Application of the M Technique in Hospitalized Very Preterm Infants

A Feasibility Study

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ABSTRACT

PURPOSE: To explore the application of a novel relaxation method (the M Technique) in hospitalized very preterm infants in a level IIIC neonatal intensive care unit.

DESIGN: A feasibility, observational intervention study.

SUBJECTS: Ten very preterm infants were enrolled to receive the treatment intervention. Eligible infants born less than 30 weeks' gestation received the intervention at 30 weeks' postmenstrual age.

METHODS: Based on infant readiness, each infant received the M Technique for 5 minutes. Physiologic parameters (heart rate, respiratory rate, and oxygen saturations), behavioral variables (stress and relaxation cues), and infant behavioral state were measured 5 minutes before, during, and up to 10 minutes after the intervention, continuously.

RESULTS: Descriptive analysis revealed that baseline physiologic, behavioral state, and behavioral cue parameters changed during and after the application of the M Technique. A decrease in heart rate and respiratory rate occurred during the M Technique ($P = .006$, $P > .001$ respectively) and a decrease in heart rate occurred at the end of the M Technique session ($P = .02$). In addition, an increase in SaO_2 occurred during and at 5 minutes following the M Technique session ($P = .04$, $P = .02$, respectively). State scores decreased from baseline (mean = 5.1; range, 3-9) to after the intervention (mean = 2.0, range 1-4). As the intervention was delivered, more positive than negative behavioral cues were observed throughout, at the end, and after the M Technique session.

CONCLUSION: In this feasibility study, the M Technique can be delivered without adverse effects to very preterm infants who are 30 weeks' postmenstrual age. Additional research is needed with a larger, randomized design to determine short- and long-term effects specifically related to neurologic outcomes.

Key Words: infant behavior, neonatal intensive care unit, therapeutic touch, very preterm infant

Up to two-thirds of children born very preterm (≤30 weeks' estimated gestational age) experience cognitive impairments, a wide variety of learning disabilities, impaired executive function, and social and emotional difficulties.[1-5] These high-risk very preterm infants often begin their lives in an unprotected and overstimulating neonatal intensive care unit (NICU) during a critical period of rapid brain growth and organization. Environmental factors in the NICU, many resulting in increased stress,

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may play a role in altered brain maturation and developmental outcomes.[6,7] Neurodevelopmental supportive care strategies for very preterm infants include reducing exposure to noxious environmental stimulation and positive stimulation aimed at decreasing stress and reducing the gap between the in utero and NICU environments.[8-10]

Infant massage (IM) is recognized as a developmentally supportive intervention aimed at decreasing infant stress and optimizing the infant's sensory experience to improve long-term development. Although preterm (<37 weeks' estimated gestational age) IM benefits are well-documented, the majority of existing studies have varying protocols, are limited to healthy or convalescing preterm infants greater than or equal to 32 weeks' postmenstrual age (PMA), and are not consistently contingent on infant cues.[11-17] In addition, IM studies traditionally incorporate kinesthetic stimulation (eg, passive range of motion of the lower and upper extremities), requiring frequent repositioning of the infant between supine and prone.

Alternatively, out of concern for the physiologic fragility of very preterm infants (eg, born ≤ 30 weeks' gestational age) in the NICU, researchers have examined a wide range of comforting or relaxing touch techniques. These supplemental touch techniques include *therapeutic touch*—a noncontact, energy balancing therapy[18]; gentle human touch (GHT)—a still touch without stroking or massaging[19-22]; "touch and caressing–tender in caring" therapy—a gentle/light systematic stroking touch[23,24]; and IM with kinesthetic stimulation.[25] These studies have incorporated varying protocols resulting in limited or inconsistent results.

