shapiro-Wilk test was used to assess the normality of continuous variables. As the data were not normally distributed, the Kruskal-Wallis test was used to compare continuous variables between groups, while categorical variables were analysed using either the χ^2 test or Fisher's exact test. The Student t-test for independent samples was applied to evaluate the primary endpoint. A baseline-adjusted sensitivity analysis was performed using analysis of covariance (ANCOVA) to take into account the effect of continuous music therapy on post-procedural SBP remained consistent. A p value <0.05 was considered statistically significant. All statistical analyses were conducted using R version 4.3.2, provided by the R Foundation for Statistical Computing.

RESULTS

Study groups and baseline characteristics

After screening (n=181), a total of 104 patients fulfilled the criteria to participate in the study; four were excluded because

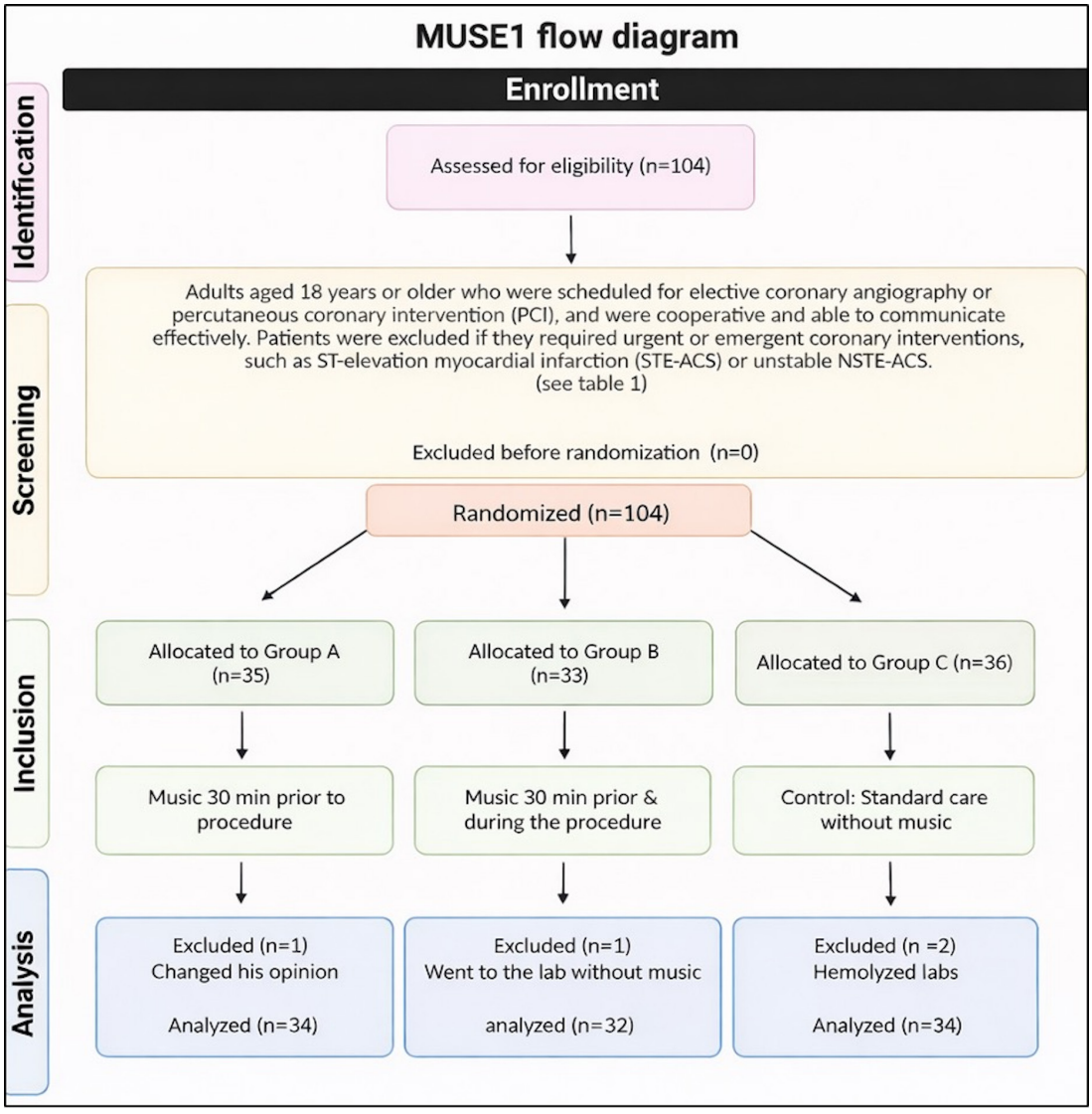


Figure 1 Study flow diagram. ACS, acute coronary syndrome.

