IJN
Iranian Journal of Neonatology
http://ijn.mums.ac.ir

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Original Article

Comparing the Effects of Swaddle and Conventional Bathing Methods on Behavioral Responses in Preterm Neonates

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ABSTRACT

***Background*:** The newborn's first bath, performed in Neonatal Intensive Care Units (NICU), is believed to be a stressful situation, especially for the premature infants. As a developmental care approach, swaddle bathing is a low-stress bathing method for vulnerable preterm neonates. Given the limited number of the studies examining this bathing method, the present study was conducted with the aim of comparing the effects of swaddle and conventional bathing methods on some behavioral responses in premature infants.

***Methods*:** This study was a randomized clinical trial conducted on 50 premature neonates admitted to NICU. The neonates, who met the inclusion criteria, were randomly assigned into experimental and control groups. The infants in the experimental group received swaddle bathing and those in the control group were given conventional bathing. To record the behavioral responses, the infants' faces were filmed in close-up during the bathing. The data were analyzed, using Chi-squared test, independent samples t-test, and Mann-Whitney U test.

***Results*:** The results demonstrated that the occurrence rates of such behaviors as facial grimace (P<0.001), mouthing/yawing movements (P<0.001), tongue extension (P=0.017), eyes open (P=0.027), and fussing/crying (P<0.001) were significantly lower in the experimental group than those in the control group. In addition, the percentage of eyes closed was higher in the experimental group, compared to the control group (P=0.006).

Conclusion: According to the findings of this study, swaddle bathing can reduce the neonatal stress during bathing. Consequently, this kind of bathing can be used as an appropriate, low-stress, and pleasant method for the preterm neonates in NICU.

Keywords: Bath, Behavior, Neonatal intensive care units, Premature infant

Introduction

Intrauterine environment plays a critical role for the growth, development, and security of the neonates. When an infant is born prematurely, he is deprived of this secure environment. According to the World Health Organization statistics, almost 15 million preterm neonates are annually born around the world, which represents more than one-tenth of the total births. In Iran, approximately 12.9% of the pregnancies end in preterm birth (1). The premature neonates often need to be hospitalized in NICU for the survival and development of their central nervous system as well as other organs. The medical procedures that these neonates undergo are stress-provoking, which is contradictory with the requirements of neurosensory development (2). These stressors adversely affect the development and organization of vision, hearing, sleep pattern, and growth in the preterm infants and eventually cause long-term neuro-developmental impairments (3).

Implementing caregiving practices based on the developmental care approach is a strategy that can reduce the stress level and improve the developmental outcomes in the premature and ill

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Please cite this paper as: Paran M, Edraki M, Montaseti S, Razavi Nejad M, Comparing the Effects of Swaddle and Conventional Bathing Methods on Behavioral Responses in Preterm NeonatesIJN.. *2016; NOV, 7(4) DOI:10.22038/ijn.2016.7778*

neonates (4). Bathing is a simple and common caregiving practice in NICU, which can be a stressful experience for the infants, specially the premature ones, since they are in vulnerable physiological conditions (5).

Studies have shown that preterm neonates experience higher behavioral stress following a bath. In a study, Peters examined the behavioral effect of sponge bathing on the premature infants and demonstrated that this bathing method significantly enhanced the neonatal stress behaviors (6). Likewise, the results of another study by Tapia et al. indicated significant changes in the behavior of the premature infants after a sponge bath (7). Liaw et al. conducted a study to investigate the effect of tub bathing on the behavioral state and stress of the preterm neonates and revealed that this bathing method can increase stress behaviors in the preterm neonates (8).

In the swaddle bathing method, which is based on the developmental care approach, the neonate is bathed while swaddled in a flexed midline position, and then immersed in a tub of water. Each limb is unswaddled, washed and rinsed one at a time, and then re-swaddled (9). Some benefits of this bathing method include decreased physiological and motor stress, conserved energy, improved state control (e.g., decreased crying and agitation), facilitated social interaction by keeping the infant in a calm and quiet-alert state, increased self-regulatory behaviors, increased security, enhanced infant's ability to cooperate in breast- and bottle-feeding, and maintaining body temperature (10, 11).

Despite these beneficial effects of swaddle bathing, there has been limited studies examining its effects on the behavior of the preterm neonates. At the same time, the conventional bathing method used in most of the NICUs in the country does not seem to be safe for the infants, especially the premature ones. Therefore, based on the mentioned necessities and the special importance of this subject, this study was conducted with the aim of comparing the effect of swaddle and conventional bathing methods on some behavioral responses in premature infants.

