

Effects of Music Therapy on Oxygen Saturation in Premature Infants Receiving Endotracheal Suctioning

Lih-Lih Chou • Ru-Hwa Wang* • Shu-Jen Chen** • Lu Pai***

ABSTRACT: The purpose of this study was to investigate how premature infants' oxygen saturation changed in response to music therapy while they were receiving endotracheal suctioning. A convenience sample of 30 premature infants was selected from three neonatal intensive care units. A one-group repeated measures design was adopted for this study. The oxygen saturation of all subjects was first measured while they were receiving endotracheal suctioning during a four-hour control period with regular care. Then, four hours after the control period was completed, an experimental period began in which the music "Transitions" was played. One minute before suctioning, the level of oxygen saturation was measured to provide the baseline data. During a period of 30 minutes after suctioning, the oxygen saturation was recorded every minute to analyze the clinical effects of music therapy. The results showed that premature infants receiving music therapy with endotracheal suctioning had a significantly higher SPO_2 than that when not receiving music therapy ($p < .01$), and the level of oxygen saturation returned to the baseline level faster than when they did not receive music therapy ($p < .01$). Accordingly, it is hoped that giving appropriate music therapy as developmental care to premature infants when performing any nursing intervention may enhance not only the quality of nursing care but also quality of the infant's life.

Key Words: music therapy, oxygen saturation, premature infant, endotracheal suctioning.

Introduction

There has been an increase in the population of surviving tiny premature newborns as a result of high technology and improvements in quality of care. Prematurity is the main factor that is responsible for respiratory distress syndrome (RDS) remaining a major neonatal problem (Hallman & Gluck, 1982). When premature babies suffer from RDS, mainly due to lack of lung surfactant which contributes to decreased surface tension in the alveoli (Schmidt & Thews, 1983), mechanical ventilation can not be avoided in many cases to keep the airway patent. Endotracheal suctioning should be performed to remove retained secretions from the trachea according to the

patient's need. Routine suction of intubated infants, a common practice in neonatal intensive care units, is a procedure considered necessary to remove airway secretions and thus prevent airway obstruction. However, endotracheal suctioning in premature and high-risk infants is not a benign procedure. Endotracheal suctioning in the infant is complicated by significant morbidity, ranging from short-term hypoxia to structural damage, and death (Norris, Campbell, & Brenkert, 1982).

Music therapy was first used by Miss Florence Nightingale in Crimean War to help the recovery of sick soldiers (Jonas-Simpson, 1997). Music is often referred to as the universal language because of its ability of break down cultural, educational, linguistic, and emotional barriers. It can

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reduce feelings of loneliness by producing familiar, comforting stimulation reminiscent of family, homeland, or past experiences (Cook, 1986). Because endotracheal suctioning in the infant is complicated by significant morbidity, and although the number of investigations involving music and its effects on health is increasing, there is no study specifically addressing the effects of music on premature infants in Taiwan. This study describes the effects of music therapy on the oxygen saturation of 30 endotracheally intubated premature infants.

Literature Review

Endotracheal suctioning in the neonatal intensive care unit is a routine procedure. Although suctioning can help premature infants by removing secretions to keep the airway patent and avoid obstruction, the procedure itself may also prolong the infant's recovery from his initial condition. Because of the impaired circulatory autoregulation of premature infants, endotracheal suctioning may induce some negative effects, such as hypoxemia, dysrhythmias (bradycardia and tachycardia), cerebral blood flow fluctuations and laryngospasm (Abrams & Johnson, 1984; Cassani, 1984; Durand, Sangha, Cabal, Hoppenbrouwers, & Hodgman, 1989; Fanconi & Duc, 1987; Perlman & Volpe, 1983; Shah, Kurth, Gwiazdowski, Chance, & Delivoria-Papadopoulos, 1992; Simbruner, 1991). In addition to the changes indicated above, endotracheal suctioning can cause other complications, such as traumatic injuries, including necrotizing tracheobronchitis (NTB) and pneumothorax, infections, and aspiration pneumonia (Barnes, Assonye, & Vidyasagar, 1981; Jung, & Newman, 1982). Cerebral blood flow velocity is highly sensitive to changes in systemic blood pressure. The inability to maintain stable cerebral perfusion has been linked with the pathogenesis of intraventricular hemorrhage in this population of infants (Ment, Ehrenkranz, & Duncan, 1988; Volpe, 1989).