procedural data were not analysable. The 100 patients with data were randomised to: group A (music therapy before procedure), n=34 patients; group B (music therapy before and during procedure), n=32 patients; and group C (control, standard of care treatment), n=34 patients. Baseline demographic and clinical characteristics were balanced across groups, with no differences in sex distribution, age, cardiovascular risk factors or comorbidities. The mean age was 67.3 years, with 19% being females. The prevalence of hypertension (72%), diabetes mellitus (35%), prior PCI (27%), prior diagnostic coronary angiography (33%) and smoking status were balanced across groups. Minor history of depression and anxiety was only noted among group A patients (5.9%) (table 1).

Baseline physiological parameters and biomarkers

Baseline physiological parameters, including SBP, DBP, HR and SpO_2, were similar across groups. Baseline biochemical markers (BNP, troponin, cortisol) also showed no significant differences. Psychologist-assessed baseline anxiety status was higher in groups A and B compared with group C (4.47±2.49, 4.44±2.08 vs 3.12±2.40; p=0.029) (table 2).

Music type and duration

Music therapy selections varied across patients, reflecting an individualised and tailored playlist curated by the music therapist. The most common music genre was pop (28.0%), followed by jazz (14.0%), nature sounds (11.0%), classical music (9.0%) and opera (4.0%). The mean initiation time of music before the procedure was 32.6±14.5 min overall, with group A averaging 30.0±17.3 min and group B averaging 35.0±11.7 min before the arterial puncture. In group B, music was continued throughout the duration of the procedure (table 3).

Procedural parameters and outcomes

Radial access for percutaneous coronary interventions was used in 98% of cases. Procedural safety events were infrequent: intraprocedural complications such as coronary dissection and vasovagal reaction occurred in two patients (5.9%) in group A,

Table 1 Baseline characteristics of study population

	Group A	Group B	Group C	P value
Number of patients	34	32	34	
Male (%)	26 (76.5)	27 (84.4)	28 (82.4)	0.694
Age (mean (SD))	67.06 (8.86)	66.41 (8.28)	68.47 (8.02)	0.593
Previous coronary revascularisation (%)	12 (35.3)	11 (34.4)	10 (29.4)	0.858
Hypertension (%)	27 (79.4)	21 (65.6)	24 (70.6)	0.448
CKD (%)	0 (0.0)	0 (0.0)	1 (2.9)	0.375
Stable angina (%)	12 (35.3)	10 (31.2)	9 (26.5)	0.733
Unstable angina (%)	11 (32.4)	10 (31.2)	11 (32.4)	0.994
Previous PCI (%)	12 (35.3)	9 (28.1)	6 (17.6)	0.257
Previous MI (%)	9 (26.5)	4 (12.5)	6 (17.6)	0.341
History of CABG (%)	0 (0.0)	1 (3.1)	0 (0.0)	0.342
Smoking history (%)				0.805
Never	16 (47.1)	11 (34.4)	14 (42.4)	
Current	15 (44.1)	19 (59.4)	17 (51.5)	
Former	3 (8.8)	2 (6.2)	2 (6.1)	
DM (%)	12 (35.3)	11 (34.4)	12 (35.3)	0.996
Arrhythmia (%)	2 (5.9)	5 (15.6)	2 (5.9)	0.283
AF (%)	1 (2.9)	4 (12.5)	1 (2.9)	0.172
VT (%)	1 (2.9)	1 (3.1)	1 (2.9)	0.999
β-blocker use (%)	16 (47.1)	15 (46.9)	10 (29.4)	0.239
History of anxiety or depression (%)	2 (5.9)	0 (0.0)	0 (0.0)	0.138

AF, atrial fibrillation; CABG, coronary artery bypass grafting; CKD, chronic kidney disease; DM, diabetes mellitus; MI, myocardial infarction; PCI, percutaneous coronary intervention; VT, ventricular tachycardia.

with no events in groups B or C (p=0.138); and intraprocedural arrhythmias, ranging between atrial fibrillation, premature ventricular contractions and non-sustained ventricular tachycardia, were reported in two patients (5.9%) in group A, none in group B, and four patients (11.8%) in group C (p=0.132) (table 4).

