

Impact of Music Therapy on Breast Milk Secretion in Mothers of Premature Newborns

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ABSTRACT

Introduction: The promotion of breastfeeding is a simple and efficient strategy in reducing morbidity and mortality in neonates worldwide. Milk from the mother of a Preterm New Born (PTNB) infant contains a higher concentration of nutrients and energy than that produced by mothers of a full-term infant. Studies have shown that music therapy can reduce maternal anxiety, helping mothers cope with the hospitalization of their newborns in Neonatal Intensive Care Unit (NICU).

Objective: To evaluate the impact of music therapy on amount of breast milk secretion among mothers of premature newborns by reducing maternal stress.

Materials and Methods: Mothers of premature babies who were admitted to NICU at a tertiary health care centre were included as subjects. Mothers of premature infants were enrolled in the study once they came to NICU to express breast milk from Dec 2012 to May 2013. Each subject was assessed for 4 sessions on MT (Music Therapy) and 4 sessions on NMT (No Music Therapy)

over 4 days. Breast milk was expressed using breast milk pump and quantity was measured for two sessions each day once at 11.00am and other at 4.00pm. Raga malkauns and yaman by flute was used for music therapy. MT was administered for 4 sessions in a randomized manner during the study period of 30mins (15mins prior to and 15mins during Breast milk amount). To assess the psychological stress, PSS questionnaire was administered on day 1 and day 4 of MT. Mother's saliva was collected to estimate salivary cortisol level on the last day of study during the sessions with MT and NMT.

Results: Music therapy was associated with a significant reduction in stress level as shown by improved PSS score and reduced salivary cortisol. Subjects who received music therapy had significant increase (p-value- 0.033) in breast milk expression when compared to mothers who didn't.

Conclusion: Music therapy can be easily used in the breast milk expression room as a method to increase breast milk secretion in mothers who are stressed because of their neonates being admitted in NICU.

Keywords: Maternal stress, Neonatal Intensive Care Unit, Salivary cortisol

INTRODUCTION

The rate of premature births has increased steadily in the past decade. Any complications of a premature newborn will be addressed in the Neonatal Intensive Care Unit (NICU) which adds to more stress in the mother. Mothers whose babies are born prematurely are often scared and nervous. In addition to this, most mothers of very preterm infants, for a variety of reasons such as illness, stress and other factors related to preterm birth, are unable to express sufficient amounts of milk to exclusively feed their infants [1-5]. Use of mother's own breast milk compared to infant formula has a positive impact in reducing potential serious neonatal morbidities and also contributes to improvements in neuro developmental outcomes [1,2,6-9].

Rational for the study

The delay in initiation, immaturity of the mammary gland, and inhibition of milk ejection caused by stress may result in poor milk yield and declining milk production [10]. Music therapy has been used in several areas, such as mental health, special education, rehabilitation and social development. Many studies have found various physiological effects of music in the listeners. Study done by Michael Miller shows that music results in improved endothelial function, as measured by flow-mediated vasodilation [11]. The mechanism(s) underlying the effect of positive emotions on endothelial vasoreactivity remains to be identified, one possible link is endorphin-mediated activation of endothelium- derived nitric oxide, an effect opposite to that observed when the potent vasoconstrictor endothelin- 1 is released in response to mental stress [12]. Other biomarkers associated with music listening include oxytocin secretion [13].

As shown by Menon V listening to music strongly modulates activity in a network of mesolimbic structures namely nucleus accumbens (NAc) and the ventral tegmental area (VTA), which are involved in reward processing. Also the activity is modulated in hypothalamus

and insula, which are thought to be involved in regulating autonomic and physiological responses to rewarding and emotional stimuli [14]. Few studies have shown that music therapy can reduce maternal anxiety, helping mothers cope with the hospitalization of their newborns in neonatal intensive care unit (NICU) [15]. Not many studies have addressed the influence of music therapy on milk production.

OBJECTIVE

To evaluate the impact of music therapy on amount of breast milk secretion among mothers of premature newborns by reducing maternal stress.