Recently, a novel alternative to providing these conventional techniques to hospitalized high-risk infants was introduced, called the M Technique.[26] The M Technique is a gentle, structured stroking technique aimed at reducing stress and anxiety in fragile intensive care patients who are unable to tolerate conventional massage.[27,28] The M Technique does not require frequent infant repositioning and can be delivered on the basis of infant cues. Each movement and sequence are done in a set number of repetitions using a set pattern, pressure, and speed, making it easy to learn and easily reproducible for research and clinical practice.[27] To our knowledge, no studies have examined the effects of the M Technique on infants born very preterm. Therefore, our goal was to explore the application of the M Technique in hospitalized preterm infants within a level IIIC NICU who were born less than 30 weeks' estimated gestational age and were no greater than 30 completed weeks' PMA at the time the M Technique commenced. To achieve our goal, a feasibility study was conducted to determine whether the M Technique intervention is appropriate for this population of infants and whether further efficacy testing should be employed.

METHODS

Sample and Setting

Ten very preterm infants admitted to the level IIIC NICU in a large Midwestern academic pediatric hospital were recruited from February 2011 to May 2011 for this pilot study to explore the application of the M Technique. Inclusion criteria were (1) infants born less than 30 weeks' gestation (determined by Ballard), (2) 30 weeks' PMA at the time of the M Technique intervention (appropriate for gestational age), and (3) no evidence of major brain injury (eg, grade IV intraventricular hemorrhage). Infants with septic shock, nonintact skin, respiratory failure (eg, supplemental Fio_2 requirement >75%), severe brain injury, persistent tachycardia, bradycardia, or those deemed unstable as determined clinically by the attending physician, were excluded.

Procedures

The NICU research committee and the hospital's institutional review board approved the study. Parents of infants who met the sample selection criteria were contacted by one of the study team members. After parent consent was obtained, each participant was scheduled to receive the M Technique intervention.

M Technique Training

The principal investigator participated in a 3-day adult, pediatric, and neonatal M Technique certification class given by the developer, Jane Buckle. All infants received the intervention once, which was administered by the principal investigator and lasted approximately 5 minutes. Specific criteria were identified for the M Technique to be discontinued if the infant demonstrated signs of persistent physiologic distress (eg, heart rate [HR] < 100 or > 200 beats per minute for 15 seconds or more, or arterial oxygen saturations levels < 85% for longer than 30 seconds) or if the infant required an increase in supplemental Fio_2 concentration during the M Technique administration. None of the infants exhibited these signs of physiologic distress during the M Technique period; therefore, it was not necessary to discontinue the technique before the end of the 5-minute period.

The M Technique was provided according to a detailed protocol (see Box). The protocol was similar to the M Technique intervention designed by Buckle[27] and used in infants following craniofacial surgery.[26] The M Technique is a method of structured touch that follows a systematic set structure and pattern. Each movement and sequence follow a distinctive pattern that is not modified. Planned

Box. M Technique Protocol

- Timing of the M Technique therapy was based on a schedule that best supported each infant, generally at least, 1.5-2 hours postfeeding (*if on a q 3-hour feeding schedule*).
- Before, during, and after the M Technique administration, each infant's behavioral and physiologic cues and state were closely examined to avoid overstimulation. Administration of the technique was *not* commenced if the infant was in a quiet sleep state.
- Before commencing the M Technique, the principal investigator confirmed with the attending physician and the bedside nurse whether the infant was still considered a candidate to receive the M Technique. At this point, the nurse was instructed to place the infant in a midline prone position with extremities in flexion (supported by developmental positioning aids) after routine care.
- Baseline data obtained.
- Hands warmed before commencing the M Technique.
- Confirmed infant was in the prone position and the upper half of the positioning aid was opened, keeping the lower extremities and buttocks in a well-supported flexed position.
- *Let your presence be known*—hands cupped with one hand resting gently on the infant's head and the other on the infant's lower back/buttocks (offer gentle still touch/containment).
- Stroking began using a pressure of 3 (0-10) or moderate pressure with a set rhythmic sequence, each stroke repeated 3 times.
- Stroking was applied to the infant's back using the pads of the second and third fingers of both hands.
- Total duration: 5 minutes (approximately 20 seconds per stroke).
- Ended with still gentle touch/containment.

