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Mozart Piano Sonatas as a Nonpharmacological Adjunct to Facilitate Sedation Vacation in Critically Ill Patients

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Abstract

Critically ill patients frequently receive sedatives in order to treat agitation in the ICU; however, adverse outcomes are linked with long-term use. The aim of this pilot study was to evaluate the effectiveness of music listening in facilitating sedation vacations. This study was conducted in neurotrauma ICUs where 50 adult critically ill patients were randomized into a music (n = 25) or no music (n = 25) group. The music group had a greater decline in heart rate ($P = .042$) but not in respiratory rate ($P = .081$) or systolic blood pressure ($P = .653$) when compared with the control group. There was no statistically significant change in sedation scores between groups ($P = .567$); however, patients in the music group were more likely to remain off sedation infusions (64% vs 52%). Music listening may be a cost-effective, nonpharmacological intervention to reduce agitation in critically ill patients.

Keywords

music medicine, ICU, sedation vacation, agitation, Mozart

The use of sedation vacations in patients involve interrupting sedation infusions on a daily basis in an effort to reduce the number of days on mechanical ventilation.[1] It has been previously demonstrated that a wake up and breathe protocol coupled with daily spontaneous awakening trials (ie, interruption of sedatives) lead to a reduction in the number of days on mechanical ventilation and ICU length of stay.[2] Sedation vacations have also been included in a "bundle" to reduce ventilator-associated pneumonia (VAP) and have been endorsed by the Canadian ICU Collaborative and the Canadian Safer Healthcare Now! campaign.[3] Furthermore, sedation vacations may be important in helping to lower the incidence of delirium in intubated, mechanically ventilated patients by minimizing sedative use.[4] One promising avenue to aid sedation vacations may be music listening,[5] which can be considered a form of music medicine.[6]

Music medicine is the use of music in the treatment and management of somatic and mental diseases and most relevantly has been beneficial for anxiety reduction in mechanically ventilated patients.[6,7] Given that pain and anxiety are common among patients in the ICU, and that the extensive use of sedatives poses high long-term health risks, music listening provides a low-cost, potentially side-effect-free intervention that is suitable for patients of all age groups.[8] Several studies have shown that the classical style of music, like that of Mozart, generates physiologic responses that alter cognition.[9-11] Relaxing musical compositions incorporate predictable dynamics, slow tempo, low pitch, and simple repetitive rhythms, all of which have been found to calm physiological responses such as slowing heart rate (HR), respiratory rate (RR), and lowering systolic blood pressure (SBP).[12] Mozart piano sonatas were investigated in this study for 2 key reasons: (1) listening to Mozart piano sonatas have been correlated with positive mood and arousal in human studies[10] and (2) selectively playing piano sonatas may help to eliminate the influences of different musical instruments, such as organ and string instruments, and standardize the selection of music being played.[10]