Music therapy is defined as "the prescribed use of music and musical interventions to restore, maintain, and improve emotional, physiologic, and spiritual health and well-being." It is described as "a behavioral science that uses specific music to produce desired changes in behavior, emotions, and physiology" (Guzzetta, 1995).

Music can change the reactions of autonomic nervous system in the thalamus, regulate the nervous impulse conduction of the limbic system and reticular activating system (RAS), and in turn, lead to a decrease in the release of

adrenocorticotropic hormone (ACTH) and in adrenergic activity, and increase tolerance to pain (Beck, 1991; Cook, 1986).

Music therapy – the systematic application of music to promote positive changes in behavior and physiological indicators by decrease in heart rate, respiratory rate, blood pressure, metabolic rate, oxygen consumption, skeletal muscle tension, and so on – has been used successfully in a variety of hospital settings (Beck, 1991; Dubois, Bartier, & Pratter, 1995; Ezzone, Baker, Rosselet, & Terepka 1998; Kaminski & Hall, 1996; Kathleen, 1998; Mornhinweg & Voignier, 1995; Olson, 1998; White, 1992).

Some practitioners have found that an infant's neurological development, particularly in the last trimester of pregnancy, is in part determined by his or her interaction with the environment. This means that an intervention in the environment of a developing infant (such as use of music therapy) that has been shown to improve oxygenation, may also enhance brain development (Sammons, & Lewis, 1985).

Caine (1991) studied 52 preterm and low-birth weight neonates in a neonatal intensive care unit to examine the effects of music on selected stress behaviors, weight, caloric and formula intake, and length of hospital stay, by playing 60 minutes of tape recorded vocal music, including lullabies and children's music. The results showed significantly reduced initial weight loss, length of NICU and total hospital stay, and daily group mean of stress behaviors, and increased daily average weight, and formula and caloric intake. Collins and Kuck (1991) observed 17 premature infants in an agitated state for 10 minutes under silent conditions followed by 10 minutes of music combined with intrauterine sounds played free field in the isolette. The babies' oxygen saturation level was significantly increased by this one 10-minute trial of auditory stimulation. Standley and Moore (1995) reported the therapeutic effects of music and mother's voice on premature infants during a period of three consecutive days. Infants hearing music had significantly higher oxygen saturation levels and had significantly fewer occurrences of Oximeter alarms on the first day. Burke, Walsh, Oehler, & Gingras (1995) studied four premature infants following suctioning. According to their reported findings all the infants spent more time sleeping during the playing of taped music than without music intervention, and their levels of oxygen saturation were improved during

the music sessions. Such results suggest that music is effective in reducing stress-related behaviors in premature infants. Standley (1998) reported findings on the therapeutic effects of music on premature infants: they had significantly increased weight gain per day and decreased days to discharge during auditory stimuli. Standley (2000) studied 12 premature infants to assess music as a reinforcement for non-nutritive sucking, and reported that music contributed significantly to the development of non-nutritive sucking in premature infants.

The utilization of selected music as a therapy in antenatal and neonatal settings may lead to a more harmonious, psychologically satisfying and reassuring environment for the neonate to develop within.

Methods

Research Design

A one-group repeated measures design was adopted for this study. Thirty premature infants from three neonatal intensive care units were selected to participate. All subjects first underwent a control period with regular care, and then an experimental period with the music "Transitions", while receiving endotracheal suction. There was a four-hour watched period between the control period and the experimental period. During both the control period and the experimental period, the infants' oxygen saturation was measured.

