

Preterm Infants and Maternal Voice, Family Visitation, and Discharge Timing

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The purpose of this pilot study was to describe the combined effect of exposure to a recording of maternal voice and family visitation on discharge timing in preterm infants cared for within a neonatal intensive care unit (NICU) without an ongoing program of developmental care. Using a retrospective comparative design, a convenience sample of 67 preterm infants participated. Experimental infants participating in a larger ongoing study listened twice a day to a recording of their mother's voice. Control infants received routine NICU care. The median number of family visits (3 per week) was used to differentiate between high (≥ 3) versus low (< 3) levels of visitation. A near significant reduction in the number of episodes of feeding intolerance ($F = 3.16$; $p = .08$) was noted between infants who heard the maternal voice recordings and whose families visited more often (experimental mean = 2.8; control mean = 5.5). A significant, yet counterintuitive finding, was noted in the number of days to discharge (i.e., the length of stay), independent of exposure to the maternal voice recordings ($F = 8.42$; $p < .01$). The number of days to discharge were fewer if family members visited less frequently (mean = 44.4 days) compared to those infants whose family visited more (mean = 61.3 days). Findings suggest that the combination of maternal voice and family visitation may have a positive effect on decreasing the number of days to discharge. Future research is needed to verify this combination's effect on discharge outcomes in preterm infants.

Introduction

Measurement of discharge timing (i.e., length of stay) for preterm infants from neonatal intensive care units (NICU) includes several milestones. These milestones include respiratory stability and the ability to oral feed, which may be improved by the inclusion of developmental care, family visitation, and exposure to maternal voice. Health milestones maintain importance because the longer an infant remains hospitalized, the greater the risk of contracting a nosocomial infection (Clark et al., 2004), the more cost incurred (Clark et al., 2004; Committee on Hospital Care, 2003), less time for interaction with the family, and increased family stress (Cooper et al., 2007; Petrou, 2003). The purpose of this pilot study was to discern the effect of maternal voice and family visitation on discharge timing in preterm infants.

Methods to Improve Discharge Timing

Methods to improve discharge timing include programs that are centered on developmental care, which improves ability to oral feed, and maternal visitation and voice, which both decrease days to discharge.

Developmental Care. Programs of developmental care which began in 1986 by Heidi Als and colleagues, individualized care based on the maturity and health status of each individual infant and focused on oral feeding and other health milestones. Such emphasis is placed on the ability to oral feed because most newborn preterm infants are incapable of doing basic functions such as breathing, sucking, and swallowing during feeding (Lau, Smith, & Schanler, 2003) and to digest nutrients properly (Diehl-Jones & Askin, 2004). This inability forces the infant to stay within the hospital until standard function achievement is complete, confirming the importance of this health milestone. The program later was altered to incorporate an emphasis on parent-infant interactions to form a bonding relationship between the infant and mother early on.

Infants participating in developmental care programs have been shown to require significantly fewer days of mechanical ventilation and supplemental oxygen support (Als et al., 2003; Becker et al., 1991; Fleisher et al., 1995). Research shows that the use of developmental care programs has also been associated with decreased length of hospital stay for preterm infants (Als et al., 2003; Becker et al., 1991; Brown & Heermann 1997; Melnyk et al., 2006; Zeskind & Iacino, 1984), diminished parental stress (Melnik et al., 2006), and quicker weight gain (Westrup et al., 2000). With the findings from multiple studies showing

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numerous benefits for infants and parents resulting from this program of care, the use of developmental care has become more prevalent. Family visitation is one important component of developmental care programs.

Family Visitation. While currently there is research establishing the effect of maternal visitations on a preterm infant's days to discharge, there is no information linking whether or not visitations by other family members would also improve discharging timing.

