Original Article

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The Effects of Multi-sensory Stimulation on the Facial Expression of Neonates during Eye examinations for Retinopathy of Prematurity Screening

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ABSTRACT

BACKGROUND AND OBJECTIVE: Eye examination for retinopathy of prematurity (ROP) screening is a painful procedure, which may cause changes in the facial expression and behavior of premature neonates. Multi-sensory stimulation is a non-pharmacological and anti-pain formulation known to affect the behavioral norms of neonates during painful procedures. This study aimed to determine the effects of multi-sensory stimulation on the facial expression of premature neonates undergoing eye examination for ROP screening.

METHODS: This single-blinded, randomized clinical trial was conducted on 80 premature neonates randomly divided into two groups: The intervention group, who received multi-sensory stimulation including the stimulation of taste, touch, sight and smell, and the control group, who received standard care. The facial expression of each neonate was recorded based on the scoring criteria of Premature Infant Pain Profile (PIPP) before, during and after performing the eye examination (IRCT:1N2014100119359).

FINDINGS: The mean gestational age of the neonates in the intervention and control groups was 30.4±1.7 and 30.6±1.8 weeks, respectively. The mean scores of facial expression changes during the eye examinations were 2.8±2.6 and 6.4±2.5 in the intervention group and control group, respectively ($p<0.001$). Immediately after performing the eye examinations, facial expression scores of the studied neonates in the intervention group and control groups were recorded as 2.2±2.1 and 5.2±2.9, respectively.

CONCLUSION: According to the results of this study, multi-sensory stimulation was able to reduce the manifestations of facial expression in the studied neonates. Therefore, this method could be used to diminish these manifestations in neonates during painful examinations.

KEY WORDS: Multi-sensory Stimulation, Retinopathy of Prematurity, Facial Expression.

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Introduction

According to the World Health Organization (WHO), neonates who are born before the 37th week since the first day of the last menstrual period are considered as preterm (1). These neonates are normally admitted to the neonatal intensive care unit (NICU) in order to receive diagnostic and therapeutic interventions, most of which are painful procedures (2). One of the painful examinations for the preterm neonates admitted to the NICU is the eye examination for retinopathy of prematurity (ROP) screening. Although ROP in preterm infants is an important part of the screening examination, these procedures are likely to impose certain complications.

The International Evidence-based Group for Neonatal Pain classifies the eye examinations for ROP as painful procedures for preterm neonates admitted to the NICU, which could also lead to behavioral changes (3). Several studies have observed facial and cry responses as a result of the pain caused by these examinations. Facial expression changes during medical examinations are important in measuring the amount of pain, as researchers believe these changes to be the non-verbal indicators of pain. In preterm neonates, behavioral signals such as facial and cry responses are the most common indicators used to express pain (4, 5). In most cases, pharmacological agents are the method of choice to relieve pain during eye examinations (6); however, since their pharmacokinetic and pharmacodynamic effects in neonates are unknown, using these agents could be a challenging process (7).

Nowadays, there are numerous non-pharmacological techniques available to control and relieve pain. Non-pharmacological methods of pain relief are safe, non-invasive, low-cost, and they are also applicable within the context of functionally independent nursing (8). Sensory overload, or multi-sensory stimulation, is a non-pharmacological analgesic technique used to avoid pain and behavioral changes, such as neonatal facial responses, caused by pain during neonatal examinations, and it is now part of the national guideline of neonatal pain relief. Based on The Gate Control Theory of Chronic Pain, applying different types of stimulation in neonates could noticeably affect the average time of neonatal examinations (9).

With reference to multi-sensory stimulation, the International Association for the Study of Pain published a report in December 2004 stating that the combined use of various non-pharmacological techniques is likely to offer more clinical effectiveness than the independent use of each of these techniques. Furthermore, Anand et al. believed multi-sensory stimulation to be an effective non-pharmacological method during the painful examinations of preterm neonates (10).

