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Effect of Clustered Nursing Care on Sleep Behaviors of the Preterm Neonates Admitted to the Neonatal Intensive Care Unit

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ABSTRACT

Background: Premature neonates admitted to the neonatal intensive care unit (NICU) undergo sleep disorder due to various manipulations. The present study aimed to investigate the effect of clustered nursing care on sleep behaviors in premature neonates admitted to NICUs.

Methods: This clinical trial study was conducted on 60 neonates selected through convenience sampling method out of the infants admitted to the NICU. First, in the control group, a constant nurse took care of the neonates in a complete shift. The nurse observed the neonates sleep behaviors every two min for 45 min and recorded them in the questionnaire. The intervention group was investigated one week after the control group. The neonates 'sleep behaviors were observed and recorded every two min by Prechtl instrument. All the data were analyzed by the Mann-Whitney U test using SPSS software version 16.

Results: The mean sleep times in the control group were as follow: quiet sleep 5 min and 86 millisecond, active sleep 21 min and 50 milliseconds, quiet wake 4 min and 6 milliseconds,alertness9 min and 6 milliseconds, and cry1 min and 76 millisecond .On the other hand, in the neonates who received clustered care in the intervention group, the mean timings were as follow: quiet sleep time 19 min and 33 millisecond, active sleep 24 min and 66 millisecond, quiet wake 1 min and 76 millisecond,alertness2 min and 76 millisecond, and cry0.13 min. According to the mentioned times, it could be concluded that the neonates in the test group had a quiet and active sleep ($P < 0.05$).

Conclusion: Findings of this study demonstrate that cluster care can significantly increase the time of quiet and active sleep in the newborns. Based on the result, it is recommended that this kind of care be provided in the NICU program, as well as in the syllabus of students and nursing retraining.

Keywords: Clustered care, Neonatal intensive care unit, Neonate, Sleep

Introduction

The World Health Organization has defined preterm birth as the birth below 37 full weeks of pregnancy or less than 295 days since the first day of the last menstruation (1). Iran is one of the areas with a high prevalence of early childbirth as premature neonates make up about 10% of the births (2). Early childbirth in the developed and advanced countries is 5-12%while has the prevalence of more than 40%in the developing countries (3).

Neonates admitted to the neonatal intensive care units(NICUs)need special care to survive (4). In NICU, newborns are exposed to painful and invasive procedures and environmental stimulus, such as light and sound. In addition, they also experience noninvasive procedures, including changing diapers, nutrition, position change, weighting, and health care (5), which are stressful in many ways (3). Stress inflicted on newborns through various methods may result in neurological damage resulting in abnormal development (6). One of these stresses is a

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disturbance in the natural sleep cycle of the neonates (7).

Studies have shown that infants are exposed to at least 16 invasive and non-invasive procedures during the first 14 days of admission to NICU (8), which lead to behavioral and physiological changes in neonates (9). On the other hand, repeated stress, especially in the early stages of neonatal development, has long-term and profound impacts on various systems, including the central nervous system (10). One of the problems that is probable to occur is sleep disorder (4). Sleep is one of the essential needs of neonates (8) and those admitted to the NICU are in the phase of fast brain development. Research has demonstrated that sleep plays a critical role in brain development (10).

The NICU is full of optical and acoustic stimuli. Moreover, nursing care and medical treatments cause much stress in the neonate. Consequently, premature newborn is more susceptible to severe stress than adults who are admitted to the intensive units (11) and newborns sleep is more likely to be disturbed. Therefore, it is very important to take measures to support the neonate sleep in these units (11).

Sleep is important for neonatal development regarding the sensory system, brain, memory, and learning abilities. It improves physical development (10) and brain development of the neonates, which is the ability of the brain to alter its structure and function based on genetic information and environmental alterations (10). Furthermore, sleep has an impact on neonatal vision and plays an important role in memory processing (12).

During quiet sleep, the secretion of various hormones, namely melatonin and growth hormone augments. Moreover, in quietsleep, the production of proteins increases and protein degradation reduces leading to tissue regeneration and enhancement of the body function (13). Today, the role of sleep in the regulation of body temperature, energy storage, and reduction of neonatal apnea has also been proven (13)

In healthy newborns, sleep deprivation for 2-4 h results in changes in cardiac function during the next period of sleep. Subsequently, during the quiet sleep period, the base heart rate rises as a result of elevated sympathetic activity (14). Furthermore,tonicity and respiratory problems, such as apnea are increased (15) causing movements, including jumping and crying. All these complications lead to hypoxia, augmented heart rate, increased intracranial pressure, and intraventricular hemorrhage of the brain in infants (14). Consequently, sleep disturbance can lead to fatigue and irritability in newborns (16).