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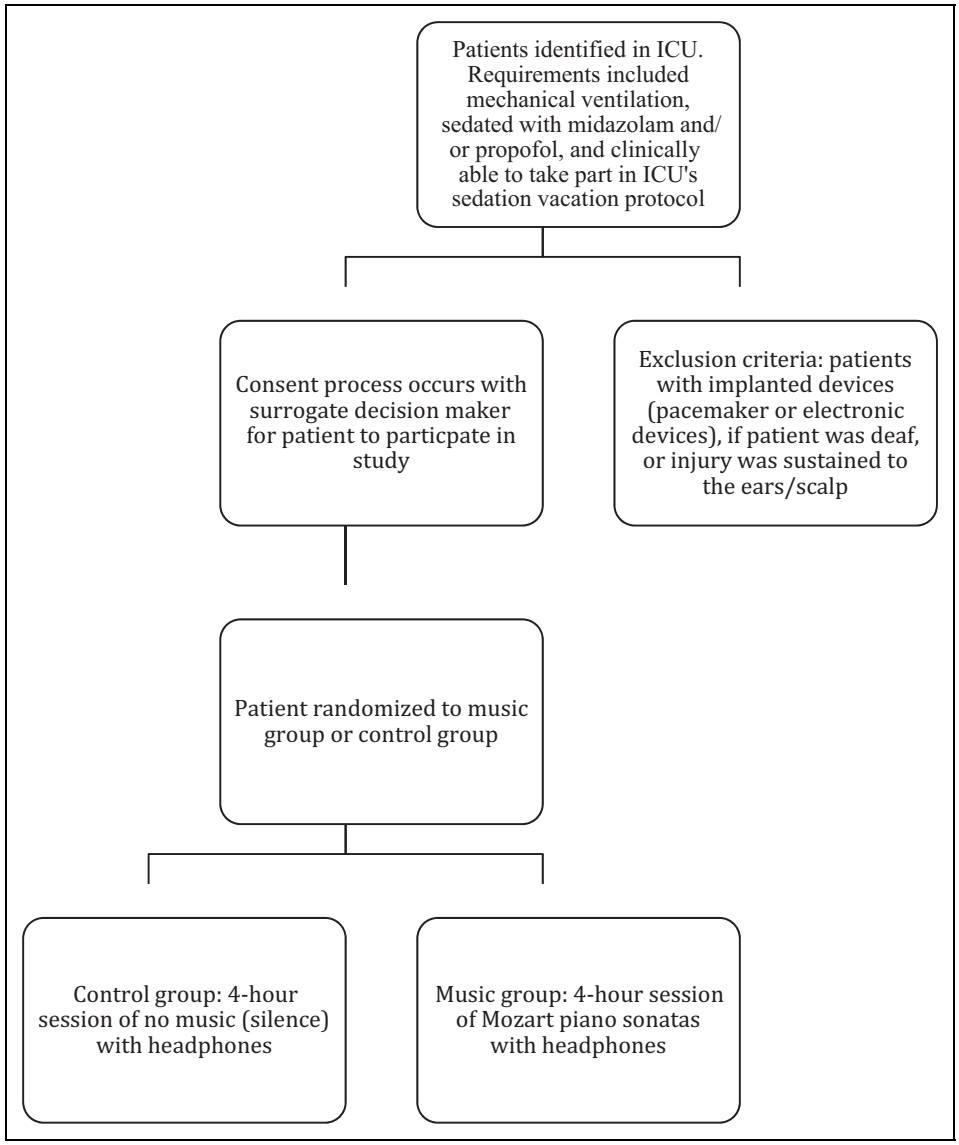

Figure 1. Flow diagram of study design.

The aim of this pilot study was to determine the effect of Mozart piano sonatas in facilitating a 4-hour sedation vacation in mechanically ventilated critically ill patients. The time of 4 hours was chosen to match the sedation vacation protocol used in our ICUs. Measures of outcome included vital signs such as HR, RR, SBP, modified Ramsay sedation score, and whether the sedation vacation was successful. Sedation vacation was defined as stopping a continuous sedation infusion until a patient was able to follow commands or become fully awake.

Methods

Study Protocol

This was a prospective randomized clinical trial study of critically ill patients at the Hamilton General Hospital, a university teaching hospital in Hamilton, Ontario, Canada. Annually, over 1000 adults are admitted into our ICUs, collectively hosting 25 patient beds. This study received institutional review board approval (Hamilton Health Sciences Research Ethics Board, REB number: 08-489, Protocol number: 022-2008) before commencement.

Study Population

Fifty patients were recruited consecutively (Figure 1), according to a set of predetermined criteria: the inclusion criteria required subjects to be on mechanical ventilation, sedated with midazolam and/or propofol (infusion or bolus), and take part in the ICU's sedation vacation protocol (Figure 2). Patients were excluded if the patient had an implanted device or devices (eg, pacemaker or other electronic devices that could interfere with the music player or vice versa), if the patient was deaf, or if the patient sustained injury to the ears and/or scalp, thereby