During the procedure, mean HR was significantly lower in both music therapy groups compared with controls (group A: 70.59±12.24 beats/min (bpm); group B: 71.62±10.48 bpm; group C: 80.12±12.54 bpm; p=0.002). There was a numerical trend toward lower procedural SBP in group B (125.88±16.06 mm Hg) compared with group C (136.59±18.11 mm Hg, p=0.057). Oxygen saturation remained stable across groups. Sedation was required in 17.6% of control patients but in none of the music therapy ones (p=0.002), indicating a potential beneficial effect of music intervention on sedative administration.

Table 2 Baseline parameters per group

	Group A	Group B	Group C	P value
Number of patients	34	32	34	
SBP (mean (SD))	143.88 (22.14)	137.84 (15.53)	140.62 (17.75)	0.426
DBP (mean (SD))	77.59 (11.40)	77.06 (11.35)	79.68 (13.31)	0.646
HR (mean (SD))	72.41 (11.02)	74.44 (13.39)	79.65 (13.69)	0.059
SpO_2 (mean (SD))	98.26 (0.96)	98.25 (1.08)	98.47 (0.93)	0.595
BNP (mean (SD))	255.91 (335.62)	339.00 (590.44)	488.41 (1353.94)	0.546
Troponin (ng/L, mean (SD))	12.71 (6.69)	13.12 (7.98)	18.09 (17.45)	0.119
Cortisol (nmol/L, mean (SD))	336.09 (110.07)	334.50 (119.02)	368.88 (120.41)	0.397
Anxiety (mean (SD))	4.47 (2.49)	4.44 (2.08)	3.12 (2.40)	0.029
STAI questionnaire (mean (SD))	36.71 (11.60)	37.03 (10.67)	35.47 (11.11)	0.834

BNP, brain natriuretic peptide; DBP, diastolic blood pressure; HR, heart rate; SBP, systolic blood pressure; SpO_2, peripheral oxygen saturation; STAI, State-Trait Anxiety Inventory.

Table 3 Music type and timing/duration of the intervention

	Group A	Group B	Group C	P value
Number of patients	34	32	34	
Type of music played (%)				<0.001
No music	0 (0.0)	0 (0.0)	34 (100.0)	
Opera	3 (8.8)	1 (3.1)	0 (0.0)	
Jazz	8 (23.5)	6 (18.8)	0 (0.0)	
Pop	14 (41.2)	14 (43.8)	0 (0.0)	
Nature	5 (14.7)	6 (18.8)	0 (0.0)	
Classical	4 (11.8)	5 (15.6)	0 (0.0)	
Time to music initiation before procedure (mean (SD))	30.00 (17.32)	35.00 (11.68)	NA (NA)	0.422

Post-procedural parameters and outcomes

Post-procedural SBP, the study's primary endpoint, was significantly lower in the continuous music group (group B: 120.53±15.44 mm Hg) compared with group A (134.21±28.65 mm Hg) and group C (133.91±19.94 mm Hg). This reduction in group B corresponds to a mean difference of –13.4 mm Hg versus group C (p=0.003) and –13.3 mm Hg versus group A (p=0.018), underscoring the superiority of continuous music exposure (figure 2, online supplemental figure 1).

In the baseline-adjusted ANCOVA sensitivity analysis, the effect of continuous music therapy on post-procedural SBP remained consistent. Compared with standard care, group B had a significantly lower adjusted post-procedural SBP (adjusted mean difference −11.7 mm Hg, 95% CI −21.2 to −2.3; p=0.015). Group B also showed lower adjusted post-procedural SBP compared with group A (adjusted mean difference −10.1 mm Hg, 95% CI −19.6 to −0.6; p=0.038), whereas no significant difference was observed between group A and group C (adjusted mean difference −1.6 mm Hg, 95% CI −10.9 to 7.7; p=0.729).