Sleep deprivation affects the understanding of the neonates from pain, which elevates the irritability of the neonate to pain (14). In addition, there will be irreparable problems for future neonate growth(16). Regarding the importance of sleep in newborns, several strategies have been proposed to improve the sleep of this population admitted to NICUs. The results of studies have investigated the effect of positioning (17), swaddling (18), rest periods (19), and non-nutritive sucking on the sleep of the neonates (20).

Clustered care is a method that has been introduced in some sources as a stress relief agent for the neonates (21). Clustered care means clustering or classifying several common nursing cares with each other instead of taking nursing cares apart (16). Some studies have indicated that preterm newborns can sleep better when rest periods are provided for them. The process of weight gain increasesand the incidence of apnea decreases in these neonates (14).

The goal of clustered care is to provide longer rest periods in newborns, minimize manipulations, reduce hospitalization, and minimize infections in neonates admitted to the NICU. Studies have reported that when infants sleep longer, they gain weight better and apnea is minimized, which helps to maintain energy in premature neonates. Clustered care also reduces neonates stress and improves weight gain (22).

Valizadeh et al. conducted a study in Tabriz University of Medical Sciences in 2013 to compare the behavioral responses of the premature neonates in clustered care with four on-invasive cares. In this study, 31 premature neonates were admitted to the NICU under the three procedure-clustered care, including the measurement of the armpit temperature, replacement of the prop-pulse oximetry, and position change (exceptinvasive measures, such as venipuncture and blood sampling).

In addition,the four-procedureclustered carewas executed, including the armpit temperature measurement, replacement of the prop-pulse oximetry, position change,and oral nutrition. Finally, the impactsof these practices on neonates behaviors were evaluated (21). The results of the mentioned study showed that the behavioral signs were more acceptable following the three-variable clustered care, compared to the four-variable clustered care (23).

Another study was performed by Holsti et al. (2007) on newborns of 30-32 weeks old in the NICU. They examined the influence of clustered care on pain and sleep in premature neonates during a blood test. The variables analyzed in this study entailed the newborn sleep, heart rate, and behaviors. The control neonates in this study received routine care during blood sampling, placement of lancet on the neonates' limbs, and after blood sampling.The aforementionedstudy showed that the infants who received clustered care had better sleep, lower heart rate change, as well as lower behavioral changes,in comparison with the subjects in the control group (24).

In the extensive national and international literature reviews, studies concerning clustered care were limited.Inall of these studies, the clustered care encompassed diaper change, abdominal measurement, armpit temperature measurement, and oral care (with the exception of invasive measures, such as venipuncture and blood sampling) (23). Meanwhile, studies on the response of newborns to clustered care have been emphasized (22). On the other hand, it is not clear which specific types of care and how should be combined with each other. Moreover, the neonatal tolerance threshold has not been known in clustered care (25). With this background in mind, the researcher aimed to study the impact of clustered care on the sleep behavior of premature newborns.

Methods

Study Design

This clinical trial aimed to evaluate the effect of clustered care on the sleep of the newborns admitted to the NICU. Clustered care and routine care were provided for the intervention and control groups, respectively. Due to the nature of the study and for prevention from data interference and coordination among the different care providers, sampling of the control group was completed first and sampling of the intervention group was performed one week later. The sampling procedure was conducted at one hospital in order to minimize the influence of the varieties in care caused by the different study settings.

Study Setting

Samples were selected from the newborns admitted to the NICU of Arash Hospital in Tehran. Sampling was performed during October 2017-March 2017. The inclusion criteria of the neonates entailed the gestational age of 30-37 weeks, minimum weight of 1000 g, absence of abnormalities at the time of birth, gavage order, no prohibition of position change, no treatment with sedatives in the last 24 h, no seizure and anticonvulsants usage, and lack of medication taking by the mother during pregnancy. Neonates with septicemia, intraventricular hemorrhage grades three and four, periventricular leukomalacia, and in need for more than two invasive interventions, such as vessel replacement and suction were excluded from the study.

The present study was approved by the Ethics Committee of the School of Nursing and Midwifery and the School of Rehabilitation with the ethics code of R.TUMS.FNM.REC.1396.3590. The research goals were explained to the parents of the newborns and informed written consents were taken from them.

Sample Size

Altman's nomogram was used to calculate the sample size. Considering the significance level < 0.05 (maximum type I error of 5%), power of 80% (maximum type II error of 20%), connecting the two testing power points, and discovery of the 1 unit difference, the sample size was calculated to be 30 people for each group.

Data Collection Instruments

The data collection tool was a demographic questionnaire,including the gestational age in weeks, age after birth at the time of sampling in days, 5-minApgar score, gender, weight at the study time, method and amount of nutrition,birth order, and demographic characteristics of the mother,namely maternal age and type of delivery.