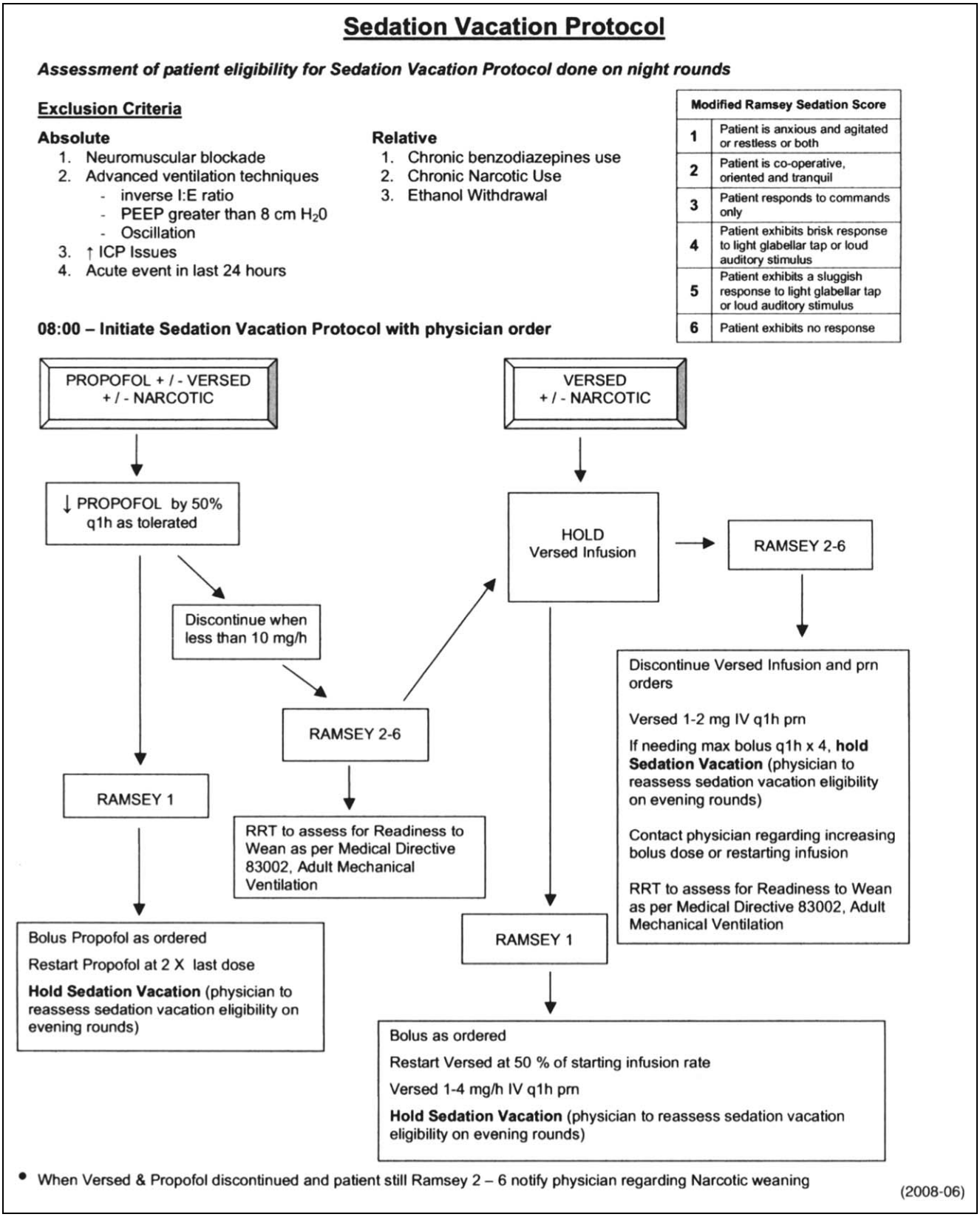

Figure 2. The Modified Ramsay sedation scale and sedation vacation protocol used.

Table 1. Mozart Piano Sonata Playlist.

Order Played in Study	Full Name of Composition	Short Name of Composition	Year Composed	KV Number	Length of Track	Performer	Composer
1	Disc 4, track 5. Piano Sonata No. 5 in G, K.283 - 2. Andante	Andante	1775	KV 283	4:05	András Schiff	Wolfgang Amadeus Mozart
2	Disc 3, track 8. Piano Sonata No. 9 in D, K.311 - 2. Andantino con espressione	Andantino con espressione	1777	KV 311	5:47		
3	Disc 4, track 8. Piano Sonata No. 10 in C major, K.330 - 2. Andante cantabile	Andante cantabile	1783	KV 330	6:50		
4	Disc 5, track 8. Piano Sonata No. 12 in F, K.332 - 2. Adagio	Adagio	early 1780s	KV 332	4:49		
5	Disc 1, track 2. Piano Sonata No. 13 in B flat, K.333 - 2. Andante cantabile	Andante cantabile	1783	KV 333	5:55		
6	Disc 1, track 5. Piano Sonata No. 16 in C, K.545, *Sonata facile* - 2. Andante	Andante	1788	KV 545	5:23		
7	Disc 5, track 11. Piano Sonata No. 17 in B flat, K.570 - 2. Adagio	Adagio	1789	KV 570	7:58		
8	Disc 2, track 8. Piano Sonata No. 18 in D, K.576 - 2. Adagio	Adagio	1789	KV 576	4:59		

prohibiting headphone use. A surrogate decision maker gave consent for patients to participate in the study.