Subjects

Thirty premature infants placed in incubators who met the selection criteria were recruited. The selection criteria were: premature infants (1) whose gestational age was between 28 to 36 weeks, (2) with respiratory distress syndrome (RDS) but without congenital abnormality or severe heart disease, (3) assisted with ventilator through endotracheal tube and receiving endotracheal suctioning every two to four hours, (4) with a clinical neonatal therapeutic intervention scoring system (NTISS) score of less than 30, (5) fraction of inspired oxygen (FiO_2) used $\leq 40\%$, and (6) whose parents agreed to participate in the study.

Data Collection Procedure

One minute before suctioning, the level of oxygen saturation was recorded to provide the baseline data. During

the period of 30 minutes after suctioning, the oxygen saturation was recorded every minute. The interval the control period and the experimental period cannot be less than four hours.

The infants' suctioning was done by the author. The infants did not receive any other intervention during the study period. The standard suctioning procedure comprised: (1) preoxygenation: the FiO_2 was increased to 10% above maintenance one minute before suctioning, (2) injection of 0.5 ml normal saline into the endotracheal tube for a five-second period, then reventilation, (3) insertion of a No. 6 French suction tube and delivery of 80 mmHg of suction pressure, (4) suction period less than 10 seconds, (5) reventilation for 30 seconds after suction and regulating the ventilator to the same setting as before suctioning.

Instruments

An Aiwa JS379 tape player was used for the music intervention. An appropriate decibel level for the tape player was determined to be 60 decibels (dB), measured using a TES 1351 Sound Level Meter. The tape player was then placed approximately 20 centimeters from the premature infant's ear.

The music played was a recording called "Transitions" (Placenta Music, Inc., Atlanta, Georgia), made by Dr. Fred J. Schwartz. He used 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 (Collins & Kuck, 1991).

A HP M1166A model 66S monitor was used to measure levels of oxygen saturation for each subject before, during and after endotracheal suctioning. To determine the reliability of the HP monitor, the engineer corrected the monitor by computer before study, and continuously followed up every half month to determine the reliability of data.

Statistical Analysis

SPSS/Windows 8.0 statistical software was used for data analysis in this study. Descriptive statistics, including frequency, percentage, mean, standard deviation, and range were computed for the demographic data. A paired *t*-test was used to examine differences in oxygen saturation before and after endotracheal suctioning with music therapy.

Results

Characteristics of the Sample

Thirty premature infants were selected from the neonatal intensive care units of three teaching hospitals in Taipei. The demographic data of subjects are presented in Table 1.

Effects of Music Therapy on Oxygen Saturation

Paired *t*-tests were utilized to compare the mean oxygen saturations of the two periods. The results showed that the mean oxygen saturation during the 30 minutes after endotracheal suctioning of the control period was significantly lower than that of the experimental period ($94.19 \pm$