Similarly, Bellieni et al. observed multi-sensory stimulation to be an efficient analgesic formulation, which could also affect pain-related behaviors (11). In another study, Bellieni et al. observed that during the procedure of obtaining blood from the heel in different groups of patients using a variety of pain-relieving agents, the patients receiving multi-sensory stimulation had the lowest rate of facial expression changes (12). Eye examinations could lead to behavioral changes in preterm infants, and facial expression is considered as one of the main indicators of these changes. Despite the fact that multi-sensory stimulation is believed to be a simple, effective and safe analgesic technique in behavioral measures during painful neonatal examinations, no studies have been conducted on the specific effects of this method on facial expression changes in screening for ROP in preterm infants. Therefore, the present study aimed to evaluate the effects of multi-sensory stimulation on the facial expressions of preterm neonates receiving ROP screening.

Methods

This clinical trial was approved by the Ethics Committee of Mashhad University of Medical Sciences (Research No. /1/930010/). A letter of recommendation was also obtained from the School of Nursing and Midwifery affiliated to Mashhad University of Medical Sciences, which was presented to the Specialized Eye Hospital of Khatam-ol-anbia. After clarifying the objectives and procedures of the study to the authorities, managers and the administrative staff of the hospital and obtaining the required permission, the study was conducted from June 2014 to July 2014 on preterm neonates who were admitted to Khatam-ol-anbia Hospital of Ophthalmology in Mashhad (IRCT: 2014100119359N1). Based on the medical history of the admitted neonates, the inclusion criteria of the study were as follows: 1) gestational age ≤32 weeks; 2) birth weight <1500 g; 3) neonates weighing between 1500-2000 g diagnosed with severe systemic diseases

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within 4 weeks of birth; 4) neonates receiving ROP screening for the first time; 5) neonates requiring cardiac pulmonary resuscitation or surgery; 6) neonates with intraventricular hemorrhage grade 2 and above; 7) neonates using sedatives within the last 24 hours, and 8) 5-minute Apgar score of less than 6.

In addition, neonates who needed positive pressure ventilation or connection to the endotracheal tube, or those with major congenital malformations and defects of the central nervous system were excluded from this study. The eye examinations were performed within an hour after breastfeeding by the mother while the baby was calm and sober. In case of the need for cardiopulmonary resuscitation or detection of apnea during the examinations, the neonates would be excluded from the study. In order to measure the scientific validity of data collection tool, the validity content was calculated, and Premature Infant Pain Profile (PIPP) was also used for the study of neonatal facial expressions (11).

The reliability of the collected data was calculated using the inter-rater reliability method in 10 neonates, and correlation-coefficient was estimated as 0.89. In total, 80 neonates were selected randomly by convenient sampling and were equally divided into two groups of intervention and control.

Initially, the research forms consisting of the inclusion and exclusion criteria of the study were completed by the researcher via interviews with the parents of the selected neonates. All the neonates were under similar conditions in terms of environmental factors (e.g. light, temperature and noise).

In a study by Bellieni et al. (11), after stabilizing the conditions of the neonates, the intervention was performed using a multi-sensory stimulation program (including the stimulation of sight, taste, touch and smell). Initially, the neonates were placed in the supine position with bent arms and legs so that they would be able to move freely (17).

As the facial tactile stimuli, the upper and lower limbs of the neonates were gently touched by the mother. This intervention was performed 15 minutes prior to the beginning of the examinations (11). As for the visual stimulation, the mother would look at the neonate's face trying to make close eye contact and attract the attention of the baby. This intervention was also performed 15 minutes prior to the beginning of the examinations (11).

For auditory stimulation, the mother would speak to the neonate gently and continuously for as long as 15 minutes prior to the examinations (11). As for the olfactory stimulation, we used vanilla solution and stained a piece of sterile gauze with 0.64 gr of warm diluted vanilla (99% HRCL) and 100 mL of distilled water. The gauze was held at a distance of approximately one to two millimeters from the baby's nose without any contact. Similarly, this intervention was performed 15 minutes prior to the beginning of the eye examinations (11).