Music Selection

Mozart piano sonatas were selected from the study by Conrad et al, owing to their slow compositional movements with a focus on slow tempos.[13] Additional details of these 8 Mozart piano sonatas, including the order played; the full and short name of the composition; year composed; the KV number (Köchel catalogue), which is a chronological catalogue of compositions by Mozart; and the length of the track are provided here (Table 1). The title of the audio CD collection is *Mozart The Piano Sonatas*, performed by the classical pianist András Schiff, and was originally composed by Wolfgang Amadeus Mozart (1756-1791). Furthermore, the reasons for selecting these specific 8 Mozart piano sonatas from the 50 and more possible Mozart piano sonatas were as follows: (1) there are currently no studies to demonstrate the differences in these 8 compositions compared to other Mozart piano sonatas, in terms of the ability to promote relaxation, and (2) we aimed to select Mozart piano sonatas that have been used in previous published studies, such as the study by Conrad et al,[13] in an effort to increase the homogeneity and comparability between study designs. The sonatas were played in sequential order during a 4-hour session so as to standardize the music program. The music volume was set to 50% of the maximum allowed setting as to prevent excessive volume. Music tracks were repeated until 4 hours elapsed. A 4-hour music session was selected to support the entire length of the sedation vacation for each patient, which at this particular ICU was 4 hours in length.

Data Collection

The sample of 50 critically ill adult patients was randomized using sealed, numbered, opaque envelopes into the music or control group at a ratio of 1:1. The music group received headphones and a numbered iPod shuffle (2, 3, or 5; fourth generation, Apple Inc, Cupertino, California) preloaded with 4 hours of Mozart piano sonatas. Headphones were not noise canceling due to limited resources but were lightweight stereo headphones. The control group received headphones with a numbered iPod shuffle (1, 4, or 6) preloaded with no music (quiet background noise could be heard; not complete silence from the ICU surrounding). Volume on each music player was set to 50% of the maximum volume, as it would prove difficult to ask each critically ill patient whether the music was loud enough for them individually. Investigators tested this predetermined music volume at the onset of the study and determined that the volume was not too loud or too quiet. The music was also set to 50% of the maximum volume because it was the level that was undetectable by anyone standing nearby, unless they wore the headphones.

The bedside nurse was blinded to whether the patient wearing headphones was receiving music or not and was instructed to administer the intervention for 4 hours. The bedside nurse recorded baseline measurements of HR, RR, SBP, Ramsay sedation score, and the amount of midazolam and/or propofol being administered and then pressed Play. Measurements were recorded at 30-minute intervals. All data were recorded on the researcher-designed data collection form. The sedation vacation protocol was concurrently initiated. Our ICU's protocol asked the nurse to discontinue any parenteral midazolam and wean intravenous propofol by half for each hour until off.

Table 2. Baseline Measurements for the Music (n = 25) and Control (n = 25) Groups.

Pretest	Control (n = 25)	Music (n = 25)	*P* Value
Age,[a] mean ± SD	50.52 ± 17.45	50.25 ± 19.25	.504
Gender,[b] n			
Male	14	21	
Female	10	3	.023
Diagnosis,[b,c] n			
Trauma	10	11	.157
Medicine	10	4	.001
Neurosurgical	1	5	.014
Surgery	2	4	.014
Vitals, mean ± SD			
HR	88.12 ± 14.11	94.84 ± 20.05	.265
RR	21.16 ± 4.42	21.04 ± 6.86	.143
SBP	146.72 ± 22.62	142.00 ± 24.10	.464
Ramsay score,[d] median	3	4	.913

Abbreviations: HR, heart rate; RR, respiratory rate; SBP, systolic blood pressure; SD, standard deviation.
[a]Student *t* test.
[b]Chi-square test.
[c]Missing data were excluded; for 1 patient in the music group and for 2 patients in the control group, diagnosis data were unknown.
[d]Mann-Whitney *U* test.

