Music Exposure as a Supplementary Intervention for Neonatal Withdrawal Syndrome

Eliasar A. Simon, Elmer S. David, Jennifer L. Vidal, Walter Zahorodny
Department of Pediatrics, UMDNJ/New Jersey Medical School, Newark, New Jersey

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Abstract

Objective: This study tested the hypothesis that antenatally narcotic-exposed newborns (ANENs) exposed to music will show diminished distress behavior and arousal state and will require a shorter course of pharmacotherapy for drug withdrawal.

Study Design: Equivalent numbers of randomly assigned, ANENs were assigned to music-exposure (n=10) or standard no-music (control) (n=10) conditions. Subjects in the two groups were comparable with regard to gestational age, birth weight, Apgar scores at 5 min, drug (type) exposure, age at treatment, Finnegan (neonatal withdrawal severity) scores, and pharmacotherapy. The arousal state and the duration of pharmacotherapy were compared between the two groups.

Results: Music-exposed ANENs spent more time asleep than controls (p-value ≤0.02). Music-exposed subjects spent less time crying than controls (p-value ≤0.02). There was no statistically significant difference between groups with regard to the duration of treatment (p-value ≤0.19) for neonatal withdrawal.

Conclusion: The intense distress of ANENs was reduced by exposure to classical (piano) music.

INTRODUCTION

Within the first 24 hours of life, the majority of antenatally narcotic-exposed newborns (ANENs) begin experiencing a stressful and protracted withdrawal syndrome. Hypertonicity, increased behavioral distress (moderate to continuous crying)[1], and other extensive central nervous system manifestations of hyperirritability, gastrointestinal dysfunction, respiratory distress, and nonspecific autonomic symptoms like yawning, sneezing and sweating are characteristic manifestations of neonatal withdrawal syndrome[2]. Tremors which are initially mild and occur only when the withdrawing infant is disturbed, often progress to the point where they occur spontaneously. Narcotic-exposed infants tend to exhibit an exaggerated Moro reflex and increased deep tendon reflexes. High-pitched cry is common. The rooting reflex is exaggerated in these neonates and they suck frantically. ANENs may also have feeding difficulty and regurgitate frequently[3].

Low-dose morphine in the form of tincture of opium alone or in combination with barbiturate (phenobarbital) is most frequently prescribed to control the withdrawal of

these hyperaroused infants. Swaddling, gentle rocking, special attention to feeding, and the use of positioning to reduce the severity of neonatal narcotic withdrawal are commonly employed as behavioral interventions[4, 5, 6 7].

Music has been widely used to induce relaxation states and reduce stress and anxiety. Music exposure has also been found to be effective in lowering arousal states and distress behaviors in newborns[8]. Research findings indicate that infant activity decreases in response to auditory stimuli like mother's heartbeat, metronome or lullabies[9, 10] but the largest decreases are caused by music[11].

A recent study by Son Moon, et. al. showed that soothing classical music induced sleep easily, maintained sleep longer, and decreased behavioral changes in normal newborns in the nursery[12]. To date, no studies have attempted to use music as a supplement for the intense excitability of neonatal withdrawal.

While the exact physiological mechanism underlying the pacifying effect of music has not been delineated, the melodic component of music has been singled out as instrumental in this effect[13, 14, 15].

The objective of this study was to assess the efficacy of classical music exposure as a complementary intervention for ANENs. We hypothesized that narcotic withdrawing newborns exposed to music would be positively affected by the music exposure. We predicted that narcotic-withdrawing newborns exposed to soothing classical music would show diminished arousal and distress, thereby, requiring a shorter course of pharmacotherapy and a shorter length of hospital stay.

METHOD

Subjects

The study population consisted of 20 inborn newborns of narcotic-using mothers. All infants were admissions to the University of Medicine and Dentistry of New Jersey (UMDNJ), The University Hospital (UH) Intermediate Care Nursery (ICN) for neonatal withdrawal. Successive patients that met study criteria were recruited into this study with maternal informed consent. The study subjects were full-term newborns with no medical complications other than narcotic withdrawal, gestational age between 37 and 42 weeks, Apgar scores of 7 or greater at 5 minutes, positive urine toxicologic screen for opiates and/or methadone and/or heroin, with Finnegan (neonatal withdrawal severity) scores of 8 or greater. All subjects received pharmacotherapy for withdrawal. All subjects showed normal hearing (in both ears) by otoacoustic emission (OAE).