The second part of the instrument was the Prechtl scale for the sleep-wake cycle. This tool identifies five sleep-wake cycles for premature neonates. Cyclesincludequiet sleep, active sleep, quiet alert state, active alert state, and cry. Each of the steps would get the scores-1, 0, and 1 according to the behavioral symptoms of the newborn. The instrument has a table whose horizontal rows represent the time and vertical columns of the instrument include the five stages of sleep (i.e., quiet sleep, active sleep, quiet alert state, alert state, and wake) and physiological symptoms (i.e., heart rate, respiration, and arterial oxygen saturation).

In the quiet sleep state, there is no rapid eye movement, no movement in the body, and the

heart rate, as well as respiration, is regular. Active sleep state is defined as closed eyes with rapid eye movement and body movement while the heart rate, in addition torespiration, are irregular, and there are short awakenings. In the quiet wake state, the eyes are open, slight movements in the body are observed, and the heart rate, as well as respiration, is regular.

In the alert state, the eyes are open, the body and eyes movements are seen, and heart rate, in addition to respiration, is irregular. In the crying state, which is the most alert state of the neonate, there is a severe turmoil with a crying face and large facial symbols. The cry is sometimes rhythmic and strong, while sometimes weak and silent. The validity and reliability of the Persian version of this instrument have been confirmed in the study by Abdeyazdan et al. in 2015(18).

In this study, the validity of the checklist was assessed using content and face validities through opinions of ten faculty members of Tehran University of Medical Sciences. After receiving comments from these individuals, the necessary corrections were made. Regarding the reliability of the checklist, the agreement of observers was reviewed using Kappa Cohen meaning the simultaneous observation of six neonates by two observers. The reliability value between the two observers was obtained as 0.96, which is acceptable.

Following collecting and encoding the data, data analysis was performed using SPSS software version16 at a significance level of 5%. The data were described by the mean and standard deviation. The Shapiro-Wilk test was used to test the normality of the data.

Data Collection

At first, the control group was selected and studied by the convenience sampling method. In the control group, the nurse routinely performed the care for the newborns and the researcher immediately examined the sleep behaviors of the neonate for 45 min after the neonate was fed. The behaviors of the subjects were observed and recorded every 2 min according to Prechtl scale.

At the next step, one week after the training of the nurses about how to implement clustered care and its objectives, the intervention group was studied. Before feeding, the participants in the test group received all nursing cares, such as replacing diapers, weighing, replacing pulse oximetry probe, and one of the invasive interventions that could be a blood vessel replacement, suctioning, or blood sampling by a trained nurse.

During the whole period of observation of the sleep behaviors in the newborns within 45 min, no intervention was performed on the infants. The neonates' sleep behaviors, similar to the control group, were observed and recorded every 2 min using the Prechtl instrument. In both groups, the behaviorswere observed and recorded by two individuals.

Data Analysis

All the data were analyzed utilizing SPSS software version 16. The data distribution was examined bytheShapiro-Wilk test. Due to the lack of normal distribution, the Mann-Whitney U test and Chi-Square test were used to compare the sleep times between the two groups. The significance level in all tests was considered as $P < 0.05$.

Results

The findings of the present study showed that 53.3% of the newborns in the control group were male and 66.7% of the newborns in the intervention group were female (P=0.118). The mean age of the neonates in the control and intervention groups was 17.20±8.25 and 15.56±5.21 days, respectively (P=0.356).

Moreover, the mean weight of the infants in the control and intervention groups was 1702.66±653.26 and 1693.33±562.25 g, respectively (P=0.423). The Apgar score of the subjects in the intervention group was 8.23±0.678 and in the control group was 8±0.830 (P=0.137). The gestational age of the participants in the intervention and control groups was 31.93±1.63 and 31.26 ± 2.76 weeks, respectively (P=0.4). It was found that 60% of the infants in the control group and 70% of the neonates in the intervention group were breastfed (P=0.417). According to the analyses, the two groups were not significantly different regarding gender, age, weight, Apgar score, gestational age, and being breastfed.

The results of our study demonstrated that the mean duration of quiet and active sleep in the participants of the intervention group, who received the clustered care, was more than the control group. There was a statistically significant difference between the two groups in terms of the duration of quiet and active sleep phases. The duration of the quiet wake, alertness, and crying the control group was longer than the test group (Table 1).

Table 1. Comparison of the mean time of the various stages of sleep and wake in the newborns of the control and intervention groups

Sleep stage	Control	Intervention	Mann-Whitney U test
Quiet sleep	5.86±3.94	19.33± 4.04	P < 0.001
Active sleep	21.5±3.67	24.66±5.65	P = 0.004
Quiet wake	4.06±4.12	1.76±3.01	P = 0.007
Active alert state	9.6±4.37	2.76±1.83	P < 0.001
Cry	1.73±2.21	0.13±0.57	P < 0.001

Discussion

The current study aimed to investigate the effect of clustered care on the sleep behaviors of premature newborns admitted to the NICU. In this clinical trial, the sleep of the neonates who received the clustered carewas compared with the sleep patterns of infants who received routine care. According to the results of this study, the neonates who were in the intervention group and received the clustered care had longer quiet and active sleep than those who were in the control group and received routine care.