modification or termination of the stroke was to be done only if the infant demonstrated signs of physical or behavioral distress. It was not necessary to terminate the intervention but a brief 5- to 10-second pause was warranted in 2 of the participants to promote self-regulation during administration of the intervention. Each stroke within each movement is repeated 3 times. The rationale for this set repetition is to decrease anxiety in the individual receiving the technique. For example, when the first stroke is provided, the receiver will take notice; the second stroke, the receiver recognizes the stroke; the third stroke, the receiver anticipates what is going to happen and begins to relax. The M Technique uses a set pressure of 3 (more than a tickle) where 0 is no pressure and 10 is crushing pressure. The speed of the M Technique is slow, constant, and rhythmical. The M Technique can be provided on any part of the body, but for this study the technique was delivered to the infant's back while in a prone position.

Outcomes Measures

The aim of this feasibility study was to explore the impact of the M Technique on physiologic, behavioral, and state responses in very preterm infants. The M Technique was provided once over a 5-minute period. Physiologic parameters (HR, respiratory rate [RR], and oxygen saturation), behavioral variables (signs of distress and relaxation cues), and behavioral state (Anderson Behavioral State Scale [ABSS]) were continuously measured beginning 5 minutes before, during, and up to 10 minutes after the intervention.

Infant Physiologic Measures

Heart rate, RR, and oxygen saturations (SaO_2) were measured continuously beginning 5 minutes before, during, and up to 10 minutes after the intervention. The HR, RR, and SaO_2 measures were obtained via an IntelliVue MP70 patient monitor (Philips, Andover, MA) and Nellcor pulse oximeter (Nellcor Puritan Bennett, Inc, Pleasanton, CA) and confirmed by a member of the research team who separately tracked each autonomic response. This research team member, a neonatal occupational therapist, documented autonomic responses at baseline and every minute throughout the data collection period. The same individual collected these data throughout the study.

Infant Behavioral Measures

Observations of each infant's positive (eg, eyes widened, face brightened, hands to mouth, hands opened and relaxed, pink, relaxed breathing, relaxed posture) and distressed (eg, brow bulge, eyes clinched, fingers splayed, crying, fussing, grimace, hiccup, self-repositioning) behavioral cue responses were measured and documented at baseline and continuously throughout the entire data collection period. A member of the research team continuously monitored both positive and distressed infant behavioral cues. This research team member is a neonatal nurse practitioner with more than 30 years of neurodevelopmental supportive care experience and is trained in infant observations. This same member of the research team measured the behavioral cues throughout the entire study.

Infant Behavioral State

Twelve categories of infant behavioral state (eg, quiet sleep, irregular sleep, active sleep, very active sleep, drowsy, alert inactivity, quiet awake, active, very active, fussing, crying, and hard crying) were measured using the ABSS.[29] The ABSS allows for classification of behavior into states from sleep to awake to crying. Infant behavioral state was assessed and documented at baseline and every minute throughout the entire data collection period by a member of the research team, trained to reliability. This trained research team member is a neonatal physical therapist with more than 20 years of experience in neurodevelopmental supportive care. For one-third of the observations, a second member of the research team independently judged behavioral states to ensure reliability. Interrater reliability was assured at a level greater than 90% throughout the study. However, to ensure consistency, the same member of the research team recorded each infant's behavioral state throughout the study.

Statistical Analysis

All data were analyzed in SPSS 18 software (IBM SPSS, Chicago, IL). Descriptive statistics were used to analyze infant characteristics, physiologic, behavioral state, and cue responses. *P* values were calculated on the basis of a 1-sample *t* test and a Wilcoxon signed-rank test to determine differences from baseline in the physiologic parameters during and after the M Technique session.

RESULTS

Table 1 summarizes the characteristics of the participating infants' birth weight, gestational age,

TABLE 1. Infant Characteristics

Infant Characteristics (N = 10)	Mean ± SD
Birth weight, g	1160 ± 198
Range, g	860-1420
Gestational age, wk	27.9 ± 0.9
Postmenstrual age on the day of study, wk	30 ± 0
Male, n (%)	2 (20%)
Female, n (%)	8 (80%)
Black, n (%)	7 (70%)
Caffeine, n (%)	8 (80%)
Room air, n (%)	3 (30%)
Nasal cannula, n (%)	3 (30%)
High humidity nasal cannula, n (%)	3 (30%)
SiPAP with back-up rate, n (%)	1 (10%)

Abbreviation: SiPAP, bi-level continuous positive air pressure.

