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Original Article

Non-nutritive Sucking and Nesting Greatly Reduces Pain During Retinopathy Screening in Premature Infants

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Abstract ***Purpose:*** To evaluate the efficacy of non-nutritive sucking combined with nesting in the reduction of pain associated with fundus oculi screening in premature infants. ***Methods:*** A randomised clinical trial involving fundus oculi screening was carried out in 120 healthy premature infants. Infants assigned to the intervention group received non-nutritive sucking and nesting, while the control group simply received routine nursing. Pain was assessed using the Premature Infant Pain Profile before and during the eye examination. Simultaneously, we evaluated a range of physiological parameters and crying time. ***Results:*** There were no significance differences between the control group and the intervention group in terms of gestational age, corrected gestational age or mean birth weight at retinopathy of prematurity screening. However, the intervention group showed a significantly lower mean Premature Infant Pain Profile score after fundus oculi screening compared to the control group (P<0.05). Significant differences between the two groups were also identified in crying time, heart rate, breathing rate, oxygen saturation, blood pressure and facial expression. ***Conclusion:*** Non-nutritive sucking, combined with nesting, alleviated pain in premature infants during retinopathy of prematurity screening, and appeared to provide infants with a feeling of warmth and safety. This technique is worth promoting for use during retinopathy of prematurity screening.

Key words Non-nutritive sucking; Nursing; Premature Infant Pain Profile; Retinopathy screening

Introduction

Retinopathy of prematurity (ROP) is a developmental vascular proliferative disease of the retina, which often affects premature infants with low-birth-weight and can lead to childhood blindness.[1] In China, the incidence of ROP is reported to be 17.8% for premature newborns with a birth weight (BW) of 2,000 g or less and/or a gestational age (GA) of 34 weeks or less.[2] ROP can be prevented with timely treatment by the use of appropriate screening programs; as such, early eye examinations for ROP are extremely important for premature infants.[3] However, the routine procedure used for ROP screening may be painful for preterm infants and has been linked to transient changes in heart rate, respiratory rate, blood pressure and oxygen saturation.[4,5] Pain evaluations, using the Premature Infant Pain Profile (PIPP), have also shown that most infants suffer pain during ROP screening.[4,5] Therefore, it is critical for physicians to develop new methods to assess pain and provide safe and effective pain-relief interventions during ROP screening. In China, it is not routine practice to use nursing methods to provide comfort to premature infants when they undergo ROP screening protocols that involve mild to moderate pain.

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Previous studies have reported that the use of non-nutritive sucking (NNS) and nesting can reduce pain in neonates and premature infants during painful procedures.[6-8] However, the effect of NNS, either alone or in combination with nesting, as a procedural pain-relief intervention for ROP screening remains undefined. In the present study, we investigated the efficacy of NNS, combined with nesting, for the alleviation of pain associated with ROP screening in premature infants.

Methods

Study Design

This is a methodological research study aimed at developing a technique involving NNS, combined with nesting, to alleviate pain in premature infants during painful procedures.[9]

Setting and Sample

We performed a randomised controlled trial, involving premature infants, between January 2015 and May 2016 in Nanfang Hospital. We recruited 120 premature infants, with a GA of ≤32 weeks and divided randomly these cases into two groups with a computer based randomisation process according to their ROP screening sequence and by sealed opaque envelopes: an interventional group (n=60) and a control group (n=60). The interventional group received NNS and nesting care, while the control group simply received routine nursing. Nests were made with a cotton bedsheet in a manner suitable for babies.[10]

Ethical Consideration

All protocols were reviewed and approved by the Ethics Committee of Nanfang Hospital, an affiliate of Southern Medical University, China. Detailed written informed consent was obtained from the parents of all eligible infants.

Intervention and Eye Examination

All infants were fed 1 hour prior to eye examination. A topical anaesthetic (Minims® Tetracaine Hydrochloride, 0.5% w/v) was applied 30 second before the eye examination in all infants. For each infant, the study protocol was applied only on the first screening examination and all infants were examined by the same ophthalmologist. All infants underwent ROP screening using RetCam3 retino-digital photography (Clarity Medical System Inc., Mohali, Punjab, India).