Post-procedural HR also remained significantly lower in the music therapy groups (group A: 67.09±11.56 bpm;

Table 4 Procedural parameters

	Group A	Group B	Group C	P value
Number of patients	34	32	34	
Procedure duration (mean (SD))	20.59 (11.01)	17.41 (5.97)	17.29 (7.72)	0.204
PCI (%)	15 (44.1)	7 (21.9)	15 (44.1)	0.099
Sedation use (%)	0 (0.0)	0 (0.0)	6 (17.6)	0.002
HR PR (mean (SD))	70.59 (12.24)	71.62 (10.48)	80.12 (12.54)	0.002
SBP PR (mean (SD))	133.41 (20.48)	125.88 (16.06)	136.59 (18.11)	0.057
DBP PR (mean (SD))	76.76 (10.14)	74.78 (10.33)	75.53 (11.23)	0.743
SpO_2 PR (mean (SD))	98.12 (1.20)	98.34 (0.83)	98.21 (0.98)	0.663
Vascular access (%)				0.362
Radial	34 (100.0)	30 (93.8)	34 (100.0)	
Femoral	1 (3.4)	1 (3.1)	0 (0.0)	
Intraprocedural complications (%)	2 (5.9)	0 (0.0)	0 (0.0)	0.138
Intraprocedural arrhythmias (%)	2 (5.9)	0 (0.0)	4 (11.8)	0.132

DBP, diastolic blood pressure; HR, heart rate; PCI, percutaneous coronary intervention; PR, procedural; SBP, systolic blood pressure; SpO_2, peripheral oxygen saturation.

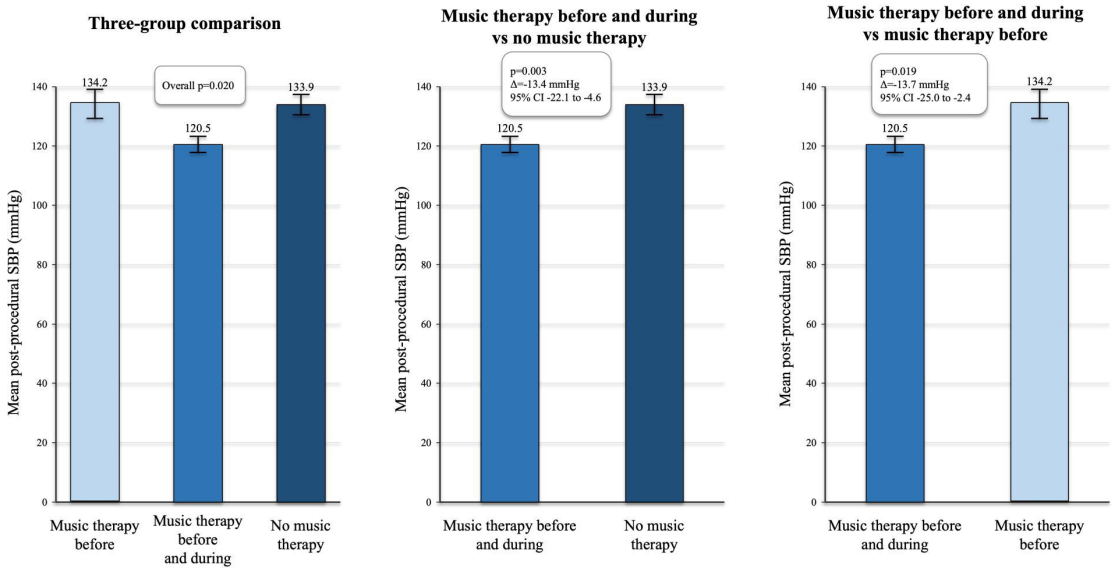


Figure 2 Primary endpoint (post-procedural systolic blood pressure) per group. Central illustration: Impact of tailored music therapy on haemodynamic response during invasive coronary angiography, with or without ad hoc percutaneous coronary intervention. SBP, systolic blood pressure.

group B: 65.44±8.02 bpm) compared with control (group: 75.53±11.66 bpm; p<0.001). DBP and oxygen saturation showed no significant between-group differences.

Pain levels immediately post-procedure were lowest in group B (0.09±0.30), followed by group A (0.26±0.79), and highest in group C (0.65±0.92; p=0.008). Post-procedural anxiety scores were numerically lower in groups A and B compared with controls (1.65±1.72, 1.53±1.67 vs 2.50±2.03; p=0.063), though this did not reach statistical significance. STAI post-procedural scores were also lower in group B (28.44±7.84; p=0.120), though differences were non-significant.

Post-procedural cortisol levels were reduced from baseline in all groups, with no significant intergroup differences (group A: 284.21±153.65 nmol/L; group B: 274.22±115.81 nmol/L; group C: 302.85±145.99 nmol/L; p=0.700). BNP levels remained unchanged and similar between groups (p=0.556). High-sensitivity TnI levels were significantly lower in group A (11.29±4.52 ng/L) and group B (12.84±6.85 ng/L) compared with the control group (18.97±17.63 ng/L; p=0.015) (table 5).