TABLE 2. Descriptive Mean ± SD and Range for Heart Rate and Respiratory Rate and Oxygen Saturations Prior to and at 1-Minute Intervals During and 5- and 10-Minute Intervals Following the Administration of the M Technique

Physiologic Parameters (N = 10)	Baseline Mean ± SD (Range)	1 min Mean ± SD (Range)	2 min Mean ± SD (Range)	3 min Mean ± SD (Range)	4 min Mean ± SD (Range)	5 min Mean ± SD (Range)	5 min Post-M Mean ± SD (Range)	10 min Post-M Mean ± SD (Range)
Heart rate	173 ± 23 (133-215)	171 ± 16 (147-198)	168 ± 16 (142-192)	165 ± 17 (130-192)	165 ± 14 (140-189)	163 ± 15 (131-185)	166 ± 16 (131-186)	164 ± 13 (134-178)
Respiratory rate	64 ± 17 (30-83)	52 ± 20 (33-85)	54 ± 17 (35-83)	53 ± 14 (36-84)	51 ± 17 (35-78)	54 ± 14 (38-80)	55 ± 17 (25-78)	59 ± 16 (30-85)
Oxygen saturation	95 ± 5 (85-100)	94 ± 6 (84-100)	95 ± 6 (83-100)	94 ± 8 (77-100)	96 ± 5 (86-100)	97 ± 3 (90-100)	97 ± 3 (87-100)	97 ± 3 (89-100)

and average PMA when the M Technique commenced. Additional infant characteristics are summarized revealing that the majority of the infants were black (70%), females (80%), and receiving caffeine (80%) and supplemental oxygen (70%) when the M Technique commenced.

Physiologic Responses

Although HR, RR, and arterial Sao_2 data were collected continuously, for the analyses reported here, data were averaged at baseline and during the M Technique at 1-minute intervals and then at 5 minutes and 10 minutes after the M Technique. Descriptive analysis revealed that baseline HR (mean = 173 beats per minute) and RR (mean = 65 beats per minute) progressively decreased throughout and at the end of the intervention (Table 2). Oxygen saturations increased over the course of the intervention (Table 2). A difference from baseline in the physiologic parameters during and after the M Technique was observed (Table 3). A decrease in HR occurred from baseline to the lowest level during the intervention ($P = .006$). In addition, a decrease in HR occurred from baseline to the end of the intervention ($P = .02$). A decrease in RR occurred from baseline to the lowest RR level during the intervention ($P > .001$). Finally, an increase in Sao_2 levels occurred from baseline to the highest Sao_2 level during the intervention and from baseline to the highest Sao_2 level 5 minutes after the M Technique ($P = .04$, $P = .02$, respectively).

Behavioral State Responses

The majority of infants were in an active or very active state at baseline with a few being fussy or crying (Table 4). No infant was awakened from a quiet sleep state to initiate the M Technique therapy. For the ABSS scoring the higher the behavioral state score, the more active or fussy the infant. The average behavioral state scores decreased from baseline (mean = 5.1) to after the M Technique session (mean = 2.0), indicating a more quiet sleep state.

Behavioral Cue Responses

Table 5 provides a summary of the percent of times infants displayed distressed or positive behavioral cues. More positive behavioral cues were observed than distressed sign throughout, at the end, and after the M Technique session. The Figure provides a graph depicting the cues by time point. Distressed behaviors decreased over time and were nonexistent within 4 minutes after the M Technique therapy commenced and continued 5 and 10 minutes after the M Technique session. Similarly, positive behavioral responses increased over time and all participants displayed positive behavioral cues within 4 minutes after the M Technique commenced and continued 5 and 10 minutes after the M Technique session.

