Nursing Practice Today

Nurs Pract Today. 2014; 1(3): 140-146.

Original Article

The effect of in-arms-holding by mothers on sleep-wake states disorders of pre-term neonates in neonatal intensive care unit: A pilot study

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ARTICLE INFO

Received 16 July 2013
Revised 31 August 2013
Accepted 26 October 2013
Published 6 July 2014

Available online at:
http://npt.tums.ac.ir

Key words:
pre-term neonate,
sleep-wake states,
in-arms-holding

ABSTRACT

Background & Aim: Mother-infant separation is one of the main causes of sleep-wake states disorders in neonatal intensive care unit (NICU). The current study was conducted to investigate the effect of in-arms-holding by mothers on sleep-wake states disorders of preterm neonates.

Methods & Materials: In a pilot study, through a semi-experimental pretest-posttest method, 35 preterm neonates with gestational age between 32 and 37 weeks and their mothers were selected from NICU of Valiasr Hospital, Tehran, Iran. Data collection process was carried out using the behavioral states scale of Newborn Individualized Developmental Care and Assessment Program. Sleep-wake states data were collected in three phases: 20 min before intervention, 70 min of intervention (mother holding), and 20 min after intervention. The collected data were analyzed using repeated measures analysis of variance (RM ANOVA) and Bonferroni test in the SPSS for Windows 17.0.

Results: About 57% of neonates were male. The results of RM ANOVA showed that there were significant differences between three phases of study in terms of deep sleep ($P < 0.001$, $F = 20.400$), light sleep ($P < 0.001$, $F = 167.230$), drowsiness ($P < 0.001$, $F = 26.770$), quietly awake ($P < 0.001$, $F = 27.380$) and crying ($P = 0.001$, $F = 4.370$), but there was no significant difference for actively awake.

Conclusion: Holding the preterm neonates by their mothers seems to improve their sleep-wake states. Medical and nursing staff in NICUs and nurseries may be recommended to use this kind of care to prevent sleep and wake disorders of neonates.

Introduction

It is documented that preterm neonates are fetuses living out of their mothers' uterus. These neonates, for their survival, need specific care services through advanced technologies of neonatal intensive care units (NICUs) (1). Although in the NICUs the neonates' chance of survival increases, but the environmental and medical conditions, ever much essential (2) have short-term and long-term complications on neonate's growth and development (3).

One of the main complications of this environmental care is sleep-wake states disorder. Indeed, sleep-wake states of the fetus are developed in the third trimester of pregnancy but in preterm neonates, these states are also premature, and its development occurs with delay, in an unconventional environment (4). In general, there are limited data about sleep-wake states of preterm neonates hospitalized in NICUs (5). However, many studies have shown that these

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Please cite this article in press as: Amini E, Bastani F, Rajai N, et al. The effect of in-arms-holding by mothers on sleep-wake states disorders of preterm neonates in neonatal intensive care unit: A pilot study. *Nurs Pract Today. 2014; 1(3): 140-146*

neonates are usually agitated, actively awake, frequent crying, sleep deprivation, frequent arousal, sleep disruption and highly drowsiness and do not have an organized sleep and wake pattern (6, 7). It is worth to mention that deep sleep and quietly awake are the main states for preterm neonates, but they rarely experience these two states in the NICU (8).

Sleep-wake states disorders of preterm neonates lead to several consequents such as: decrease brain development (9), learning disorders, long-term negative behavioral effects, disorders of vision maturation (10), reduction in pain threshold (11), increase of sensitivity to illnesses (12), disorder in the initial development of senses, alertness disorders, cognitive deficiencies, physiological disorders (13), etc.

Many studies have shown that early infant-mother separation is one of the factors that lead to sleep and wake disorders (14). For instance, Barrett et al. found that when Rhesus monkeys were separated from their mothers for 48 h, they had shorter night sleep and earlier waking in the morning (15). Also, in the study of Hofer, 2-week old rat Pups, which were separated from their mothers for 24 h had an increase in time of awaking, state transitions, body movements, and decrease in paradoxical sleep time (16). In another study, Reite et al. showed that when monkey neonates were separated from their mothers for 4 days, their behavioral and physiological criteria changed to agitation responses, and when they were put beside a mature female monkey as its child, they slept near her (17). Likewise, several human studies showed this effect. For example, in the study of Morgan et al., when term infants were separated from their mothers for one hour, 86 % decrease in their quiet sleep was reported (14). Cong et al. in a study concluded that, during heal stick (for blood sampling), when the preterm neonates received kangaroo care with their mothers, 50-83% of their time was spend in quiet awake state but when they received incubator care, 50-87% of the time was spend in crying state (18). Moreover, Messmer et al. in their study found that extremely low birth weight neonates during kangaroo care with their parent had more time sleep ($P < 0.05$) than when they were in incubator (19).