Excluded were newborns with Apgar scores less than seven at five minutes and infants who failed the hearing test. Newborns with identified neonatal deficits such as congenital anomalies, gastroesophageal reflux, metabolic disorder, intraventricular

hemorrhage, sepsis, respiratory disease were excluded in the study. No exclusions based on race, gender, ethnicity, nor religious orientation made.

PROCEDURE

The study protocol was conducted with the approval of the UMDNJ/New Jersey Medical School Institutional Review Board. Informed consent was obtained from newborns' mothers. At enrollment, each subject was randomly assigned to the music-exposure group (n=10) or to the standard treatment (control) group (n=10). Subjects in the music group were exposed to instrumental harmonic classical music (**table 1**) pre-recorded using MIDI (Musical Instrument Digital Interface) grand piano mode employing digital keyboard synthesizer, sequencer, and a mixer. These pieces were rendered at a tempo of 60 to 80 beats per minute in order to simulate the rhythm of maternal heart rate.

Table 1: Classical piano music used in the study.

Classical Music Selections

1. Adagio in Bb, piano sonata no. 1, 2nd movement @ 75 beats/min by W. A. Mozart.
2. Berceuse opus 57 @ 80 beats/min by F. Chopin.
3. Fantasie Impromptu in Db, no. 66 @ 60 beats/min by F. Chopin.
4. Minuetto in Eb @ 80 beats/min by L. V. Beethoven.
5. Nocturne in B, opus 32, no. 1 @ 60 beats/min by F. Chopin.
6. Adagio in G, sonata 3, K545, 2nd movement @ 60 beats/min by W. A. Mozart.
7. Nocturne opus 27, no. 2 @ 80 beats/min by F. Chopin.
8. Waltz in Bb, opus 39, no. 8 @ 75 beats/min by F. Chopin.
9. Prelude in A, opus 28, no. 7 @ 70 beats/min by F. Chopin.
10. Nocturne in Eb major, opus 9, no. 2 @ 80 beats/min by F. Chopin.
11. Prelude in Em, opus 28, no. 4 @ 60 beats/min by F. Chopin.
12. Sonata 5, k589h, 1st movement @ 80 beats/min by W. A. Mozart.

*All classical music selected were recorded for playback on CD (compact disc)

In room A, subjects in the music group heard the recorded music at a sound level of 60 to 70 dB from 8 A.M. to 5 P.M. delivered through the overhead speaker for the duration of pharmacotherapy. In room B, control group neonates received pharmacotherapy plus standard supportive care. All subjects received appropriate supportive care for withdrawal, including swaddling, and were positioned prone or on their sides for sleep. Mothers were away during the study period.

Study subjects were videotaped in room C during two, 60-minute testing periods, beginning one hour prior to scheduled 1200- and 1600-hour feedings for five

consecutive days. Tapes were reviewed and documented by a blinded-study associate the infants' behavioral state changes as defined by Prechtl norms[16] (**Tables 2 and 3)**

Table 2:

Prechtl's Behavioral States of the Newborn Infant

State 1: Eyes closed, regular respiration, no movements.
State 2: Eyes closed, irregular respiration, small movements.
State 3: Eyes open, no movements.
State 4: Eyes open, gross movements.
State 5: Crying (vocalization).

Table 3:

Time	**Behavioral State**			(circle one)	
00 Minutes	1	2	3	4	5
10 Minutes	1	2	3	4	5
20 Minutes	1	2	3	4	5
30 Minutes	1	2	3	4	5
40 Minutes	1	2	3	4	5
50 Minutes	1	2	3	4	5

*This table is a sample of data-collection sheet wherein we recorded the first three-minute (observed state) of every 10-minute interval in a 60-minute (one-hour) testing session.

In this study, times spent in behavioral states 1 (eyes closed, regular respiration, no movements) and 2 (eyes closed, irregular respiration, small movements) were merged and addressed as asleep state. Times spent in behavioral states 3 (eyes open, no movement) and 4 (eyes open, gross movements) were merged and addressed as awake state.

DATA ANALYSIS

The percentage of time subjects were asleep, awake, and crying were compared between music-exposed group and no-music-exposed group.