DISCUSSION

The main findings of our study can be summarised as follows:

1. The MUS.E I randomised trial showed that tailored music therapy initiated before and continued during invasive coronary angiography significantly reduced the primary endpoint of post-procedural SBP compared with standard care.
2. This finding remained consistent after adjustment for baseline SBP, addressing the potential influence of baseline haemodynamic differences between groups.
3. Among secondary endpoints, continuous music exposure was also associated with lower post-procedural HR, lower pain scores and lower high-sensitivity TnI levels, whereas DBP, SpO_2, cortisol, BNP and STAI scores did not differ significantly between groups.

The relaxing influence of music on the limbic system and higher cortical centres likely plays a role in reducing adrenergic outflow.[10] These benefits are in line with a recent meta-analysis of 21 studies (2141 patients) in invasive coronary procedures (angiography, PCI and coronary artery bypass grafting), which found that listening to music significantly reduced post-procedural pain, anxiety, HR and SBP, with the largest effects observed after the procedure.[13]

While the standard STAI psychological questionnaire did not reveal a statistically significant difference in post-procedural scores, the acute anxiety rating scale suggested a trend toward lower anxiety in the music therapy group B. Pain levels showed a significant reduction in both intervention groups compared with the control group, with group B consistently reporting the

Table 5 Post-procedural parameters

	Group A	Group B	Group C	P value
Number of patients	34	32	34	
Immediate post procedure pain level (mean (SD))	0.26 (0.79)	0.09 (0.30)	0.65 (0.92)	0.008
Anxiety level post (mean (SD))	1.65 (1.72)	1.53 (1.67)	2.50 (2.03)	0.063
HR post (mean (SD))	67.09 (11.56)	65.44 (8.02)	75.53 (11.66)	<0.001
SBP post (mean (SD))	134.21 (28.65)	120.53 (15.44)	133.91 (19.94)	0.02
DBP post (mean (SD))	75.62 (13.66)	72.19 (10.25)	75.03 (10.66)	0.448
SpO_2 post (mean (SD))	95.74 (8.60)	98.31 (0.78)	98.12 (0.91)	0.072
Cortisol post (nmol/L, mean (SD))	284.21 (153.65)	274.22 (115.81)	302.85 (145.99)	0.7
BNP post (mean (SD))	263.53 (306.45)	332.69 (576.72)	482.29 (1307.05)	0.556
Troponin post (ng/L, mean (SD))	11.29 (4.52)	12.84 (6.85)	18.97 (17.63)	0.015
STAI questionnaire post (mean (SD))	32.94 (9.67)	28.44 (7.84)	31.76 (9.52)	0.12

BNP, brain natriuretic oeptide; DBP, diastolic blood pressure; HR, heart rate; SBP, systolic blood pressure; SpO_2, peripheral oxygen saturation; STAI, State-Trait Anxiety Inventory.

lowest scores. These findings are congruent with a recent meta-analysis that demonstrated significantly lower anxiety scores in music therapy recipients.[9]

However, the results of earlier studies by Nilsson *et al*[14 15] differ from our findings. Those studies, which also measured pain, anxiety and sedative use, reported no significant benefit of music on these outcomes. Anxiety and relaxation scores were unchanged, pain ratings were similar and sedative use was equal across groups. In contrast, our trial demonstrated clear improvements, particularly in pain reduction and sedative use, which represents a crucial finding as no patient in either music group required sedative medication, whereas 17.6% of control patients did (p=0.002). This finding shows that music can effectively reduce the need for sedatives during invasive coronary procedures, and highlights a potential non-pharmacological strategy to improve patient safety and reduce future addiction risks. This divergence likely reflects key methodological differences: Nilsson's studies used a fixed MusiCure soundtrack delivered via speakers and were conducted under routine sedative administration; whereas our study employed personalised, patient-preferred music, avoided baseline sedative use and offered continuous exposure with earphones. Moreover, our study extended beyond these subjective outcomes by incorporating objective haemodynamic measures and biochemical stress markers, broadening the scope of evidence for music therapy in the catheterisation laboratory. Finally, and most importantly, our study was performed in patients undergoing invasive coronary angiography, with or without ad hoc PCI and not only in patients undergoing diagnostic procedures like the studies by Nilsson.