Despite negative effects of mother-neonates separation in studies, in many NICUs, mothers are separated from their preterm neonates and only in certain times can visit them. So that, this study was conducted to investigate the effect of in-arms-holding by mothers on sleep-wake states disorders in preterm neonates hospitalized in NICU.

Methods

This is a pilot study of a semi-experimental pretest-posttest method. The subjects of this study included 35 preterm neonates and their mothers who were sampled from October to November 2011 from NICU of Valiasr Hospital in Tehran, Iran. The inclusion criteria regarding the neonates were: gestational age of 32-37 weeks; body weight more than 1500 g; not taking theophylline, phenobarbital, midazolam, phentalin; feeding every 2 h; having no disease for example, congenital brain malformations, meningitis, seizures, encephalopathy, congenital abnormalities, intraventricular hemorrhage grade III and IV, herpes, sepsis, heart and metabolic diseases; Apgar score in the 5^{th} min ≥ 6. Furthermore, the inclusion criteria to study for the mothers were: no history of prenatal substance abuse; accessibility to the mother; having no problem that prevent to perform the program, for example, having pain. Exclusion criteria of study for neonates include: heart rate more than 180 beat/min or less than 100 beat/min; breath rate more than 60 or less than 30 breath/min; arterial O_2 saturation less than 88%; decrease in temperature less than 1°C from the baseline temperature; having chest tube; breathing support devices; peripheral arterial line; central catheter. Exclusion criteria for mothers include: mother refusing to participate in the study; any factor that result in disruption of study for example backache.

In this study, sleep-wake states of preterm neonates were assessed by using the behavioral state scale of Newborn Individualized Developmental Care and Assessment Program (NIDCAP). In this scale, six overall states of sleep and wake were defined for preterm neonates as: deep sleep, light sleep, drowsiness, quietly awake, active awake, and crying. Each of these states is defined based on their particu-

lar behavioral and physiological cues such as regular respiration pattern, having or lack of rapid eyes movement, openness or closeness of eyes, facial expressions, gross body movements, skin color, mouth movements, etc. The state scale of NIDCAP sheet is divided into 2-min time epochs (Figure 1). Every 2 min, the observer should observe the behaviors of the neonate for 30 s and mark the predominant states. Typically a state of sleep or wake must last 2-3 s to be recognized as a predominant state. However, if states of quietly awake and crying occurred for less than 2 s, were marked, because these states are rare in neonates (20). To determine the reliability of the scale, first the researcher was trained by the designer of the scale through the internet. Then, the researcher and another study member, who has delivered needed instructions from the first researcher, simultaneously and independently start to observe sleep and wake behaviors of 10 non-study infants using this scale. The results of Pearson statistical test revealed that inter-rater reliability between two observers was maintained at 78% (P = 0.008). The validity of this scale was evaluated previously (21). The required demographic information was collected by a demographic form.

This study was approved by Ethics Committee of Tehran University of Medical Science. The samples were selected based on the inclusion criteria, using the information in their medical chart and asking from their physician. Then, the researcher gave the needed information about the study to the mothers and in the cases they were willing to participate in the study, asked them to sign an informed consent sheet. Overall 37 neonates were eligible for this study, but two mothers refused to participate in the study because of the cesarean section pain. Finally, 35 neonates were enrolled in the study. The study was performed after the first infant feeding in the afternoon; at this time the unit was less crowded. Before starting the study, in addition to neonates' feeding, any needed care service for the neonates was performed by the nurses, except painful invasive procedures. To monitor the neonates during the study, the thermal prop and monitor leads were attached to the neonates for stopping the study in the event of any disorder in physiological criteria.