Methods

This study was a single-blind randomized clinical trial which was carried out on the preterm neonates admitted to NICU of Hafez Hospital in Shiraz, Iran, during July 2013-January 2014. Considering the power of 90% and alpha level of 0.05, the sample size was calculated to be 50 subjects (25 neonates in each group), using the following formula:

$$n = \frac{\left(Z_{1-\alpha/2} + Z_{1-\beta}\right)^2 (\sigma_1^2 + \sigma_2^2)}{(\mu_2 - \mu_1)^2}$$

The eligible neonates were selected through convenience sampling method, and then were randomly assigned into two experimental and control groups, using block randomization. The inclusion criteria were as follows: 1) gestational age of 30-36 weeks, 2) postnatal age of 7-30 days, 3) no use of sedatives or skeletal muscle relaxants, 4) no major congenital, chromosomal, or neurological abnormalities, 5) no need for surgery, 6) no severe postnatal growth problems, 7) no evidence of grade II or higher intraventricular hemorrhage, 8) stability of physiological parameters, and 9) no sm ubstance abuse or sedative drug use by the mother. The exclusion criteria were occurrence of seizures or symptoms of physiological instability as well as parents' unwillingness to continue participating in the study.

After obtaining permission from the ethics committee of Shiraz University of Medical Sciences and Hafez Hospital, the researcher was allowed to enter the study environment. Subsequently, the parents were informed about the importance and objectives of the study and their written informed consents were obtained. The infants in the experimental group were bathed, using the swaddle bathing method, whereas those in the control group were given conventional bathing. In the experimental group, the neonates were wrapped in a soft towel with their arms and legs kept in a flexed midline position. After being taken out of the incubator, they were immersed in a tub of water so that the water was just below their shoulders. To support the infant's feet, they were placed in the bottom corner of the tub. A container of warm water and cotton wool balls were used to gently wipe the eyes from the inner corner to the outer (nose to ear), and then the entire face was cleaned. To wash all the extremities including the arms, abdomen, genital region, and legs, they were unwrapped one at a time and washed with cotton wool balls, and then re-swaddled. The back was washed through the cloth so as not to disorganize the infant and the hair was washed at the end. Subsequently, the cloth was removed and the infant was quickly wrapped in a dry towel and placed under the radiant warmer.

On the other hand, in the control group, the neonates were taken out of the incubator and different parts of their bodies were washed under the tap water. Then, the body was covered and the head and face were washed. Subsequently, the

baby was quickly wrapped in a towel and placed under the radiant warmer. To increase the accuracy of the study and have similar stress experience during bathing, both swaddle and conventional bathing were performed by an experienced nurse in a quiet environment. At the start of each bathing, the water temperature was measured with a thermometer and was set at 37-38°C for both methods. All the baths were performed one hour after feeding during morning shifts, when the infants were in a calm and stable condition. Although the duration of each bath was determined based on the neonate's needs and cues, all the baths took less than 5 min.

To record the behavioral responses in both groups, an experienced camera operator filmed the infants' faces from the beginning to the end of each bath with a digital camera (Canon Power Shot A470). The behaviors targeted in this study included distress behaviors and states, which could be observed from the neonates' faces. The distress behaviors entailed facial grimace, mouthing/yawing movements, and tongue extension and the behavioral states included eyes open, eyes closed, and fussing/crying.

To determine the total frequency of each behavioral response, a trained observer who was blind to the interference type and the study objectives watched the video recording and interpreted them at 10-sec intervals for each infant. Then, the occurrence rates of behavioral responses were calculated for the infants in the two groups, using the following formula: (behavioral frequency/total bath time × 100). Finally, the two groups were compared regarding the occurrence percentage of their behavioral responses.

The data collection tools included a demographic characteristics form and an event recording sheet, which records the frequency of behavioral responses. The demographic characteristics form was compiled by the researcher based on the relevant studies. This form included information such as gender, 1- and 5-min Apgar scores, birth weight, weight at bath time, gestational age, postnatal age, mother's age, and delivery type. The demographic characteristics of the subjects were collected through their medical records and questioning their parents. The validity of the event recording form was evaluated, using content validity, i.e., the form was given to five faculty members and the relevant comments were applied accordingly.