Differences in the duration of treatment from the start of pharmacotherapy to the discontinuation of pharmacotherapy between groups were analyzed.

RESULTS

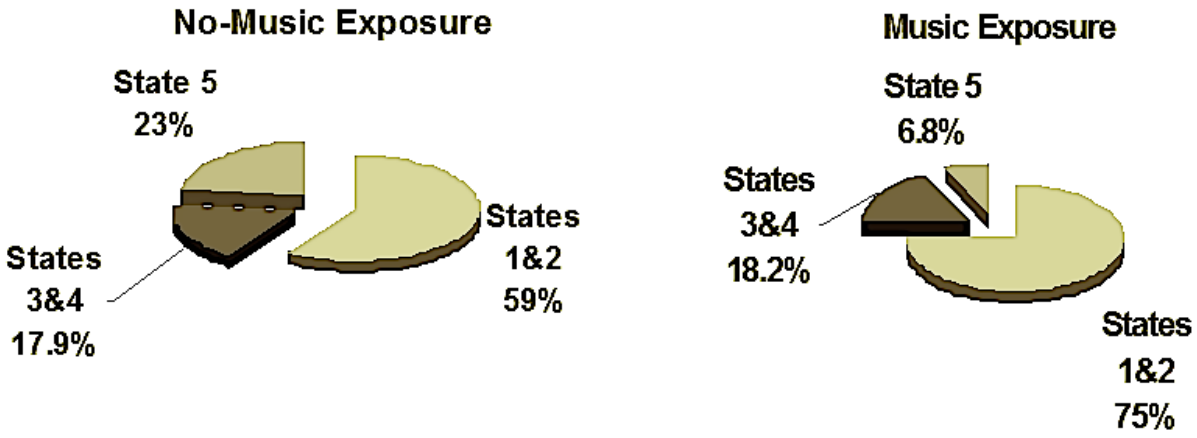
There was no statistically significant difference between the two groups (**Table 4**) with regard to gestational age, birth weight, Apgar scores at 5 minutes, drug (type) exposure, age at initiation of withdrawal treatment, Finnegan (withdrawal severity) scores, and pharmacotherapy with tincture of opium.

Table 4: Subject comparison between groups (mean±SD)

	Music-Exposure	No-Music Exposure (control)
N	10	10
Age (wk)	38±1	39 ± ? 1
Birth Weight (g)	2,976 ± 269	2,839 ± 357
Apgars @ 5 min	9 ± 0	9 ± 0
Drug exposure	Opiates &/or Methadone	Opiates &/or Methadone
Age (d) @ Tx	3 ± 1	3 ± 1
Finnegan scores	8 ± 1	8 ± 1
PharmacoTx	8 gtts Tinc of Opium	8 gtts Tinc of Opium
Hearing test	+	+

As shown in **Figure 1**, antenatally narcotic-exposed newborns receiving complementary classical piano music exposure spent more time asleep (states 1 and 2) when compared to controls (75% vs. 59%, p-value ≤0.02). Music-exposed subjects also spent less time crying (state 5) than controls (6.8% vs. 23%, p-value ≤0.02). There was no statistically significant difference between the two groups with regard to the amount of time spent awake (18.2% vs. 17.9%, p-value ≥0.05).

Figure 1:



As shown in **Table 5**, group comparison as to the duration of treatment showed no statistically significant difference between music-exposure group and standard treatment (control) group (Wilcoxon/Kruskal-Wallis test, p-value≤0.19).

Table 5: Duration of treatment between groups

Group	Mean (days)	Standard Error of the Mean
No-Music (control)	23.4	4.54
Music-Exposure	17.2	2.68

DISCUSSION

Study findings confirmed that arousal state and distress behavior of ANENs may be significantly reduced by complementary classical music exposure. Although there was no statistically significant difference in the duration of treatment between music-exposure group and no-music (control) group, a trend toward shorter course of treatment and LOS (length of stay) of antenatally narcotic-exposed newborns exposed to music in conjunction with standard pharmacotherapy was observed. The lack of a difference in the duration of treatment between the two groups may be due to the small study sample size and calls for further research with a larger population.

CONCLUSION

Based on the results of this study, we recommend that classical music exposure be used to complement the standard pharmacotherapy of antenatally narcotic-exposed newborns.

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