Under the sedation vacation protocol, no additional administration of midazolam or propofol was considered a successful sedation vacation during the 4 hours. Sedation vacations were performed during morning rounds, and patients enrolled must be receiving their first sedation vacation. The ICU staff were instructed not to interact unnecessarily with the patient during sedation vacation, and any alarms were silenced. Ventilation was standardized during the sedation vacation, with no changes in ventilation settings permitted. If the patient became agitated (Ramsay 1), then a clinically appropriate dose of sedative was given and the sedation infusion was allowed to be either increased or restarted. If, at any time during the 4 hours, additional sedatives were given, this signaled the end of the intervention so as to prevent confounding. At the end of music listening, the bedside nurse evaluated the patient's vitals. All physiological measurements and demographic data were documented accordingly and were later entered into a computer database. To control for infection, the iPod shuffles were enclosed in a ziplock plastic bag to maintain cleanliness, and all equipments were wiped down with isopropyl alcohol after use.

Modified Ramsay Sedation Scale

The modified Ramsay sedation scale is the most widely used sedation scale in our ICU. The scale was developed as a simple scale scored from 1 to 6, ranging from an anxious and agitated/restless patient to no response to a light glabellar tap.[14] A Ramsay score of 2 or 3 was considered ideal, indicating that the patient was oriented, cooperative, and responded to commands. The HR, RR, and SBP were selected as variables indicative of relaxation. Measurements were obtained at baseline, at every 30 minutes during the intervention, and ended at 4 hours.

Statistical Analysis

All data were entered into a Microsoft Excel database. Data were analyzed using Microsoft Excel 2011 (Microsoft Corp, Redmond, Washington), SPSS 17.0 (IBM Corp, Armonk, New York), and GraphPad Prism version 5.0a (GraphPad Software, California), and arithmetic averages are presented with corresponding standard deviation (SD). For baseline measurements, an unpaired, 2-tailed Student *t* test was performed for age, HR, RR, and SBP, and a chi-square test (χ^2) was performed for gender and diagnosis. Sedation scores were analyzed using the Mann-Whitney *U* test, and the number of patients who passed or failed the sedation vacation was analyzed using Fisher exact test. Statistical significance was considered when the value of $P < .05$.

Results

A summary of baseline characteristics is provided for all study patients (Table 2). The majority (42%) of patients had trauma-related injuries. All patients received mechanical ventilation during their intervention time. A comparison of demographics and clinical characteristics showed no significant differences between groups in terms of age, diagnosis, and baseline HR, RR, and SBP. The exception was gender ($P = .023$), where there were 10 females in the control group compared to 3 females in the music group. The baseline median Ramsay sedation scores for the control group and music group were 3 and 4, respectively.

For both groups, the physiological parameters are compared at 0 hour and 4 hours of the intervention (Tables 3 and 4). The control group started and maintained a lower mean HR than that of the music group (Figure 3). However, the mean HR in the music group declined more rapidly within a span of 4 hours, yet the mean HR was still lower in the control group ($P = .042$, $t = 2.210$, $df = 16$). Patients in the control group had a lower RR (Figure 4; $P = .081$, $t = 1.865$, $df = 16$) and SBP (Figure 5; $P = .653$, $t = 0.4579$ $df = 16$), at the end of 240 minutes. However, for up to 30 minutes, patients in the music group had lower RR values compared to the control group. But beyond 1 hour, patients in the control group had lower RR values. Similarly, patients in the music group had lower SBP scores at around 1 hour. Further, the effect size of HR, RR, and SBP was 0.452, 0.243, and 0.452, resulting in a small to medium effect size between groups. There was no statistically significant difference in Ramsay sedation scores between the music and control group following intervention ($P = .567$); however, patients in the music group were more likely to remain off sedation infusions (Figure 6; music group, 64% success: 16 successful vs 9 failed versus control group, 52% success: 13 successful vs 12 failed). Overall, there was a statistically significant difference in HR but not in RR, SBP, or Ramsay sedation scores between the music and control group over the 4-hour intervention period.