MATERIALS AND METHODS

This study was carried out on mothers of premature babies (gestation less than 34wk) requiring hospitalisation to NICU in the MS Ramaiah Medical College and Teaching Hospitals, Bangalore, Karnataka, India from Dec 2012 to May 2013. Mothers of premature babies were studied as anxiety & stress levels are higher in mothers of premature babies [16]. The study was approved by the institutional scientific and ethical review board (IEC). The study protocol was explained and informed consent was obtained as per ICH GCP guidelines.

A detailed history and clinical examination was performed for the subjects. Subjects with severe hearing deficiency and those who did not give consent were excluded from the study. Demographic data and birth history were recorded. Details of previous pregnancy if any, daily routine, work pressures were also noted.

Breast milk collection

Study subjects were educated and trained to use the breast milk pump. Music therapy was given to mothers when they were seated

comfortably in a quiet room. A total of 30 min rendition of the raga Malkauns and Yaman played on the flute was used for music therapy. Mothers heard the music with ear phones at a comfortable level of volume of their choice from iPod. At the end of 15mins, breast milk pump (Medela Lactina Select advanced version 1997, Medela, McHenry, IL) was connected. Breast milk was expressed using breast milk pump for 15mins with the mother continuing to listen to music while expressing milk. The volume of milk expressed was measured in ml, by a graduated milk collecting bottle. The breast milk was collected twice a day once at 11.00 am and other at 4.00 pm for 4 days and the volume of milk expressed was recorded. Music therapy was administered for 4 sessions out of total 8 sessions of collection of breast milk, in a randomized manner by permuting number method. During the other 4 sessions, mothers were just made to express breast milk using breast milk pump without listening to music. Expressed breast milk was fed to the baby.

PSS self evaluation questionnaire

Perceived stress scale (PSS-14) self-evaluation questionnaire was used to measure the level of stress. Participants respond to each PSS item by rating themselves on a five point scale. All subjects were asked to fill the PSS questionnaire on day 1 and day 4. The participants had no time limit for responding to the questionnaire. However, subjects took only 6 to 8 min to complete the questionnaire.

Salivary cortisol assay

Two samples of saliva were collected to estimate salivary cortisol level, once before playing music and other at the end of music session on the last day of the study.

Eating, drinking, chewing gum or brushing teeth was avoided for 30 min before collection of saliva. It was recommended to rinse the mouth thoroughly with cold water 15 min prior to sampling. Saliva samples were collected using special saliva sampling vials. The saliva samples were stored at 2°C to 8°C. Sample was analysed using DRG Salivary Cortisol HS ELISA Kit, based on the principle of competitive binding.

STATISTICAL ANALYSIS

In the absence of any literature providing the yield of breast milk with and without music therapy, a sample size of 30 was fixed based on the projected admissions of preterm babies during the 6 months study period in NICU. All the quantitative parameters such as maternal age, birth weight of new born, parity, gestational weeks, amount of milk expressed, socioeconomic group, salivary cortisol etc, is described in terms of descriptive statistics such as mean and standard deviation along with 95% confidence interval. Paired t-test was employed to test for the differences in the amount of milk expressed and other quantitative parameters with and without intervention. ANOVA was employed to test for association between the quantities of breast milk secreted among the subjects during 4 sessions of music therapy.

RESULTS

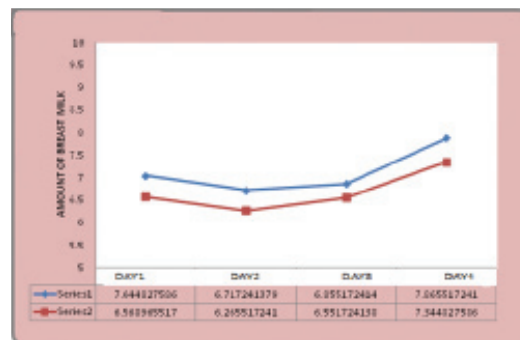
Over a period of 6 months, 30 mothers were studied. Salivary sample of one mother could not be analysed due to technical issues. Therefore, 29 mothers of premature newborn babies were included in the study for analysis of results. All the 29 mothers underwent music therapy for 4 days. Mean age of the mothers was 24 y (SD±2.9) & 37% of them had a married life of one year. Eight mothers had vacuum deliveries, eight normal vaginal deliveries (NVD) and remaining 13 mothers underwent caesarean section. Twenty nine neonates (F: 14, M: 15) were examined on 240th day (34.2 ± 1.19wk).