For the gustatory stimulation, we used one ml of 33% glucose solution pulled by a syringe by the researcher and placed in the infant's mouth without any needles. As the infant gently sucked the syringe, the solution was injected into the mouth for 30 seconds. This intervention was performed 2 minutes prior to the eye examinations (11). Before the implementation of the multi-sensory stimulation, the mother would be trained and monitored by the researcher during the procedure. All the mothers were coordinately trained in this regard. The control group received no interventions and were provided with similar care to the intervention group. All the infants were examined by the same specialist, and the changes in the facial expressions of the neonates were evaluated prior to the eye examinations, during the first and second examinations, and immediately after the completion of the examinations in four 30-second stages.

During all the stages of examination, since the researcher was not able to detect the exact facial expression of the neonates, the changes were recorded by a camera from one minute prior to the examination to 2 minutes after it. In order for this study to be single-blinded, the evaluation and scoring of the facial changes were performed after the viewing of the recordings by another person who was blinded to the procedures and the study groups.

Data analysis was performed using SPSS V.16, and to evaluate the normal distribution of the quantitative data, Kolmogorov-Smirnov and Shapiro were used. In case they were normally distributed between the two study groups, the comparison of the quantitative variables was performed using independent t-test and otherwise, Mann-Whitney test was the method of choice.

For the comparison of dependent variables between the two groups during different stages of the examinations, repeated measures analysis of variance (rANOVA) was used, and in case of abnormal distribution, Friedman test was used with $p<0.05$ considered as significant.

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Result

In this study, the intervention group consisted of 25 female subjects (62%) and 15 male subjects (38%), and the control group included 18 female (45%) and 22 male subjects (55%). The mean gestational age in the intervention group and the control group was calculated to be 30.4±1.7 and 30.6±1.8, respectively. The two study groups were homogeneous in terms of age, gender, standardized age, birth weight and weight at the time of examination (table 1).

Table 1. Characteristics of study groups

Variable	Multi-sensory stimulation Mean±SD	Common cares Mean±SD
Fetal age	30.4±1.7	30.6±1.8
Chronological age	35.1±1.9	34.9±1.8
Birth weight	1385.8±249.4	1355.8±254.0
Weight in examination time	1995.0±205.6	1944.0±205.1

Before the eye examination, the mean scores of facial expression in the intervention and control groups were 0.3±0.6, and there were no significant differences between the two groups in this regard. During the first stage of the eye examination, the mean scores of facial expression in the neonates of the control group was higher than those of the intervention group by approximately 3.5 scores. At this stage, the mean scores of facial expression in the intervention group and the control group were 2.5±2.4 and 6.1±2.7, respectively (p<0.001) (table 2). During the second phase of the eye examination, the mean scores of facial expression changes continued to increase in both groups. At this stage, the mean scores of facial expression changes were 3.1±2.8 and 6.8±2.3 in the intervention and control groups, respectively (p<0.001). About 30 seconds after the end of the eye examination, the mean scores decreased to 2.2±2.1 and 5.2±2.9 in the intervention and control groups, respectively (p<0.001). In addition, one minute after the end of the eye examinations, the mean scores of facial expressions were observed to decline (p<0.001). About 5.1 minutes and 2 minutes after the eye examinations, the mean scores of facial expression changes in the intervention and the control groups were recorded as 0.7±1.6 and 0.4±1.3 (p<0.001), respectively. According to the obtained results, the mean scores of facial expression changes in the neonates of the intervention group significantly changed during 7 different assessment phases (p<0.001). Similarly, a significant change in the mean scores was observed in the control group (p<0.001), while the rate and degree of the facial expression changes in the two groups was also found to be significant (p<0.001). Therefore, it could be concluded that the increase in the facial expression changes during the first and second phases of eye examinations in the control group was significantly higher than the intervention group.