TABLE 3. Change in Heart Rate, Respiratory Rate, and Oxygen Saturation From Baseline

Difference From Baseline[a]	Mean	Mean Difference ± SD	P[b]
Heart rate			
Baseline	173		
Lowest during intervention	163	−15.2 ± 13.6	.006
Highest during intervention	171	−0.5 ± 8.1	.85
At the end of intervention	163	−12.8 ± 14.9	.02
5-min postintervention	166	−7.6 ± 11.1	.06
10-min postintervention	164	−9.8 ± 14.1	.06
Respiratory rate			
Baseline	64		
Lowest during intervention	51	−25.7 ± 15.2	.0005
Highest during intervention	54	3.9 ± 15.3	.44
At the end of intervention	54	−8.7 ± 16.8	.14
5-min postintervention	55	−9.5 ± 17.1	.11
10-min postintervention[c]	59	2 (−9, 6)	.68
O_2 saturation			
Baseline	95		
Lowest during intervention	94	−3.1 ± 5.3	.10
Highest during intervention	97	2.9 ± 3.9	.04
At the end of intervention	97	2.0 ± 4.1	.16
5-min postintervention	97	2.3 ± 2.7	.02
10-min postintervention	97	2.2 ± 3.5	.08

[a]Calculated as value at time-point (during intervention, end of intervention, etc.) minus baseline value.

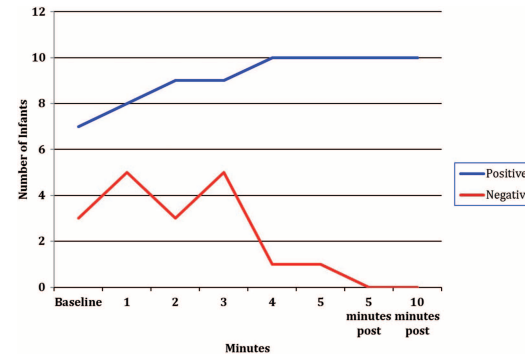
[b]P value based on one-sample t test.

[c]Median (25th, 75th percentile) presented. P values are based on the Wilcoxon signed rank test.

TABLE 4. Descriptive Data of Infant Behavioral State Using the Anderson Behavioral State Scale (ABSS) Score

ABSS (N = 10)	Mean ± SD (Range)
ABSS at baseline	5.1 ± 2.08 (3-9)
ABSS at 1 min	3.8 ± 2.70 (2-10)
ABSS at 2 min	2.8 ± 1.32 (1-5)
ABSS at 3 min	2.2 ± 0.79 (1-4)
ABSS at 4 min	2.4 ± 0.70 (2-4)
ABSS at 5 min	2.0 ± 0.47 (1-3)
ABSS at 5 min post–M Technique	2.0 ± 0.82 (1-4)
ABSS 10 min post–M Technique	2.6 ± 1.17 (1-5)

FIGURE.



Negative and positive infant cues by time-point.

DISCUSSION

Results from this study suggest that a 5-minute infant-driven M Technique intervention has no adverse effect on very preterm infants' physiologic parameters, behavioral cues, and state. These physiologic results are consistent with other supplemental comforting touch studies including therapeutic touch[18] and "touch and caressing–tender in caring"[23,24] therapies in which HR or oxygen saturations were not adversely affected in very preterm infants. However, unlike the present study, these studies did not examine infant behavioral state or behavioral cues, which may further support the relaxing effects of these supplemental touch techniques. Similar to this study, GHT studies[19-22] have examined physiologic and behavioral state and/or cues to evaluate its effect on hospitalized very preterm infants. The majority of the GHT studies have resulted in no adverse physiologic effects and a reduction in negative behavioral effects. In a pilot study, Harrison and colleagues[20] demonstrated that infants who received GHT had less time in active sleep ($P = .008$), less motor activity ($P = .003$), and less behavioral distress ($P = .033$) during the GHT intervention compared with baseline, but these same benefits were not observed post-GHT periods. However, in a larger randomized controlled trial, Harrison and colleagues[21] did report a decrease in oxygen saturations across the 3 phases of GHT at baseline, during, and after the intervention. Although a statistically significant ($P \leq .001$) decrease in oxygen was observed, it did not appear to be clinically significant. In addition, 19% of the infants in the GHT group had to have 1 or more GHT sessions terminated early because of a decrease in HR or a decrease in oxygen saturations. The investigators of the GHT study[21] noted that the infants with decreased oxygen saturations were those infants who were lower in gestational age and birth weight and had higher morbidity levels than infants who did not require early termination of the GHT sessions. This decrease in oxygen saturation did not occur in this study. Although this study does not report morbidity levels, infants within this study are of similar GAs and birth weights and are slightly younger in PMA compared with the GHT study.[21] No infant in the current study required early termination of the M Technique. It is important to note that this adverse effect on oxygen saturations may not have been observed in this study because the M Technique intervention was delivered only once and to only 10 patients.