Clustered care in this study could significantly increase the quiet and active sleep time of the newborns. It seems that according to the results of this study, this method can improve the sleep state of the admitted neonates. Research findings showed that the amount of rapid eye movement (REM) sleep in the neonates elevated when the stimulation of the neonate decreased. For instance, War et al. (2016) found that when the intensity of light and sound in the ICU diminishes, the REM sleep increases (1).

Augmentation in the REM sleep improves the sensory and neuronal development of newborns. Lack of sleep in the early stages of life has been known fornegative evolutionary outcomes and is probably related to the initial interaction of the neonate with the physical and caring environment. The caring setting in NICUs may cause excessive irritability in newborns, who are also medically vulnerable and experience frequent waking periods. Due to the undeveloped brain, it is not possible for the neonate to adapt to changes and stimuli leading to the disturbed physiological balance of brain (26).

In a clinical trial study conducted by Holstiet al. in 2005, 54 neonates with a birth weight of 29.3±2.2g were studied. The newborns received two types of routine and clustered cares sequentially. The study design was a crossover, meaning that the newborns were divided into two groups and first one group received clustered care followed by the routine care and the other group received the cares reversely. Their results did not show significant differences between the two groups regarding the responses of the newborns that were examined by the facial coding system of the neonates (27).

In the mentioned study, all the newborns in both control and intervention groups received both the clustered and routine cares. However, in the present study, the newborns who were in the control group received the routine care, while those who were in the test group received the clustered care. In the study performed by Holsti etal., clustered care did not affect neonatal behavioral responses .However, in the present study, clustered care had an impact on the sleep behaviors of the newborns and raised the quiet and active sleep in the participants.

In another study published in 2007 by Holsti et al., 43 preterm newborns were studied. In this study, the relationship between the clustered care and the pain of preterm neonates during blood test was studied. The results indicated that clustered care increased the tolerance of the newborns when painful procedures were practiced (24). Despite the different implementation method, the present study showed that clustered care also increased quiet and active sleep in newborns.

Valizadeh et al. conducted a study in Tabriz University of Medical Sciences in 2014 entitled as “Comparison Between the Three-procedure Clustered Care and the Four-procedure Clustered Care “on 31 neonates with a gestational age of 32 weeks. The latter authors revealed that the neonates who received the three-procedure clustered care (taking temperature, replacing pulse oximetry probe, and changing position)had lower behavioral symptoms and less stress signs, such as crying, frowning, opening the fingers, and yawning, compared to the neonates who received the four-procedure clustered care (temperature, position change, replacement of probe, and gavage) (23).

According to the results of the present study, the implementation of clustered and classified care enhances sleep time in newborns. Therefore, they have longer quiet and active sleep states during a sleep cycle. In contrast, when nursing care is executed day and night, neonates experience less sleep, which can result in the

damaged development of the brain and sensory system of the infant. This issue is especially important in premature neonates, who have been admitted to the NICU for a longer time.

In the last weeks of pregnancy, the electrical patterns of sleep show the REM. It means that when premature neonate is born, it is the beginning of brain development. To sleep with REMs, the newborn needs to go into a deep sleep and it is not consistent with the 24-hour interventions. Classifying the cares can make it more possible for the neonate.

The present study is one of the first researches in this field. Studies have also been conducted to reduce light and noise, as well as scheduled care and its effect on neonatal sleep. A combination of these cares can help many neonates to sleep better. One of the strengths of this study was that it could monitor the newborns sleep for amore extended period.

The main limitation of this study is that the current study was conducted on neonates with a minimum age of 30 weeks. Therefore, the results cannot be generalized to all premature newborns. Furthermore, the infants born with abnormalities or the ones who were not fedwere excluded from the study. Therefore, the obtained results cannot be used for such neonates.

Conclusion

According to the results of this study, the cluster classification of care improves sleep time in newborns. Regarding the sleep cycle, it was shown that newborns spend more time in quiet and active sleep patterns. In contrast, when routine nursing care is performed, the newborns sleep less regardless of their sleep time. As a result, the development of the brain and the sensory system of the infant might get damaged. Moreover, findings of the current study demonstrate that cluster nursing care can reduce stimulation leading to improved sleep in a newborn. This is especially true for preterm infants who have been admitted for longer periods in the NICU.

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Conflicts of interests

The authors declare no conflicts of interest for this study.

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