A study by Zeskind and Iacino (1984) looked at quantities of maternal visitation with a set of 2 groups (1 intervention, 1 control) composed of 32 mothers and their infants ranging from 30-36 weeks of age. Both groups experienced routine care offered by the NICU staff. The intervention group, however, had the addition of help from a project interventionist who provided advocacy, explained the many actions of the NICU staff so the mothers might better understand the processes, and made an appointment each week for the mother to visit with her infant. Comparisons of the 2 groups revealed that the intervention group mothers independently (not including those set up appointments to visit infant) visited their infants more than twice as often as the mothers in the control group. Length of hospitalization was looked at as well, and the intervention infants stayed an average of 8 days fewer than the control group. This established maternal visitation (in conjunction with a program directed towards educating the mother about her infant's health care) as a factor in decreasing a preterm infant's days to discharge.

Family visitations, in addition to maternal visitations, may be even more beneficial to the infant's discharge timing than just solely by the one member. Perhaps any increased exposure to family members is more advantageous compared to the absence of any exposure. Including other family members in family visitation may assist in providing a nurturing environment for these vulnerable babies by exposing them to a positive source of sound. Preterm infants in the NICU are constantly exposed to negative sources of sound through monitor alarms, health care professional talk, and nearby infants crying. Family visitation by multiple family members, especially the mother, would provide more opportunities of positive auditory stimulation for the preterm infant. While there is general theoretical support indicating the significance of exposure to maternal voice in the fetus and preterm infant (Lickliter, 2000), research evaluating exposure to maternal voice in preterm infants is equivocal.

Maternal Voice. In a study done by Chapman (1978) and Malloy (1979), infants 26-33 weeks post-menstrual age were split into 3 groups (Group 1, Group 2, and control),

with all receiving standard NICU care. Group 1 was exposed daily to a recording of maternal voice while Group 2 was exposed daily to an orchestra playing a lullaby. Chapman reported that the infants exposed to their mothers' voice demonstrated the gross motor pattern of laterality (preference for use of one side) more often than those infants listening to the lullaby and those in the control group. In Malloy's following study with these same infants, the weight gain and developmental outcomes were evaluated at 1 day following discharge and at 9 months of age using components of Rosenblith's Behavioral Examination of the Neonate and Bayley Scales of Infant Development (Bayley, 1969; Malloy, 1979; Rosenblith, n.d.). There were no statistical between-group differences noted; however, infants exposed to maternal voice gained more weight.

More recently, Krueger (in press) reviewed all studies addressing exposure to maternal voice in preterm infants and found that all used unsafe sound levels. All studies used decibel levels ranging between 75-80 decibels, which is much more than what is recommended. Sound levels are important in preterm infant exposure, because depending on the gestational age, the infant is undergoing neuro-behavioral advances that can be negatively affected. Out of the 7 studies viewed, the true significance of the findings are difficult to evaluate because of these high sound levels.

Taken together, the above studies suggest that both the frequency of maternal visitation and exposure to maternal voice positively impact the number of days to discharge. We therefore sought to describe whether this combination (using safe sound levels) could potentially be an effective and efficient way of decreasing length of hospitalization for preterm infants.

Study Design and Methods

A retrospective comparative design was used with a convenience sample of 67 preterm infants. Thirty-two infants within this group took part in an experimental component; 35 infants were retrospectively selected to create a control group comparison. All infants were cared for within the same time period within a level 3 NICU at an academic teaching institution in the southeastern United States. During this time period there was no ongoing program of developmental or family-centered care occurring within the NICU.

Following Institutional Review Board approval, criteria selected for inclusion were: 1) birth between 27 and 28 weeks post-menstrual age, and 2) English as a native

language. Exclusion criteria consisted of: 1) prenatally transmitted viral/bacterial infections, 2) abnormal head ultrasound, 3) sensorineural hearing loss, 4) cardiac abnormalities, or 5) abdominal disorders. Ethnicity was obtained for 66 infants (one subject's chart was not available to obtain demographic information). Among these infants, 60.6% were Caucasian 36.4% were African American, and 3% were Hispanic.

Additional demographic information obtained was the infant's gestational age at birth, Apgar score, and neurobehavioral risk score (NBRS). An Apgar score is calculated at both 1 minute and 5 minutes post birth. The infant is rated on a scale of 0-4 (0 being bad and 4 being well) on 5 categories related to the infant's health. The higher the score, the better the infant's health. The average is between 7 and 10. The NBRS score is the status of the preterm infant while hospitalized to differentiate between high risk and low risk infants.