Table 3. Absolute and Overall Changes in HR, RR, SBP, and Ramsay Score During the 4-Hour Intervention for the Control Group.

Control (n = 25)	Parameters			
Hour	HR	RR	SBP	RS
0.0	88.12 ± 14.11	21.16 ± 4.42	146.72 ± 22.62	4
0.5	92.96 ± 19.16	22.09 ± 4.65	150 ± 28.15	4
1.0	90.16 ± 18.85	20.79 ± 5.08	144.26 ± 25.59	3
1.5	91.44 ± 15.74	21.17 ± 6.06	143.17 ± 26.08	3
2.0	87.69 ± 11.52	20.81 ± 4.26	139.63 ± 29.05	3
2.5	90.86 ± 20.65	21 ± 3.65	140.25 ± 27.58	3
3.0	91.73 ± 20.52	20.8 ± 5.61	138.73 ± 27.26	3
3.5	88.23 ± 12.51	19.85 ± 5.38	137.00 ± 23.80	3
4.0	86.40 ± 7.31	21.80 ± 4.96	132.89 ± 30.03	3
Average	89.73 ± 2.21	21.05 ± 0.64	141.4 ± 5.21	N/A
Overall change	−1.72 ± 10.71	+0.64 ± 4.69	−13.83 ± 26.33	−1
P value	.59	.63	.07	.91

Abbreviations: HR, heart rate; RR, respiratory rate; SBP, systolic blood pressure; RS, Ramsay Score.

Table 4. Absolute and Overall Changes in HR, RR, SBP, and Ramsay Score During the 4-Hour Intervention for the Music Group.

Music (n = 25)	Parameters			
Hour	HR	RR	SBP	RS
0.0	94.84 ± 20.05	21.04 ± 6.86	142.00 ± 24.10	3
0.5	97.50 ± 18.21	21.58 ± 7.93	150.96 ± 25.58	3
1.0	91.18 ± 14.93	21.41 ± 6.60	134.24 ± 23.62	3
1.5	92.19 ± 14.92	22.38 ± 5.67	142.13 ± 22.92	3
2	93.13 ± 16.08	21.25 ± 5.08	144.88 ± 25.65	3
2.5	91.31 ± 15.55	22.63 ± 7.28	140.19 ± 19.79	3
3.0	91.75 ± 15.35	21.50 ± 5.92	139.19 ± 20.60	3
3.5	89.07 ± 17.16	21.33 ± 5.74	141.36 ± 23.29	3
4.0	89.42 ± 13.61	21.09 ± 5.41	147.50 ± 23.50	3
Average	92.26 ± 2.63	21.58 ± 0.55	142.5 ± 4.85	N/A
Overall change	−5.42 ± 16.83	+0.05 ± 6.14	+5.50 ± 23.80	0
P Value	.27	.98	.42	.86

Abbreviations: HR, heart rate; RR, respiratory rate; SBP, systolic blood pressure; RS, Ramsay Score.

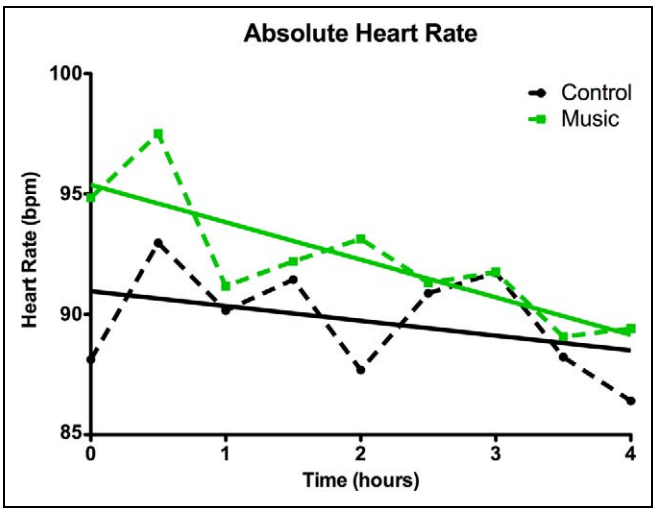

Figure 3. Mean heart rate among the music and control group ($P = .042$). The music listening group has a greater reduction effect in heart rate over the 4-hour period.