Procedure

Two experienced nurses, who had undergone web-based training using the PIPP, were tasked to evaluate the PIPP score.[11] Only examinations of the first eye were used to record the PIPP. The final outcome measurement for the PIPP score was a mean value derived from the two investigators. PIPP scores were recorded 5 minutes and 1 minute before and after the eye examination. PIPP scores <7 were considered to be indicative of no pain, while PIPP scores of 7 to 12 were classified as intermediate and those >12 were considered to be indicative of significant pain. Data regarding oxygen saturation, heart rate, blood pressure, crying time and facial expression were collected immediately after the eye examination. Secondary outcome measurements including tachycardia (>180 bpm), bradycardia (<100 bpm), desaturation (<85% for >10 s), and crying time. All of the babies were video-recorded during the eye examination. Demographics and outcome measurements were recorded on previously-prepared forms for each infant.

Data Analysis

Data are expressed as the arithmetic mean ± standard deviation (SD). The significance of differences between groups was calculated using Student's t test and $P<0.05$ was considered to be statistically significant.

Results

Baseline Characteristics

The baseline characteristics of the premature infants enrolled in this study are presented in Table 1. A total of 120 infants were enrolled. Of these, 48.3% were male and 51.7% were female; 30.8% were born by normal spontaneous delivery and 69.2% by Caesarean delivery. Mean GA was 31.52±1.8 weeks, corrected GA at examination was 35.54±1.6 weeks, and mean body weight was 2,003±178 g. There were 60 infants in the intervention group and an equal number in the control group. The background variables related to GA, corrected GA and mean BW were not significantly different when compared between the two groups.

PIPP Scores

PIPP outcome measurements are summarised in Table 2. There were no significant differences in baseline PIPP scores when compared between the two groups before eye

examination (2.1±0.6 *versus* 2.2±0.5, $P>0.05$). However, infants receiving NNS and nesting had significantly lower mean pain scores during examination of the first eye (12.9±2.0 versus 16.5±2.0, $P<0.001$) (Figure 1). In addition, 86.7% of infants in the control group presented with significant pain compared to only 43.3% of infants in the intervention group. Furthermore, only 53.3% of the intervention group experienced intermediate pain.

Table 1 Baseline characteristics of the premature infants included in this study

Variables	Intervention group (NNS + nesting) (n = 60)	Control group (n=3)	*P* value
Sex (male, %)	29 (48.33%)	29 (48.33%)	–
Method of delivery			
Normal birth	28	29	–
Caesarean	32	31	–
Gestational age (weeks), (mean ± SD)	31.3±1.9	31.7±1.6	>0.05
Birth weight (g), (mean ± SD)	2026±174	1980±181	>0.05
Corrected age at examination (weeks), (mean ± SD)	35.2±1.7	35.7±1.5	>0.05

Table 2 Premature Infant Pain Scale (PIPP) parameters each group

Variables	Relief measures		*P* value
	Intervention group (NNS + nesting)	Control group	
Crying intensity			
No crying	3	0	<0.001
Whimper	28	12	<0.001
Vigorous crying	27	48	<0.001
Facial expression			
Relaxed muscles	20	2	<0.001
Grimace	40	58	<0.001
Breathing patterns			
Relaxed muscles	32	6	<0.001
Alteration in breathing	28	54	<0.001
Pain degree			
No pain (PIPP <7)	2	0	<0.001
Intermediate (7 <PIPP <12)	32	8	<0.001
Significant pain (PIPP >12)	26	52	<0.001

Physiological Parameters

Physiological parameters, including heart rate, breathing rate, oxygen saturation, blood pressure, and crying time are shown in Table 3. There were no episodes of vomiting or choking observed in any of the study infants. Overall, premature infants who received non-nutritive sucking and nesting showed better outcomes than those receiving routine nursing. The effects upon increased heart rate and blood pressure after the eye examination were more remarkable in the control group than in the NNS + nesting group ($P<0.01$). Sustained crying was observed in only 45% of the NNS group, but in 80% of the control group. Furthermore, 33% of infants in the NNS + nesting group exhibited relaxed facial muscles, compared to only 3% of those from the control group. In addition, there was a significant difference in the breathing rate when comparing between the NNS + nesting group and the control group ($P<0.01$).