The behavioral response recording form was made by the researcher based on the similar studies. The frequency of each behavioral response during the bath (at 10-sec intervals), total occurrence of each behavior, total duration of the bath, and the occurrence rate of each behavior were recorded in the sheet for each infant. This method of assessing behavioral responses was also used by Liaw et al. (8, 12, 13), who reported the same behavioral responses as those included in the literature (2, 8, 12-15). There are several studies confirming the validity of the stress-related behavioral responses in the preterm neonates including jerk, tremor, limb extension, trunkal flaccidity, extremities flaccidity, arching, squirming, finger splays, fisting, grimacing, mouthing/yawing movements, tongue extension, eyes closed, eyes open, fussing/ crying, etc.

Given the fact that not all the aforementioned behavioral responses could be observed due to swaddling, this study examined those behaviors observable from the infants' faces including facial grimace, mouthing/yawing movements, tongue extension, eyes open, eyes closed, and fussing/crying. To examine the reliability of the behavioral response recording forms, inter-rater reliability was employed. To this aim, first, the videotapes were watched by an observer and the total occurrence of each behavior was recorded. Then, 20 video recordings were randomly selected and interpreted by an independent trained person who was also blind to the intervention type and the study hypotheses. Subsequently, the agreement between the interpretations was assessed, using Pearson's correlation coefficient (r=0.90-0.98).

The collected data were analyzed though SPSS software version 13 (SPSS Inc., Chicago, IL). The quantitative variables were reported as mean and standard deviation and the qualitative data were indicated as frequency (percentage). For the purpose of comparing the qualitative variables, the Chi-squared test was employed. Furthermore, the Kolmogorov-Smirnov test was utilized to check the quantitative variables normality of distributions.

The results of this test showed that the occurrence rate of such behavioral responses as mouthing/yawing movements, tongue extension, eyes open, eyes closed, and fussing/crying during the bath had a non-normal distribution. However, other quantitative variables were found to be normally distributed. The comparison of the mean variables between the two groups was performed, using independent t-test (for normally distributed data) and Mann-Whitney U test (for non-normally distributed data).

Results

The results of the present study revealed no significant differences between the two groups in

terms of gender, birth type, mother's age, gestational age, postnatal age, birth weight, weight at bath time, and 1- and 5-min Apgar scores (Table 1).

According to the independent t-test, the mean percentage of the facial grimace occurrence in the experimental group was significantly lower than

Table 1. Demographic characteristics of the participants in the experimental and control group

Characteristics	Experimental group (n=25)	Control group (n=25)	P-value
Gender n (%)			
Female	7(28)	13(52)	P=0.083*
Male	18(72)	12(48)	
Birth type n (%)			
Vaginal	1(4)	2(8)	P=0.552*
Cesarean section	24(96)	23(92)	
Mother's age (years) [mean (SD)]	28.52 (3.35)	28.64 (4.01)	P=0.909**
Apgar score, 1 minute [mean (SD)]	6 (0.82)	6.08 (1.04)	P=0.763**
Apgar score, 5 minutes [mean (SD)]	8.84 (0.75)	8.96 (0.93)	P=0.618**
Gestational age (weeks) [mean (SD)]	31.64 (2.02)	31.60 (1.85)	P=0.942**
Postnatal age (days) [mean (SD)]	19.32 (9)	20.12 (7.83)	P=0.739**
Birth weight (grams) [mean (SD)]	1524.20 (427.72)	1509.60 (446.23)	P=0.906**
Weight at bath time [mean (SD)]	1599 (301.44)	1608.80 (371.47)	P=0.919**

SD: Standard Deviation; *Chi-square statistics; **Independent t-test

Table 2. Comparison of the occurrence rate of behavioral responses during the bath in the experimental and control groups

Variables	Experimental groupMean (SD)	Control group Mean (SD)	P. value
Infant behaviors			
Facial grimace	12.01(16.92)	74.10(28.45)	P<0.001**
Mouthing/yawing movements	10.19(14.90)	31.33(21.31)	P<0.001***
Tongue extension	2.97(4.78)	8.98(11.55)	P=0.017***
Eyes open	18.19(27.65)	30.08(26.62)	P=0.027***
Eyes closed	81.37(28.29)	62.04(28.68)	P=0.006***
Fussing/crying	5.81(11.97)	43.41(26.54)	P<0.001***

SD: Standard Deviation; **Independent t-test; ***Mann-Whitney U test

that in the control group (P<0.001). In addition, the Mann–Whitney U test demonstrated that the mean occurrence rate of mouthing/yawing movements (P<0.001), tongue extension (P=0.017), eyes open (P=0.027), and fussing/crying (P<0.001) was significantly lower in the experimental group, compared to the control group. However, the percentage of eyes closed was significantly higher in the experimental group than the control group (P=0.006) (Table 2).