The mean volume of breast milk expressed in 116 sessions (29 mothers* 4 sessions) of MT is 7.12ml (SD±1.57ml) and in 116 sessions of NMT group is 6.68ml (SD±1.37) with a significant

difference (p-value: 0.033). It was also observed that the volume of breast milk expressed with music therapy increased significantly over a period of four days of the study period. Day 1 with MT is 7.04 ml (SD± 1.49) and NMT is 6.56ml (SD±1.49) v/s day 4 with MT is 7.86 ml (SD± 1.32) and NMT is 7.34ml (SD±1.31) & is statistically significant (p-value: 0.024) [Table/Fig-1,2].

Parameters	Without music therapy(ml)	WITH MUSIC THERAPY (ML)	P-VALUE
Day 1	6.56	7.04	0.024
Day 2	6.26	6.71	0.001
Day 3	6.55	6.85	0.0001
Day 4	7.34	7.86	0.0001

[Table/Fig-1]: Comparison of amount of breast milk expressed with music therapy and without music therapy



[Table/Fig-2]: Comparison of volume of breast milk expressed with music therapy and without music therapy (series 1 (blue) – amount of breast milk with MT, series 2 (red)- amount of breast milk without MT)

Mean PSS score on day 1 of MT is (42.44±3.27) and on day 4 is (33.48±3.47). The difference between them is statistically significant (p-value: 0.00). Salivary cortisol in the MT group is 3.31nmol/L (SD±4.35) and in NMT group is 2.99 nmol/L(SD±4.04). Salivary cortisol level showed a significant decrease after music therapy. As it was a nonparametric data, Wilcoxon signed rank test was applied and it showed a significant result (p-value =0.001).

DISCUSSION

Breast feeding is important for all newborns especially preterm babies. Breast milk is the best type of nutrition for the newborn. Breast fed preterm infants have a 20% lower risk of dying when compared to preterm infants who are not breast fed. Human breast milk contains antioxidants and enzymes, known to reduce oxidative stress in babies [17]. Breast milk contains cholesterol which helps in myelination of neurons and aids in cognition improvement in neonates [18]. Efficient breast feeding practice enhances bonding between baby and mother which reduces maternal stress.

Music, when scientifically applied, has been shown to relieve human suffering [19,20]. Music aids in physical, emotional and spiritual well being. Music in operating theatre prevents or minimizes annoyance, reduces stress and diminishes the anxiety of patients, staff and users [21]. The applications of music therapy has been tested in various settings like operating theatres, NICU, depression, mentally disabled children and many other psychiatric conditions which are associated with stress. But relatively little is known about the physiology underlying emotional reactions that music induces in listeners. Few studies have shown the therapeutic efficacy of music, based on physiological responses to it in various conditions [22,23]. Anxiolytic effects of music on patients before, during and after surgery have long been recognized and are well documented. Not only anxiety is reduced but also pain is tolerated well when music is played. As shown by Beck SL, statistically significant decrease in cancer related pain was noted by the use of music or sound. Although the mean percentage of change in pain for music was twice that for sound, the results did not differ statistically [24]. Intra-operative music decreases significantly sedative and analgesic requirements in

patients undergoing surgery [23]. The role of music in the reduction of stress manifested as an increase in breast milk secretion was assessed in our study. This study which was conducted in first week of lactation, assessed 116 sessions of breast milk expression with music therapy and 116 sessions of breast milk expression without music therapy. Volume of breast milk expressed in each session with and without music therapy was compared on day 1 and day 4. The volume of breast milk secretion significantly increased (p -value=0.033) after music therapy. Mean volume of breast milk expressed is 7.12ml (1.57) in MT group and 6.68ml (1.37) in NMT group.