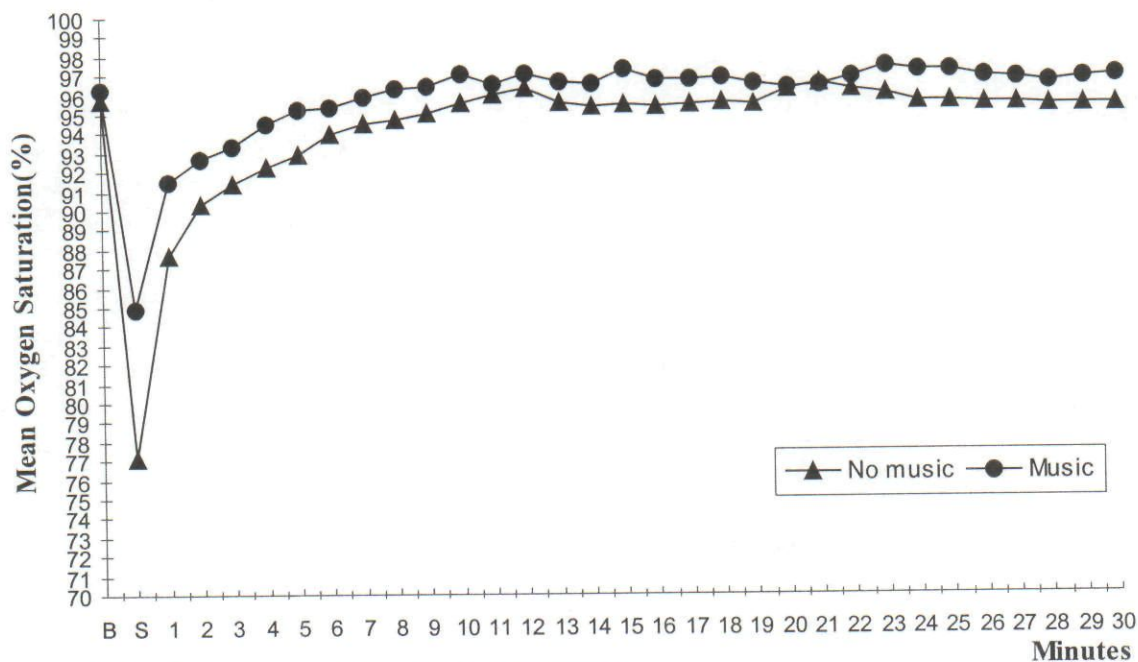
1.81 vs. 95.79 ± 2.26 , $t = 3.89$, $p = .002$). Although differences between the mean oxygen saturations at the 11th, 20th, 21st, and 22nd minutes of the two periods were not significant, in the control period the premature infants showed a greater drop at other minutes from 95.77% ($SD = 1.52$) to 77.17% - 95% ($SD = 2.94$ ~ 1.41) than in the experimental period from 96.23% ($SD = 2.21$) to 84.87% - 95.8% ($SD = 2.97$ ~ 1.83) (Figure 1).

Paired *t*-tests were utilized to compare the recovery time for oxygen saturation to the baseline data. The results indicated that the average recovery time of oxygen saturation in the control period was 9.57 ± 3.58 minutes ranging from 5 to 21 minutes, and in the experimental period it was 7.27 ± 2.29 minutes ranging from 4 to 13 minutes. A statistically significant

Table 1.
Demographic Characteristics of the Sample (N = 30)

Variable	Frequency	%	M	SD	Range
Sex					
Male	15	50.0			
Female	15	50.0			
Gestational Age					
< 30 weeks	8	26.7			
30 ~ 32 weeks	10	33.3	31.4	2.4	28-36.4
> 32 weeks	12	40.0			
Body Weight					
< 1000 g	3	10.0			
1000 ~ 1500 g	21	70.0	1327.6	301.3	728-1980
> 1500 g	6	20.0			
Apgar Score (1 minute)					
< 5	11	36.7			
5 ~ 7	19	63.3	5.27	1.26	3-7
> 7	0	0			
Apgar Score (5 minutes)					
< 5	0	0			
5 ~ 7	19	63.3	7.20	0.92	5-9
> 7	11	36.7			
NTISS (24 hours after admission)*					
< 15	6	20.0			
15 ~ 20	22	73.3	17.0	2.46	12-22
> 20	2	6.7			
Age at Study (days)					
< 3	2	6.7			
3 ~ 5	21	70.0	4.37	1.65	2-8
> 5	7	23.3			

Note. *NTISS: neonatal therapeutic intervention scoring system.



Note. B: Baseline data; S: Endotracheal suctioning.

Figure 1. Mean Oxygen Saturation by Groups

cant difference in the mean recovery time of oxygen saturation was found between the two groups ($t = 2.97$, $p = .004$).