In the pre-intervention phase of the study, the neonates, clad only in a diaper, were placed for 20 min in an incubator, in the supine position, and every 2 min, the researcher directly observed the behaviors of the neonates and recognized and recorded sleep-wake states of the them (an electronic timer every 2 min was ringing which was heard by the researcher through earphones). After 20 min, if the neonates needed any care service (except painful invasive procedures), was performed. Then, the researcher asked the mothers to sit on a comfortable chair with a backrest 45° and hold their neonates. To the prevention of cold, a blanket was wrapped around the neonates. Throughout the study, intravenous drug infusions were continued. In this phase of study as above, the sleep-wake states of neonates were recorded. After finishing the 70 min intervention, the neonates were returned to their incubators and if again they needed any care services such as changing diaper, were performed. After that, the neonates were placed in the supine position, and the researcher same as the previous phases, recorded the states of them for 20 min. During all three phases of the study, no care intervention was performed for neonates. Finally, the frequency of occurrence of each sleep-wake states, in each phase of the study were calculated and compared.

In this study, for data analysis SPSS for Windows (version 17.0, SPSS Inc., Chicago, IL, USA) was used. Through descriptive statistics the samples' characteristics were described. Also, to determine whether there were differences in three phases of study, in term of each state of sleep and wake, repeated measures analysis of variance (RM ANOVA) was used. In cases where the result of this test was the significance, the Bonferroni test was performed for pairwise comparison of phases of study about each sleep and wake states. P-value <0.05 was considered as significance criterion of the differences. Data are expressed as mean ± standard deviation (SD).

	Time/minute	crying	quietly awake	active awake	drowsiness	Light sleep	Deep sleep
Pre intervention stage	0-2						
	2-4						
	4-6						
	6-8						
	8-10						
	10-12						
	12-14						
	14-16						
	16-18						
	18-20						
During intervention stage	0-2						
	2-4						
	4-6						
	6-8						
	8-10						
	10-12						
	12-14						
	14-16						
	16-18						
	18-20						
	20-22						
	22-24						
	24-26						
	26-28						
	28-30						
	30-32						
	32-34						
	34-36						
	36-38						
	38-40						
	40-42						
	42-44						
	44-46						
	46-48						
	48-50						
	50-52						
	52-54						
	54-56						
	56-58						
	58-60						
	60-62						
	62-64						
	64-66						
	66-68						
	68-70						
Post intervention stage	0-2						
	2-4						
	4-6						
	6-8						
	8-10						
	10-12						
	12-14						
	14-16						
	16-18						
	18-20						

Figure 1. Behavioral state scale of Newborn Individualized Developmental Care and Assessment Program

Results

Of 35 preterm neonates of this study 57.1% were male with mean gestational age (SD) 34.3 ± 1.7 weeks. The other parameters were as follows: mean weight: 2219.0 ± 583.9 g, mean hospitalization period: 10.5 ± 9.6 days, mean Apgar score in the 5th min: 8.4 ± 1.0, mean mothers' age: 30.4 ± 3.0 years, and delivery type: 74.3% cesarean and 25.7% vaginal.

The mean and SD of six states of sleep and wake in three phases of study are shown in table 1. The results of RM ANOVA showed that there were significant differences between three stages of study in regard of deep sleep ($P < 0.001$, $F = 20.400$), light sleep ($P < 0.001$, $F = 167.230$), drowsiness ($P < 0.001$, $F = 26.770$), quietly awake ($P < 0.001$, $F = 27.380$), and crying ($P = 0.001$, $F = 4.370$), but there were no significant differences between three stages of study for actively awake ($P = 0.054$, $F = 3.050$). Pairwise comparisons of phases of study in relation to sleep and wake states are shown in table 2.

Discussion

In this investigation, the sleep-wake states of preterm neonates hospitalized in NICU in the situation of in-arms-holding by mother and separate from mother were compared through behavioral criteria. The results of this study showed that the sleep states (deep sleep, light sleep, and drowsiness) in preterm neonates when were held by their mothers is more than when they were separated from them (in the incubator). In this regard, Ludington-Hoe et al. also reported that the sleep hours in infants which were in skin contact with their mother is more than that of those were in incubator (22). This result is highly important since sleep is a vital need for development of sensory systems, creation of long-term and short-term memory and maintenance of brain plasticity (13). When the sleep hour is increased, the amount of purposeless activities is reduced and infant's energy stored (23). However, there is a need for further studies to investigate the long-term effect of this intervention on infants' weight gaining, growth, and development.