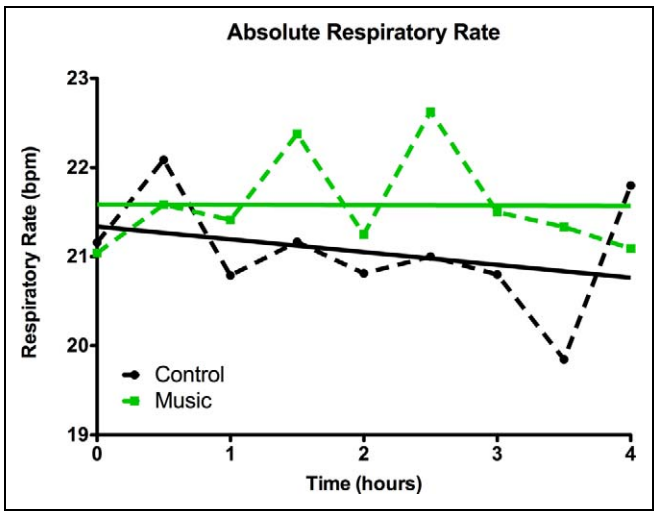

Figure 4. Mean respiratory rate among the music and control group ($P = .081$). Over the 4-hour period, the music group remained stable while the control group trended downward.

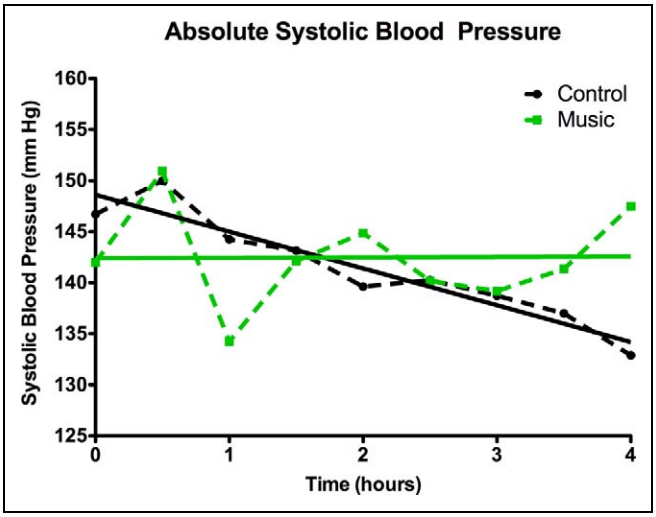

Figure 5. Mean systolic blood pressure among the music and control group ($P = .653$). Over the 4-hour period, the music group remained stable while the control group trended downward.

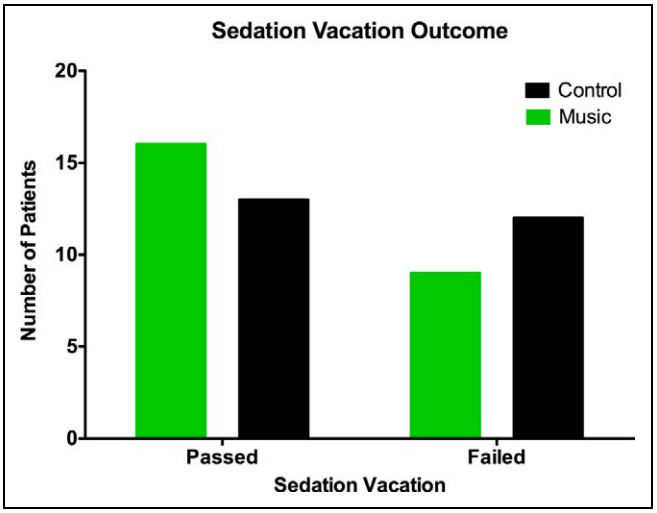

Figure 6. Comparison of patients successfully passing or failing sedation vacation. Those patients that required a bolus of sedative during their intervention failed the sedation vacation. The last data value before the administration of the sedative was used as the final value. A greater number of patients who passed the sedation vacation were from the music group.