Participants in the experimental component of this study were part of a larger quasi-experimental study entitled, *Heart Rate Variability and Learning in the 28-34 Week Old Preterm* (NIH/NINR P20 NR07791; NIH/NCRR M01 RR00082; Southern Nursing Research Society) in which 32 experimental infants listened to a CD recording of a nursery rhyme recited by their mothers twice a day for 2-6 weeks. These infants were cared for within the NICU during the same time period as the experimental infants but received standard NICU care and no exposure to maternal voice recordings.

Variables

Nursery Rhyme. A CD recording of the mother reciting a nursery rhyme was used in the experimental component of the study. The untitled rhyme (Simon & Schuster, 1985) was 9 lines long, took approximately 15 seconds to recite, and was not a common verse (making it unlikely that infants would be unexpectedly exposed to it). Recordings lasted approximately 45 seconds and were played twice a day over a 12.5-cm speaker positioned 20 cm from the infant's ear. Sound levels were measured using an A-scale of a Bruel-Kjaer (220SLM) sound level meter. Overall stimulus intensity was 50-55 dB ($M=53.9$; $SD=2.35$), with background NICU sound levels just prior to initiation of recordings ranging between 48.6 to 69.2 dB ($M=57.90$; $SD=4.01$). Fifty to 55 decibels was chosen in order to maintain the decibel level just below the normal level of human speech (58-60 dB) (Gerhardt, 1989) and to remain within recommended sound levels for the preterm infant (Graven, 2000).

Family visitation was defined as the average number of days in a week (0-7 days) for a total of 6 weeks that a family member visited the infant's bedside. Multiple family visits per day were counted as 1 visit (due to inability to quantify the length of time spent at the infant's bedside). Family members included mothers, fathers, grandparents and/or guardians. The median # of visits (3 per week) was used to differentiate between high (>3) versus low (<3) levels of visitation.

Number of days to discharge was defined by the number of days from birth to the infant's discharge home or transfer to another facility.

Average daily weight gain was obtained by dividing the infant's total weight gained in grams (from birth) by the number of days cared for within the NICU.

Days to full enteral feedings was defined as the number of days from birth to the day the infant tolerated 120ml/kg/day of either breast milk or formula feedings.

Days to full oral feeding was defined as the number of days from birth to the day the infant ingested all feedings via breast or bottle for 24 hours.

Number episodes of feeding intolerance was defined as the number of times the infant had gastric residuals equal to or greater than 3 ml/kg or was placed in NPO (receiving nothing by mouth) status due to events other than routine preparation for a procedure or intervention. Gastric residuals of less than 3 ml/kg have been shown to be safe in previous research concerning VLBW infants (Mihatsch et al., 2002).

Percent days on respiratory support was defined as the percentage of hospital days on respiratory support (nasal, CPAP, ventilator) provided.

Days of NPO status was defined as the number of days the infant was placed on NPO status for over 50% of a 24-hour period.

Procedure

A retrospective chart review for infants participating in both the experimental and control component was conducted in order to determine the quantity of family visitation and nutritional and respiratory outcomes. Data retrieval was initiated at >95% inter-rater reliability and maintained at the same by evaluating 10% of the charts once data retrieval was completed. The frequency of family visitation was extracted by 2 research assistants whose inter-rater reliability was maintained at >95% agreement. All variables related to achievement of oral feeding and respiratory support were similarly extracted by one Advanced Practice registered nurse and maintained at >95% inter-rater agreement.