TABLE 5. Descriptive Data of Infant Behaviors

Distressed/Negative and Positive Behaviors (N = 10)	%
Brow bulge	20.0
Crying	20.0
Eyes clinched	30.0
Fingers splayed	20.0
Fussing	10.0
Grimace	50.0
Hiccup	20.0
Self-repositioned	40.0
Eyes widened	20.0
Face brightened	20.0
Hands open and relaxed	60.0
Hands to mouth	70.0
Relaxed breathing	90.0
Relaxed posture	100.0
Pink	100.0

Overall, results from this study suggest that this type of structured and systematic stroking may have a relaxing effect as evidenced by a lower HR, increased Sao_2, an increase in quiet sleep, and less behavioral distress signs. Although more research is needed to determine both the short- and long-term benefits of the M Technique, results of this study suggest that NICU nurses can provide and/or encourage parents to provide a structured comforting touch method that is infant-driven, easy to learn, and relatively short in duration.

The major limitations of this study are the size and sampling technique. Since the purpose of this feasibility study was to explore the application of a novel relaxation method, the M Technique, in hospitalized very preterm infants in a level IIIC NICU, a typical power calculation was not applied. However, data from this study will aid in determining estimated sample size for future studies. As with any study using a convenience sample, sampling bias is a limitation because the small numbers of participants are challenging to represent the entire very preterm infant population. Given the small sample size, lack of randomization, and convenience sample, caution should be used in generalizing these findings to all very preterm infants in a level IIIC NICU. Finally, the examiner was not blinded and knew that the intervention was administered, which may have resulted in bias in their recording of behavior and state. This would not have influenced the physiologic measures.

A further limitation was the short-term nature of this study and the immediate outcome measures. No intermediate or long-term outcomes were collected and analyzed. Because the M Technique was administered only once, the number of times per day and the number of days the M Technique can be delivered to achieve maximum benefit were not studied and are unknown.

Although feasibility studies may have a number of limitations, well-designed and constructed feasibility studies can inform investigators about the research process.[30] Strengths of this feasibility study allowed the development of a workable and realistic research protocol to design our next phase of study. In addition, logistical problems (eg, timing of the intervention and coordination of the research team) were identified, successful recruitment approaches and data collection methods were refined, and data were obtained to aid in determining estimated sample size for future studies. Finally, this feasibility study provides evidence for future funding bodies that (*a*) the research team is competent and knowledgeable and that (*b*) the next main phase of study is worth funding.

CONCLUSION

The M Technique can be easily delivered to very preterm infants in a level IIIC NICU who are 30 weeks' PMA without notable adverse effects and with evidence of positive behavioral and physiologic impact. Based on the findings of this feasibility study, our next proposed study is to systematically test the cumulative effect of the M Technique on infant neurodevelopment in hospitalized very preterm infants. Additional research is needed with a larger, randomized, systematic methodologic design to determine the short- and long-term effects, specifically as related to brain growth, long-term neurobehavioral development, as well as decreased stress. Although not a component of this study, future research is also needed to evaluate the effectiveness of a parent-delivered M Technique and the potential impact on parent mental and emotional health and parent-infant synchrony.

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