Discussion

Data from this study suggest that music combined with intrauterine sounds (transitions) is effective for premature infants following a stressful intervention. The study found that the mean values for oxygen saturation improved significantly during the intervention period and the mean recovery time for oxygen saturation was quicker when music was played. The result is consistent with the findings of Collins and Kuck's (1991) study that intubated premature infants in an NICU who heard taped music blended with intrauterine sounds had a significant increase in oxygen saturation levels, and is also similar to the findings of Burke et al. (1995) who reported that the levels of oxygen saturation were improved during the music situations. How could music have such an immediate impact on infant development as demonstrated in this study and other prior research? Medical researchers have been concerned about high stress and subsequent cortisone levels during hospitalization adversely affecting neurologic development of pre-

mature infants. Prior research has shown that music reduces release of the stress hormone cortisone during invasive procedures with adults and children (Standley, 1996). Perhaps music reduces cortisone levels in premature infants as it does in more mature individuals and thus prevents adverse neurologic effects. This is the first study to examine the effects of music therapy on oxygen saturation in premature infants receiving endotracheal suctioning in Taiwan. 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 behavior state and oxygen saturation observed in this study would remain significant and also to see whether a larger sample would reveal a significant change in heart rate and mean arterial pressure.

Implications

The appropriateness of providing music therapy within the discipline of nursing to advance nursing practice was demonstrated in the study. The research findings can be used by nurses to understand the effects of music therapy on premature infants in neonatal intensive care units in

Taiwan. From the empirical data in this study, providing music therapy increases the premature infants' levels of oxygen saturation in an invasive procedure, and the results of this study have implications for clinical practice, education, and research. The use of "Transitions" in the neonatal intensive care unit has the potential to be a valuable nursing intervention that is cost-effective and appealing.

Recommendations

In this study, we used a one-group repeated measures design. This methodology is not as definitive as an experimental design. Because of the absence of a comparable control group, change between pretest and posttest may be due to any other environmental variables or normal variation of subjects. Further research might use a two-group randomized controlled trial design to determine the effects of music therapy, and a longer baseline period for estimation before and after intervention is needed for further studies.

Conclusions

This is the first study to provide information about the effect of music therapy on oxygen saturation for premature infants in Taiwan. Music therapy as given in this study was a safe intervention and had a beneficial effect on oxygen saturation. Premature infant learning and the benefits of music appear to be viable and critical areas for future research. Listening to music provided for a more pleasant stimulus and an alternative perceptual focus for subjects. The findings from this study demonstrate the strength of music therapy as an independent nursing intervention. As advocates for premature infants, neonatal nurses must continually explore treatment modalities to provide these infants with quality care and hope for a bright future. Music therapy may play a role in this future.

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音樂治療對接受抽痰護理之早產兒血氧飽和濃度之影響

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摘 要：本研究之目的在探討音樂治療對接受抽痰護理之早產兒其血氧飽和濃度之影響。本研究以便利取樣法選取共 30 位符合收案條件之早產兒進行研究，採單組重覆測量設計，個案先於控制期執行常規抽痰護理，間隔四小時後，於實驗期加入”嬰兒成長音樂”(transitions)。其中以抽痰前 1 分鐘所收集之血氧飽和濃度值，作為前測基準值；後續測得包括抽痰時（音樂治療執行起）及抽痰後（至音樂治療止）共計 30 分鐘內，每 1 分鐘之血氧飽和濃度值與前測基準值之差異，作為音樂治療成效分析之比較。研究結果顯示：早產兒接受音樂治療後，其血氧飽和濃度值之變化較未接受音樂治療時為小 ($p < .01$)；並在回復至前測基準值之時間方面亦較快 ($p < .01$)，且均達統計上之顯著意義。整體而言，本研究發現音樂治療可收減緩抽痰護理造成早產兒血氧飽和濃度變化之成效。故企盼未來於臨床執行各項護理作業之際，能適時將音樂治療列入發展性的照護措施，以提昇臨床護理品質及早產兒之生活品質。

關鍵詞：音樂治療、血氧飽和濃度、早產兒、抽痰護理。

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