Table 2. Comparison of Mean Scores of Facial expressions in the two Study groups

Assessments stages	Score of face status Multi-sensory stimulation Mean±SD	Score of face status Common cares Mean±SD	P-value
Eye pre-examination	0.3±0.6	0.3±0.6	0.58
During the first eye examination	2.5±2.4	6.1±2.7	<0.001
During the second eye examination	3.1±2.8	6.8±2.3	<0.001
30 seconds after the end of examination	2.2±2.1	5.2±2.9	<0.001
1 minute after the end of examination	1.7±2.0	3.4±3.2	<0.03
1.5 minutes after the end of examination	0.7±1.6	2.3±2.7	<0.001
2 minutes after the end of examination	0.4±1.3	1.4±2.2	<0.004
The results of analysis of variance with repeated measures	Intra groups Multi-sensory stimulation	p<00.01	47.52 F
	Intra groups Common cares	p<0.001	127.56 F
	Comparing the two groups in terms of the changing in process	p<0.001	23.16 F

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Discussion

According to the results of this study, an increase in the mean scores of facial expression changes was observed during the first eye examination in both groups, which had a significant difference. The mean score of facial expressions saw a significant increase by 2.2 and 5.8 scores in the intervention and control groups, respectively, after the second phase of the eye examination. On the other hand, a significant decrease was observed in the mean scores after the completion of both eye examinations in the study groups.

The facial expression changes in the study groups were significant; therefore, it could be concluded that interventions during ROP screening could lead to the noticeable decrease of the mean facial expression scores. In a study, Modarres et al. evaluated the effects of breastfeeding on the pain caused by injection in neonates, and the mean scores of facial expression in the intervention group and the control group were 1.38±0.56 and 2.58±0.73, respectively (13). These findings confirm the increase of facial expression changes during painful procedures. On the other hand, Modarres et al. examined term neonates while in present study, the study population consisted of preterm infants. In addition, the painful interventions in these two studies were different; Modarres et al. investigated breastfeeding as a way to reduce facial expression changes during painful examinations while in the current study, multi-sensory stimulation was the method of choice.

In another study, Saki et al. evaluated the effects of different sleep positions (e.g. prone and supine), as well as sleeping in the bosom of the mother (i.e. skin-to-skin contact) on neonatal pain during venous sampling. The obtained results indicated that in the embrace position, neonatal facial changes were at the lowest rate (14), which is similar to the findings of the current study. Moreover, a statistically significant difference was observed between the two study groups in this regard. In preterm infants, facial movements occur more often than body movements in response to painful stimuli; for instance, in a study by Williams et al., crying and facial responses significantly increased during the process of sampling (15). In a study by Johnston et al., facial expression changes were significantly higher in the control group compared to the embrace-care group during the process of sampling (16). In another study, Ludington-hoe et al. evaluated the effects of skin-to-skin contact during sampling from the neonates' heel, and a significant difference was observed between the two study groups in terms of behavioral changes and facial manifestations during and after the procedure. Moreover, most of the neonates in the intervention group were calm (17). In all the aforementioned studies, facial changes significantly increased during painful interventions in the control group compared to the intervention group, which are compatible the results of the present study.

In another study by Khodam et al., neonates in both groups had facial expression changes following the intramuscular vaccine injection, which is indicative of no significant differences between them. The study of Khodam et al. is different from the current study in terms of the method of pain control and the type of painful intervention; Khodam et al. reports the use of insulin syringe for injections, and the physical and psychological conditions prevailing in the research environment to be the main causes of the insignificant difference in facial expression changes between the study groups (18). In another study by Gibbons et al., no significant differences were observed in terms of facial changes in the studied neonates. According to their findings, factors such as the severity of the disease, mechanical ventilation, gestational age, and previous painful procedures could affect neonatal behavioral responses to pain (19). Considering the fact that preterm neonates require painful examinations in certain cases, multi-sensory stimulation could be an effective non-pharmacological measure as to reduce behavioral indicators during painful procedures. Furthermore, the results of the present study indicated that multi-sensory stimulation was able to lower the rate of facial expression changes in the intervention group. Therefore, this method is recommended as a standard care procedure to reduce stress and improve behavioral indicators in preterm infants. In conclusion, it is necessary that further studies be conducted on the effects of multi-sensory stimulation on behavioral indicators during eye examinations in preterm infants, and these effects be compared to the those of non-drug pain management methods on the facial expression of neonates during eye examinations for ROP screening.

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