Table 1: Demographic Information and Outcome Variables of Preterm Infants

	Demographic Information						Outcome Variables						
	Age	1 min	5 min	Weight (gm)	NBR Score	Breast days	Days to DC	Weight Gain	Feed days	PO Feed days	Feed Intol.	NPO	Resp. Outcome
All Infants (Experimental and Control) N=67													
Visit Status: Low	24.8	5.4	7.6	1145.4	2.3	9.8	44.4	14.9	28.4	51.0	3.6	7.5	57.0%
High	25.4	5.4	7.0	1012.2	3.5	21.5	61.3	19.9	31.5	59.3	4.1	9.8	61.8%
Experimental Infants n=32													
Visit Status: Low	26.8	5.6	7.9	1107.6	1.4	8.1	41.0	16.4	26.0	48.0	3.4	6.0	51.7%
High	24.9	5.9	7.1	1069.7	3.3	27.1	61.8	21.0	27.4	56.7	2.8	9.6	58.4%
Control Infants n=35													
Visit Status: Low	23.4	5.3	7.5	1170.5	2.8	10.9	46.6	13.8	30.5	52.3	3.4	8.4	60.7%
High	25.9	4.9	6.9	949.1	3.9	15.5	60.8	18.2	36.5	61.8	5.3	10.0	65.4%

NBR = Neurobehavioral Risk Score; DC = discharge; PO = by mouth; Intol. = intolerance; NPO = nothing by mouth; Resp. = respiratory

Statistical Analyses. Data were analyzed using SAS (v8, Cary, NC). Descriptive statistics were determined to characterize the sample. A two-way ANOVA was used to compare outcomes between groups. A level of significance of $P \leq 0.05$ was used.

Results

Using a two-way ANOVA, variables related to discharge timing were compared (Table 1). A near significant finding was noted for episodes of feeding intolerance. The number of episodes of feeding intolerance was less for infants whose families visited more often, as well as heard the maternal voice recordings. A near significant difference was noted in between the high visitation Experimental (or maternal voice group) and the high visitation Control group ($F = 3.16$; $p = .08$; Experimental mean = 2.8, Control mean = 5.5). Further, a counterintuitive finding was noted. Infants in the both the Experimental and Control groups whose family members visited less were discharged earlier ($F = 8.42$; $p < .01$;

combined Experimental and Control low visitation mean = 44.4, combined Experimental and Control high visitation mean = 61.3).

Discussion

Findings suggest that the combined effects of family visitation and exposure to maternal voice recordings (within a NICU without an organized program of developmental care) does not significantly affect discharge timing. A near significant difference ($F = 3.16$; $p = .08$), however, was noted for the Experimental infants between the Low versus High visitation groups in episodes of feeding intolerance.

The finding related to episodes of feeding intolerance may be explained by a variation in feeding type between the Low versus High visitation status groups. The effect may be due to the fact that the high visitation infants experienced more days of breast milk feeds ($F = 4.77$; $p < .05$; high visitation mean = 21.5 days, low visitation mean = 9.8 days). Breast milk could have influenced this finding because it is known to decrease episodes of feeding

intolerance (Boyd, 2007). This suggests that further studies are needed to confirm whether our combination of family visitation and exposure to maternal voice is effective. The differences in number of days breastfed however could not have been known beforehand.

Additional limitations to this study are related to the accuracy and reliability of medically charted variables. A retrospective review of medical records allowed for a bias of accurate interpretations because no precise protocol was followed by the nurses for documentation of the visitations. There was a lack of identifying which family member visited, the duration of visit, and what type of interaction (whether the infant was held, spoken to, etc.) occurred. Due to this limitation, we chose to opt for the most accurate option and simply measure the absence or presence of a family member at the bedside each day. Further, infant feeding treatment and decisions on when to progress feeding are largely subjective and vary between clinicians, thus reducing the reliability of the findings.

Future studies using a prospective design are needed to increase confidence in the findings. Further, the use of quota sampling is recommended in order to balance risk status and feed type between groups in this study. In order to overcome limitations related to the reliability of taking the frequency of family visitations from the medical records, family members could be asked to record their visitations on a log. The use of a log would also allow future researchers to obtain the length of time families stayed by the bedside.

If it is true that episodes of feeding intolerance are affected by a combination of these simple interventions (exposure to maternal voice and frequent visitation by family members), additional research is needed to investigate other areas that may be impacted by exposure to maternal voice. For example, studies investigating whether mother-infant/family-infant interactions are affected by providing a combination of exposure to maternal voice and frequent visits by the family. Future investigations such as these could show immense reasoning for the importance of maternal voice and high frequencies of family visitation in the health and wellbeing of preterm infants.

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