

Music Therapy in the Neonatal Intensive Care Unit

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MUSIC THERAPY, A tool long used in the health care field, has enjoyed a resurgence during the last several decades. Recognized as a means of decreasing or alleviating discomfort and anxiety, music is being used in many health care settings such as coronary care, surgery, postanesthesia recovery, and neonatal intensive care units.¹⁻⁴ Both the physiologic and psychologic effects of music have been evaluated.⁵

Although the use of music therapy is widespread and the literature contains numerous reports of investigations into its benefits for adults, there have been few controlled studies documenting its effectiveness in the critically ill neonatal population. This article describes a study of the effects of taped intrauterine sounds combined with synthesized female vocal singing on the heart rate, mean arterial pressure, oxygen saturation, and behavior state of 17 agitated, intubated, premature infants.

THE INTRAUTERINE "LULLABY"

Stress is often concomitant with illness, and patients must often be medicated to reduce anxiety and its associated physiologic and psychologic manifestations. This may involve both discomfort caused by the route of administration and untoward side effects.⁶ Stress due to

illness may be exacerbated by the excess noise in acute patient care areas such as cardiac care units.⁷

Like the adult patient in critical care areas, neonates also appear to react adversely to the stressful environment of the modern intensive care unit. These adverse reactions are reflected in heart rate variations, decreased oxygen saturation levels, wide fluctuations in blood pressure, and increased levels of agitation.

Moss reported a significant decrease in postoperative anxiety among adult patients who received music therapy, many of whom commented positively on the experience.³

Davis and Cunningham showed therapeutically rewarding decreases in the heart rates of cardiac care unit patients who received music therapy.⁸

One of the most stressful changes that occurs during the transition from intrauterine to extrauterine life is the loss of rhythm that the fetus has become accustomed to through months of being exposed to maternal movements, breathing, and heart beat.⁹

Walker and colleagues have documented the existence of intrauterine sounds in both pregnant and nonpregnant women; mean sound levels approximated 85 decibels (dB). In pregnant women these intrauterine sounds consist of pulsatile events due to blood being circulated through the placenta and passed into the amniotic fluid. Each rush of blood through the placenta can produce sound levels within the uterus that peak around 95 dB.¹⁰ The rhythmic "swooshing" of the blood as it rushes through the placental vessels is the intrauterine "lullaby."¹¹

The physiologic capabilities necessary for hearing (cochlear function,

basilar response, and development of inner and outer hair cells are present in the fetus as young as 24 weeks.^{12,13} This phenomenon has been substantiated by cortical and brainstem evoked potentials in the very low gestational age premature infant (approximately 25 weeks).¹⁴ Research done by Olds indicates that the fetus can hear and respond to music and has the ability to discriminate sounds as early as ten weeks prior to birth.¹⁵

Salk observed that most new mothers exhibit a natural preference for holding their infants on their left side. Thinking there was reason to believe that the sound of the adult heart has a soothing effect on the infant, he hypothesized that the fetus associates rhythmical sounds with comfort and security so that similar sounds after birth have a functional connection with the experiences of the fetus *in utero*.¹⁶

Smith and Steinschneider observed that the rhythm of the blood rushing through the placenta had a calming effect on the newborn.¹⁷ Rosner and Doherty reported that soothing effects were seen when prerecorded intrauterine sounds were played to newborn infants.¹⁸

More recently, Hepper observed that some newborn infants adopted a quiet behavioral state and seemed to be calmed by the lead-in music to a popular soap opera their mothers had watched daily while pregnant.¹⁹

All these observations strongly support the use of music therapy that includes intrauterine sounds for both the term and the extremely premature infant.

THE STUDY

This study was based on the assumption that infants in an NICU are subject to many of the same stressors that negatively affect the physiologic parameters of anxious adult ICU patients. The study tested

the following hypothesis: During the time that recorded intrauterine and female singing sounds are played, agitated, incubated premature infants will show (1) an increase in oxygen saturation (as evidenced by pulse oximetry reading), (2) a decrease of heart rate to within normal limits, (3) a decrease in arterial pressure to within normal limits, and (4) a change in behavior state from agitation (or "fussy") to sleep or awake.

The music played was a recording called "**Transitions**" (Transitions Music, Inc., Atlanta, Georgia), a combination of actual womb sounds and simulations of the sounds that an unborn child might hear as his mother sings. These sounds were made by recording the uterine sounds of a pregnant woman with an ultrasonic Doppler and then blending these with synthesized female vocals.