Discussion

This pilot study evaluated the effectiveness of a single 4-hour music listening session to facilitate sedation vacation in mechanically ventilated adult ICU patients. There was a statistically significant difference between the music and control group in HR but not in RR, SBP, and Ramsay score over the 4 hours. The tendency for higher values in HR, RR, and SBP may be attributed to a greater number of neurosurgical patients in the music group. Moreover, our most interesting finding confines to the time interval of 0 to 60 minutes, where RR and SBP appear to dip lower in the music group. Although there was no statistically significant difference in Ramsay sedation scores between patients in the music and the control group following the intervention, patients in the music group were more likely to be successfully weaned off continuous sedative infusions (64% vs 52%). These findings suggest a possible trend that listening to Mozart piano sonatas may be potentially linked to increased success of remaining off sedation infusions. A greater sample size will be needed to determine whether listening to Mozart piano sonatas is statistically correlated with increased success of sedation vacations.

Strengths and Weaknesses

The use of music listening as a method of allaying anxiety in the ICU has been supported by previous literature.[15] This was the first study to test a single 4-hour session of music listening on a ventilated adult ICU population. The findings of this study suggest that patients listening to music for 4 hours have comparable RR and SBP than do patients listening to no music (silence). However, our study did have a number of limitations. First, only 25 patients per group were recruited into the pilot study. A future study should require a sample size of approximately 100 patients in each treatment group. Second, only 2 groups were observed: a music group and a control group. The addition of a third control (standard care) group may have provided a more comprehensive comparison. In terms of study design for future studies, it may be of value to constrain the intervention period to 60 minutes and examine the vitals at 5-minute intervals. This method may provide more sensitivity to detect small changes in physiological outcomes. Furthermore, there may have been differences in the way nursing staff administered a patient's medication, particularly pain medication. Some nurses may provide medications more liberally in anticipation for pain rather than waiting for pain to reach a certain level before administration.

Relationship to Other Studies

In a recent randomized controlled trial, 137 patients receiving mechanical ventilation were randomly assigned to a music listening group (n = 44), a headphone group (n = 44), or a standard care group (n = 45).[16] Music was patient selected from a variety of music options provided by the investigators (Western classical music, Western light music, Chinese traditional music, Chinese folk songs with lyrics). The HR, RR, and oxygen saturation were measured at 5-minute intervals for a total of 30 minutes. The authors found a significant reduction in physiological stress response in the music listening group ($P < .001$).[16] A number of studies have also evaluated the efficacy of music listening as a nonpharmacological intervention to reduce anxiety levels in patients.[17,18] The music in these studies was patient provided, patient selected from a list of music options provided by the investigator, or investigator selected (piano, flute, classical). Furthermore, a review of

42 randomized controlled trials have evaluated the effects of approximately 1 hour or less of music listening in postoperative patients admitted as outpatients.[8] The music in these studies was either patient selected or classical music provided by the investigator. The majority of studies showed that music listening lowered HR, RR, and BP and that no difference was observed in the results obtained in different clinical settings.[19] The music in these studies was either patient provided or patient selected from a list of music options provided by the investigator (Chinese classical, Western classical, or natural sounds). Overall, it is important to appreciate the selection of music that the patient is listening to (patient selected from own list, patient selected from investigator list, or investigator-selected music) and consider its impact on the results of each study. While most hospital patients may be able to bring their own music, it is often that patients in the ICU arrive unexpectedly and without the time, or even ability, to select their preferred type of music. Therefore, in our study, the greatest of care was made to select a type of music that was conducive to relaxing, one of which are Mozart piano sonatas.

Implications

Music listening may facilitate rapid weaning and help patients who find it difficult to wean from mechanical ventilation.[20] As a result, early extubation reduces the length of stay in the ICU[21] and in the hospital, lowers the risk of VAP,[22] and thereby diminishes the cost of care. It is also of value for ICU physicians and nursing staff to take advantage of nonpharmacologic strategies that can be easily used to reduce agitation, speed extubation, and reduce ICU and hospital stay.

Conclusion

This pilot study demonstrated that ventilated adult patients in the ICU who listened to 4 hours of Mozart piano sonatas had, on average, lower HR, but not RR, SBP, or a better Ramsay sedation score compared to the control group. However, there was a trend for more successful sedation vacations in the music group (64%) compared to the control group (52%). Our findings suggest that the use of music listening, specifically Mozart piano sonatas, provides a practical nonpharmacological intervention that can potentially support sedation vacations in the ICU.

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Authors' Note

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Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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Author Biographies

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