The results of this study about deep sleep is in keeping with other studies that showed the preterm neonates in direct skin contact with their mothers had higher amount of deep sleep hours compared with those were separated from their mothers and placed in incubator (7, 24). Deep sleep is a developmentally appropriate state for preterm neonates hospitalized in NICU; because in this state they can shout out the harmful stimuli (25). Deep sleep is also very important for weight gaining due to secretion of growth hormone and increase of protein synthesis (26). Anders et al. concluded that the infants with longer hours of sleep (without any disruption) or those with deep sleep during the night had higher IQ score when they were 6 months or 1 year old (27).

Table 1. Sleep and wake states of neonates in three phases of study

States/phases of study	Pre-intervention (mean ± SD)	During intervention (mean ± SD)	Post-intervention (mean ± SD)
Deep sleep	0.24 ± 1.22	5.42 ± 6.14	0.51 ± 1.46
Light sleep	17.50 ± 5.28	17.5 ± 5.28	2.79 ± 2.94
Drowsiness	2.20 ± 2.71	6.94 ± 4.73	2.29 ± 2.63
Quietly awake	0.11 ± 0.40	2.23 ± 2.10	0.41 ± 0.78
Actively awake	2.23 ± 2.18	0.94 ± 2.10	1.52 ± 1.72
Crying	1.04 ± 1.95	0.64 ± 1.77	1.05 ± 1.99

SD: Standard deviation

Table 2. Pairwise comparison of phases of study in term of each state of sleep and wake

States/phases of study	Pre* × Post¥		Pre × during∞		Post × during	
	Mean difference	P-value	Mean difference	P-value	Mean difference	P-value
Deep sleep	−0.27	0.24	−5.18	0.00	−4.90	0.00
Light sleep	−0.08	1.00	−14.79	0.00	−14.70	0.00
Drowsiness	−0.08	1.00	−4.73	0.00	−4.64	0.00
Quietly awake	−0.29	0.14	−2.11	0.00	−1.82	0.00
Actively awake	0.70	0.37	1.29	0.10	0.58	0.81
Crying	−0.88	0.04	1.29	0.03	0.41	1.00

*Pre-intervention phase, ¥Post-intervention phase, ∞During intervention phase

Regarding the state of light sleep, our results are in contrast to the study of Begum et al. they showed that the percentage of neonates with light sleep when were held in the incubator was 53.8%; whiles when were held by their mother as kangaroo care, decreased to 23.1% (28). However, in the study of Begum et al., the neonates had direct skin to skin contact with their mother; also the samples size was less than the current study (16 vs. 35). Helping neonates to keep light sleep is also very important due to its essential role in brain development (13). Light sleep deprivation lead to disorders in systems of somatesthetic, proprioception, chemosensory, limbic, hippocampus, kinesthetic, auditory, vision, social learning, etc. (13).

In the current study, among awake states (quietly awake, actively awake, and crying), the neonates when were held by their mothers had less crying state than when were separated from their mothers (in the pre-intervention phase). Lai et al. also found that the preterm infants that received music during kangaroo care at compared they received routine incubator care had significantly less crying ($P < 0.05$) (29).

Crying is an important developmental process and must be happened, but its length should not be excessive. Excessive crying can lead to increase of blood pressure, intraventricular hemorrhage, infant's stress, concentration of air in the stomach, colic and even gastric rupture, compromising the closure of the foramen oval, and decrease of body immune level (25).

As the results showed, the neonates had more quietly awake state in the intervention phase than the pre- and post-intervention phases. This result is in keeping with study of Cong et al. (30), that the previously was mentioned to it. In this state, there are minimum and adjusted movement activities and the attention-interaction capacities of neonates emerges (8).

These results should be interpreted cautiously because of certain limitations of the study design. The limitations of this study are include small samples size, lack of the control group and did not control of the environment factors that may be effective on sleep-wake states as light and sound levels. So that generalization of the findings, are need to conduct the further clinical trial studies with a larger number of samples.

Conclusion

The results obtained in the current investigation showed that in-arms-holding by mother, improves sleep-wake states of preterm neonates with increase the states of deep sleep, light sleep and quietly awake, as well as decrease the state of crying. Therefore, it is suggested that care givers in the NICUs minimize the neonate-mother separation and encourage the mothers to be actively present in the unit and holding their neonates.

Acknowledgments

This study was funded and supported by Tehran University of Medical Sciences (TUMS); the investigators would like to acknowledge all mothers who participated in the study.

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