Another unique finding of our study, even though this should be considered an exploratory finding, was the lower increase in cardiac troponin in patients allocated to the music groups compared with controls (p=0.015). High sensitivity is a sensitive marker of myocardial injury, and even minor elevations can occur from the strain of PCI. The reduced troponin release in music listeners raises the possibility that music may mitigate myocardial ischaemic stress during the intervention. We postulate that this reduction in troponin release may have occurred due to the effect of music in reducing the sympathetic surge, which may decrease myocardial oxygen demand and thus limit ischaemia. Further studies are warranted to confirm these exploratory findings.

In contrast to troponin, other biomarkers in our study did not show improvement by music. We measured serum cortisol (a stress hormone) and BNP (a marker of cardiac wall stress), but neither was significantly lower in the music groups compared with controls. This lack of signal may be due to the acute timing of sample collection and the inherent variability of these biomarkers. It is worth noting that prior investigations on music interventions have shown mixed results on biochemical measures. Some studies have demonstrated that music listening can stabilise or lower stress hormones during medical procedures. For example, in a double-blind study of patients undergoing surgery with regional anaesthesia, those who listened to instrumental music had significantly lower intraoperative cortisol levels and required fewer sedatives compared with controls,[16] reflecting a stress-reducing effect of music. On the other hand, other trials did not observe significant differences in catecholamines or cortisol. In our trial, the overall pattern (lower troponin, stable cortisol/BNP) provides a new insight and hints at a potential protective effect of music on the heart during invasive coronary angiography, with or without ad hoc PCI, though this finding should be interpreted with caution until verified by other studies with larger populations.

Several aspects of how the music intervention was delivered in our study may have influenced its outcome. Notably, patients were allowed to express their opinion on the preferred music to listen to, with contemporary pop music being the most frequently chosen genre (followed by jazz and then nature sounds). This underscores the importance of personalisation as familiar and pleasant music likely maximised the impact by increasing patient engagement, comfort and sense of control during the procedure.

The timing and duration of music exposure warrant careful consideration. In our trial, pre-procedural music alone (group A) provided limited, non-sustained benefit, whereas continuous exposure (group B) showed consistent improvements across the study parameters. While numerous studies have evaluated music therapy before, during or after procedures with relatively short sessions,[11] to our knowledge no randomised trial has systematically compared outcomes based on timing and duration of music. Our findings therefore highlight continuous music throughout the procedure as a potentially more protective strategy, preventing anxiety buildup and sustaining relaxation during the period of greatest physiological and psychological stress.

Building on our findings, future research should focus on large, multicentre randomised trials to confirm the benefits of music therapy in patients undergoing invasive coronary angiography, with or without ad hoc PCI, and to enable subgroup and cost-effectiveness analyses. Standardisation of protocols is needed to define the optimal timing, duration and type of music, and to evaluate whether sessions are best delivered by certified therapists or through digital platforms. In addition, studies should extend beyond immediate outcomes to assess recovery quality, complication rates and long-term psychological effects. Finally, based on the encouraging results of this trial, we have designed MUS.E II, a new randomised study comparing a control group with patients receiving continuous music therapy (initiated before and maintained throughout PCI) under the supervision of a trained music therapist, in a larger population. This will allow us to determine whether longer, structured, therapist-led interventions can further amplify the physiological and psychological benefits observed.

Limitations

This trial, while adequately powered for the primary endpoint, had a modest sample size (n=100), which may limit detection of more subtle differences and subgroup effects. Despite randomisation, some baseline and procedural imbalances were present, including numerically different rates of previous myocardial infarction and lower baseline and intraprocedural SBP in the continuous music therapy group. The intervention was unblinded, raising the possibility of expectancy bias in subjective outcomes, though we mitigated this by including objective endpoints. Our use of recorded, patient-selected music ensures reproducibility but differs from formal, therapist-led interventions with more tailored, instrumental music, which may offer additional benefits. Although the primary finding remained consistent after adjustment for baseline SBP, residual imbalance cannot be excluded. In addition, no formal adjustment for multiplicity was performed despite multiple secondary endpoint comparisons. Therefore, findings for secondary outcomes, including HR, pain, sedation use and high-sensitivity TnI, should be considered exploratory and hypothesis-generating. Finally, only short-term peri-procedural outcomes were assessed, so longer-term effects on recovery and cardiovascular health remain unknown.

CONCLUSIONS

The MUS.E I trial demonstrated how sustained pre- and peri-procedural tailored music therapy was able to reduce post-procedural SBP in patients undergoing invasive coronary angiography, with or without ad hoc PCI. These findings support music therapy as a safe, easy and effective non-pharmacological intervention to reduce cardiovascular stress and enhance the overall patient experience during coronary interventions.

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