Stress level is high in a mother whose newborn is admitted in NICU. Psychological Stress can be measured using many questionnaires. PSS questionnaire is used for subjective evaluation of stress. Perceived Stress Scale - 14 (PSS-14) is a 14-item self-report measure which asks about thoughts and feelings in the last month. Items are measured on a Likert scale scoring 1 (never) to 5 (always) with a higher score indicating greater perceived stress. In our study PSS score was assessed on day 1 and day 4. On day 1 PSS score was 42.44 ± 3.27 and on day 4 after 4 sessions of MT it reduced to 33.48 ± 3.47 showing a significant reduction in stress (p -value: 0.00). Study done by T. Ventura et al., on maternal cortisol and state anxiety showed a larger decreases in cortisol occurred in the music group (-61.8 nmol/L, ANOVA: $p = 0.01$), then followed by magazine group. Women in the music group exhibited a greater decrease in state anxiety ($p < 0.001$) [25].

The physiological parameters for measurement of stress include estimation of serum cortisol, salivary cortisol, serum ACTH, measurement of autonomic functions, etc. Salivary cortisol concentration is an excellent indicator of the plasma free cortisol concentration. The salivary cortisol concentration has been found to be synchronous with the serum concentration, indicating that the salivary assay could be substituted for the serum assay to assess circulatory rhythmicity across the 24-h time frame. Salivary cortisol appears to represent serum cortisol across the 24 h period, except for those on oral contraceptives [26]. The more pronounced cortisol responses in saliva than in serum and its closer correlation with adreno-corticotrophic hormone offer advantages over serum cortisol suggesting salivary cortisol measurement may be used as an alternative parameter in dynamic endocrine tests [27].

Objective evaluation of stress was done by assessing salivary cortisol in a study conducted by Nilsson on 75 patients undergoing open hernia repair as day care surgery were randomly allocated to three groups: intraoperative music, postoperative music and silence (control group) [27]. There was a significantly greater decrease in the level of cortisol in the postoperative music group vs. the control group after 2 h in the post anaesthesia care unit [28]. In our study salivary cortisol has been used as an objective measure of stress. Salivary cortisol level showed a significant decrease (p -value =0.001) among MT group (2.99 nmol/L ± 4.04) when compared to NMT group (3.31 nmol/L ± 4.35).

CONCLUSION

This study results suggest that music therapy has a positive effect in reducing stress in mothers of hospitalized premature neonates thereby increasing the amount of expressed breast milk. A relative increase in the amount of breast milk expressed is a boon to the premature

baby for its growth and development as it requires additional nutrition. Music therapy being a non invasive method; can easily be used clinically as a method to increase breast milk secretion.