Discussion

This study was conducted with the aim of comparing the effects of swaddle and conventional bathing methods on some behavioral responses in the preterm neonates. The results of this study indicated that the occurrence of stress-related behaviors including facial grimace, mouthing/yawing movements, tongue extension, eyes open, and fussing/crying was significantly lower in the swaddle-bathed group, compared to the conventionally bathed one. Furthermore, the occurrence of eyes closed as a self-regulatory behavior was higher in the neonates given swaddle bathing than those receiving conventional bathing. Therefore, based on these findings, the swaddle bathing method provokes significantly lower stress in the neonates, compared to the conventional method. Fern et al. have stated some of the advantages of swaddle bathing method including decreased physiological and motor stress, increased self-regulatory behaviors, calm and quiet-alert state, and improved behavioral state control (e.g., decreased crying and agitation) (10). The number of studies investigating the effect of swaddle bathing on the behavioral responses of premature neonates is handful. Nevertheless, our findings are consistent with those of Liaw et al., which examined the effect of nurse's care-giving behaviors on preterm infant behavioral responses during bathing. They reported that the infants who

were provided with more supportive behaviors by their nurses (especially such behaviors as containment and positional support) showed less stress and more self-regulatory behaviors (13). In another study, Liaw et al. examined the effect of a developmental care training program on preterm neonates during bathing in NICU. They reported a significant decrease in the occurrence of some infant behaviors categorized as startle / jerk / tremor, finger splay / grasping / fisting, extension / arching / squirming, and eyes open after the developmental care training. Whereas, the self-regulatory behaviors such as sucking and eyes closed significantly increased, the occurrence of

grimace and fussing/crying decreased in the intervention group (however, not significantly) (12). The findings of the mentioned study are in line with those of the current study. Therefore, swaddle bathing, which is a recommended developmental care approach, seems to be capable of reducing infant stress during bathing as a caregiving practice.

In tub bathing, being immersed in water can give the infant a greater sense of comfort and satisfaction (16). In addition, several studies have shown that swaddling can help decrease pain in the neonates (17-19) and is effective in reducing their behavioral stress (20, 21). Providing a contained position during bathing can decrease stress in the infants (9). In swaddle bathing, swaddling the neonates and immersing them in water simulates the secure and contained uterine environment, which provides greater comfort and satisfaction and reduces stress (5).

One of the limitations of the current study is its small sample size. Due to the numerous inclusion criteria and time limitations, access to more subjects was not feasible. Therefore, it is suggested to carry out a similar study with a larger sample size. In addition, the results of this study can be affected by the fact that the behavioral responses varied from infant to infant. Despite the fact that the neonates' faces were only filmed in close-up and the observers were kept uninformed about the research hypotheses and intervention type, it was difficult to fully blind the observers to the bathing method due to the nature of this study.

A final limitation of this study was the unwanted environmental stimuli existing in the NICU environment. Since infant's behavior can be affected by environmental stimuli, an attempt was made to perform the baths in a calm and stimulus-free setting. However, not all the environmental stimuli in the NICU could be fully controlled.

Conclusion

To minimize the destructive effects of environmental stress-inducing factors and the short- and long-term clinical outcomes caused by caregiving and medical practices during the hospitalization of preterm neonates in NICU, one of the major responsibilities of NICU nurses is to employ safe and non-invasive methods in the treatment and care of these infants. Based on the results of the present study, swaddle bathing method offers a safe, low-stress, and pleasant bathing experience for the preterm neonates in NICUs.

Further studies are recommended to compare the effect of swaddle bathing vs. other bathing methods on the neonatal behavioral responses, as well as examining the effect of this bathing method on the quality of infant sleep, mother-infant attachment, and parental stress. Similar studies are also suggested to determine the effect of other caregiving practices on neonatal behavioral responses.

Acknowledgments

This study was derived from a research project (No. 92-6606) by Maryam Paran, which was financially supported by Shiraz University of Medical Sciences and registered in the Iranian Registry of Clinical Trials (code: IRCT2013090814594N1). The authors would like to show their appreciation to the Clinical Research Development Center of Namazi Hospital and all the NICU staff of Hafez Hospital, as well as the parents who kindly participated in this study. The authors would also like to thank the Research Consultation Center at Shiraz University of Medical Sciences for their invaluable assistance in editing this article.

Conflicts of interests

The authors of the present study declare no conflicts of interest.

Funding support

This study was funded by Shiraz University of Medical Sciences, Shiraz, Iran.

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