A portable cassette tape player was utilized during the testing period. The tape player (Tele-Acoustics, Stone Mountain, Georgia) was calibrated to a sound level of 80 dB to accord with the mean sound level in utero, which has been documented to be approximately 80-95 dB.^{10,14,18} Calibration was achieved utilizing a Quest 155 Sound level Meter (Ansi Type I) with a 70-23 microphone. The tape player was placed three inches from the infant's ear, the distance deemed necessary to achieve the desired decibel level.

Methodology

The sample consisted of 17 infants (8 females and 9 males) who were patients in the NICU at Georgia Baptist Medical Center in Atlanta. To be eligible for inclusion in the study, infants had to be (1) premature (defined as 37 weeks or less); (2) intubated; (3) on monitors capable of measuring their heart rate, oxygen saturation, and mean arterial pressure (umbilical artery or percutaneous arterial catheter); and (4) in an agitated state (defined as thrashing of extremities, excessive head movements, or facial grimacing).

The project was approved by the hospital's human subjects and nursing research committees. Written, informed consent was obtained from parents prior to data collection.

All infants were tested in their own beds. Data collection periods were scheduled so as not to coincide with intrusive procedures (such as suctioning, repositioning, or IV placement) and to be at least three hours after narcotic pain medications had been given. All infants were on monitors to collect desired data, so additional handling of the infant was not required. Criteria for exclusion from the study were any deterioration in vital signs or parent's request for withdrawal from the study.

Each subject was observed individually during both a control and an intervention period. Because it was necessary to test infants in an agitated ("fussy") state, the nurses in the unit were responsible for notifying the primary investigator when a patient was eligible for data collection. Once it had been determined that the infant was in an agitated state, the observer rated the behavior state and recorded the readings for heart rate, mean arterial pressure, and oxygen saturation every 2 minutes during a 20-minute period.

The first 10 minutes constituted the control or preintervention period. The second 10 minutes, during which the tape was turned on, constituted the intervention period. During the entire 20-minute observation period, noise and movement in the infant's room as well as nursing procedures were restricted so as to decrease the chance of extraneous stimulation.

Results

Gestational age was determined from the Dubowitz score or from the obstetrical record if a Dubowitz exam was not available.

Paired *t*-tests were utilized to compare the preintervention and

intervention mean values for all variables observed. Correlation relating to sex, gestational age, or age at time of data collection was not analyzed.

Both oxygen saturation (as evidenced by pulse oximetry readings). and behavioral state improved significantly during the intervention period. Neither mean arterial pressure nor heart rate showed significant decreases during the intervention period.

DISCUSSION

Although the limited number of subjects utilized for this study precludes generalizations, we feel there is a clear indication that there may be a place for music such as "Transitions" in benefiting the tiny NICU patient. The data tentatively suggest that oxygen saturation (as evidenced by pulse oximetry readings) and behavior state can be improved in agitated, premature, intubated infants who receive music therapy in the form of recorded intrauterine sounds combined with female singing.

Some practitioners feel that an infant's neurological development is in part determined by his interaction with his environment. During the last trimester of pregnancy, the establishment of the dendritic connections between the individual neurons of the brain takes place. For certain periods there may be individual cells that are responsible for guiding this process. How these connections develop may in part depend on various environmental sensory stimuli.

The physical and sensory differences between the environment of the NICU and that of the uterus may well affect the end results of this process of brain development. This means that interventions in the environment of a developing infant, such as utilization of music therapy which has been shown to improve oxygenation, may also enhance brain development.²⁰

Any measures that will improve state and physiologic parameters during the neonatal period may positively influence later development. Sammons and Lewis postulate that there may be some relationship between developmental deficits and excessive fluctuations of vital signs.²⁰ Because marked changes in parameters such as heart rate, mean arterial pressure, and oxygen saturation have the potential to cause damage, careful control of these variables is of paramount importance.

To help the infant conserve oxygen and caloric expenditures in order to channel energy toward growth and development, investigations have suggested several ways to alter the environment. These include swaddling, use of slow controlled movements that simultaneously support the head and extremities, scheduling care to provide the infant with long periods of rest, and institution of minimal stimulation protocols.²⁰ Music therapy may provide another way for caregivers to positively alter the critically ill newborn's environment.

The findings of this research indicate a need for further study of the use of music therapy that includes intrauterine sounds for the critically ill premature infant. It would certainly be advantageous to enlarge the sample size to find out whether the change in behavioral state and oxygen saturation observed in this study would remain significant and also to see if a larger sample would reveal a significant change in heart rate and mean arterial pressure. Further research may also indicate whether similar results would be obtained with intrauterine sounds alone or with singing alone.

As advocates for small and often very ill patients, neonatal nurses must continually explore treatment modalities to provide these infants with quality care and the hope for a bright future. Music therapy may play a role in this future.

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