REFERENCES

- [1] Horwood LJ, Fergusson DM. Breastfeeding and later cognitive and academic outcomes. *Pediatrics*. 1998;101(1):e9.
- [2] Horwood LJ, Mogridge N, Darlow BA. Cognitive, educational, and behavioural outcomes at 7 to 8 years in a national very low birth weight Cohort. *Arch Dis Child Fetal Neonatal*. 1998;79(1): F12–20.
- [3] Callen J, Pinelli J. A review of the literature examining the benefits and challenges, incidence and duration, and barriers to breastfeeding in preterm infants. *Adv Neonatal Care*. 2005;5(2):72–88.
- [4] Hill PD, Ledbetter RJ, Kavanaugh KL. Breastfeeding patterns of low-birth weight infants after hospital discharge. *JOGNN: J Obstet Gynecol Neonatal Nurs*. 1997;26:189–97.
- [5] Hill PD, Aldag JC, Chatterton RT, Zinaman MJ. Comparison of milk production between mothers of preterm and term mothers: the first six weeks after birth. *J Hum Lact*. 2005;21:22–30.
- [6] Vohr BR, Poindexter BB, Dusick AM, McKinley LT, Higgins RD, Langer JC, et al. Persistent beneficial effects of breast milk ingested in the neonatal intensive care unit on outcomes of extremely low birth weight infants at 30 months of age. *Pediatrics*. 2007;120:e953–59.
- [7] Horwood LJ, Darlow BA, Mogridge N. Breast milk feeding and cognitive ability at 7–8 years. *Arch Dis Child Fetal Neonatal Ed*. 2001;84:F23–27.
- [8] Vohr BR, Poindexter BB, Dusick AM, et al. Beneficial effects of breast milk in the neonatal intensive care unit on the developmental outcome of extremely low birth weight infants at 18 months of age. *Pediatrics*. 2006;118:e115–23.
- [9] Anderson JW, Johnstone BM, Remley DT. Breast-feeding and cognitive development: a metaanalysis. *Am J Clin Nutr*. 1999;70(4):525–35.
- [10] Hopkinson J, Schanler R, Garza C. Milk production by mothers of premature infants. *Pediatrics*. 1988;81:815–20.
- [11] Michael Miller, Charles Mangano. Divergent effects of joyful and anxiety-provoking music on endothelial vasoreactivity. *Psychosomatic medicine*. 2010;72:354–66.
- [12] Nickel T, Deutschmann A, Hanssen H, Summo C, Wilbert-Lampen U. Modification of endothelial biology by acute and chronic stress hormones. *Microvasc Res*. 2009;78:364–69.
- [13] Nilsson U. Soothing music can increase oxytocin levels during bed rest after open-heart surgery: a randomised control trial. *J Clin Nurs*. 2009;18:2153–61.
- [14] Menon V, Levitin DJ. The rewards of music listening: response and physiological connectivity of the mesolimbic system. *Neuroimage Epub*. 2005;28(1):175–84.
- [15] Martha NS, Arnaldo PB, Albelino SC, Antonio JLA. Music therapy may increase breastfeeding rates among mothers of premature newborns: a randomized controlled trial. *J. Pediatr. (Rio J.)*. 2011;87(3):206–12.
- [16] N Dole, DA Savitz, I Hertz-Picciotto, AM Siega-Riz, MJ McMahon, P Buekens. Maternal Stress and Preterm Birth. *Am J Epidemiol*. 2003;157:14–24.
- [17] Porcelli PJ, Weaver RG Jr. The influence of early postnatal nutrition on retinopathy of prematurity in extremely low birth weight infants. *Early Hum Dev*. 2010;86:391–96.
- [18] Uauy R, Mize CE, Castillo-Duran C. Fat intake during childhood: metabolic responses and effects on growth. *Am J Clin Nutr*. 2000;72:1354–60S.
- [19] Landreth JF, Landreth HF. Effects of music on physiological response. *Journal of research in music education*. 1974;22:4–12.
- [20] Willard J, Livingston HM, Brown RE. How music in the operating room robs surgery of terror. *Hosp manage*. 1952;74(6):40–43.
- [21] Makama JG, Ameh EA, Eguma SA. Music in the operating theatre: opinions of staff and patients of a Nigerian teaching hospital. *African Health Sciences*. 2010;10(4):386–89.
- [22] Urdike PA, Charles DM. Music Rx: physiological and emotional responses to taped music programs of preoperative patients awaiting plastic surgery. *Ann plast surg*. 1987;19:29–33.
- [23] Whipple B, Glynn NJ. Quantification of effects of listening to music as a noninvasive method of pain control. *Scholarly inquiry for Nursing Practice*. 1992;6:43–62.
- [24] Beck SL. The therapeutic use of music for cancer related pain. *Oncol Nurs Forum*. 1991; 18(8): 1327–37.
- [25] T Ventura, MC Gomes, T Carreira. Cortisol and anxiety response to a relaxing intervention on pregnant women awaiting amniocentesis. *Psychoneuroendocrinology*. 2011;37(1):148–56.
- [26] Dorn LD, Lucke JE, Loucks JL, Berga SL. Salivary cortisol reflects serum cortisol: Analysis of circadian profiles. *Ann Clin Biochem*. 2007;44:281–84.
- [27] Aardal-Eriksson E, Karlberg BE, Holm AC. Salivary cortisol – an alternative to serum cortisol determinations in dynamic function tests. *Clin Chem Lab Med*. 1998;36:215–22.
- [28] Nilsson U, Unosson, M Rawal N. Stress reduction and analgesia in patients exposed to calming music postoperatively: a randomized controlled trial. *Eur J Anaest*. 2005;22:96–102.

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