Discussion

ROP screening procedure can be painful to preterm infants. Furthermore, repeated pain may lead to serious side-effects in the development of neurological and behavioural mechanisms in infants.[12] Consequently, there is a need to

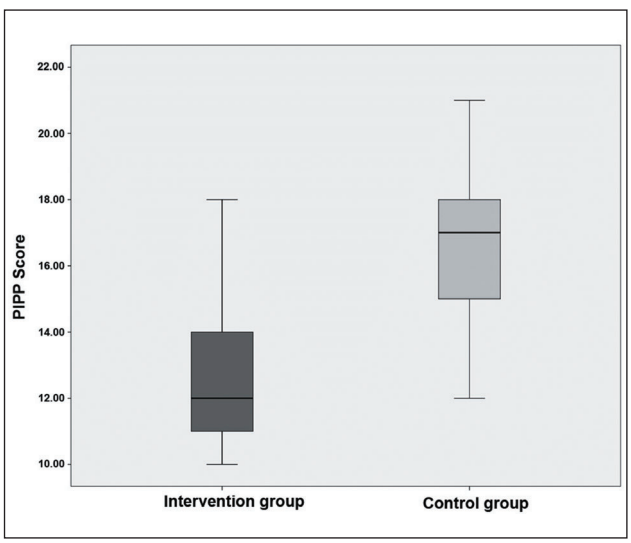

Figure 1 Box-plot graph showing Premature Infant Pain Scale (PIPP) scores of the intervention and control groups.

develop effective and safe measures to reduce procedural pain during eye examinations for ROP in premature infants. At present, non-pharmacological interventions to alleviate pain in preterm infants include oral sucrose or glucose, breast feeding, NNS, music therapy, and also techniques involving the mother such as 'wrapping' or 'kangaroo-mother' care. These measures can alleviate pain in premature infants to differing extents. For example, Dilli et al reported that oral sucrose and NNS went some way to reduce pain during eye examinations for retinopathy in premature infants.[4] Liaw et al also reported that infants receiving NNS, and facilitated sucking, had significantly lower mean pain scores during heel-stick procedures.[7] However, O'Sullivan et al showed that although sucrose, combined with NNS and swaddling, reduced the level of pain, pain scores remained consistently high.[13] On the other hand, pharmacological interventions have also been reported to alleviate pain in infants.[14] However, the side effects of medication upon infants should be considered carefully. In addition, Kabataş et al showed that oral paracetamol only reduced pain scores by a modest amount during eye examinations; moreover, there were no significant differences regarding crying time or the number of infants experiencing tachycardia/bradycardia and desaturation following the use of oral paracetamol during ROP screening.[14]

Table 3 Outcome measurements for the study infants

Variables	Relief measures, mean (SD)		*P* value
	Intervention group (NNS + nesting)	Control Group	
PIPP score before examination, (mean ± SD)	2.1±0.6	2.2±0.5	>0.05
Heart rate			
Before examination	142.5±12	140.8±13	>0.05
After examination	160.8±14	165.2±15	>0.05
Breathing rate			
Before examination	44.6±2.5	44.8±2.6	>0.05
After examination	52.2± 3.6	58.6±2.8	<0.001
Oxygen saturation			
Before examination	97.1±2.2	95.1±2.6	<0.001
After examination	93.5±2.8	89.2±2.5	<0.001
Blood pressure (mmHg)			
Before examination	64.9±6.1/ 41.9±5.8	65.4±6.3/ 42.1±5.7	<0.001/ >0.05
After examination	73.6±4.4/ 45.89±6.0	78.6±5.2/ 47.4±6.6	<0.001/ >0.05
Crying time during examination (sec), (mean ± SD)	48.6±16.6	81.2±25.8	<0.001
Duration of pain during examination (sec), (mean ± SD)	32.5±3.1	54.3±2.8	<0.001
PIPP score after examination, (mean ± SD)	12.9±2.0	16.5±2.0	<0.001

PIPP = Premature Infant Pain Profile.

In our study, for the first time, we applied NNS, combined with nesting, to relieve pain during ROP screening in premature infants. Our results showed that this procedure was effective in reducing pain during eye examinations. Crying time was shorter in infants receiving NNS combined with nesting. Lower PIPP scores were also observed in the intervention group. Nesting is based upon creating a warm box and making a natural environment similar to a nest for newborns. This natural environment is similar to an artificial uterus, and provides the infant with an environment that is physiologically similar to the uterus in terms of head flexion, proximity of the jaw to the chest wall, proximity of the upper arms to the chest, elbow flexion and positioning of the forearm towards or parallel to the chest, extreme hip and knee joint flexion, proximity of the thigh to the abdominal wall, and the positioning of the legs. Nesting care for newborns can exert a significant clinical effect, and can effectively maintain a stable environment for premature infants. The adaptation of premature infants to such environments creates a useful technique for alleviating pain and should be introduced into routine clinical practice. NNS and nesting are not pharmacological interventions, and are therefore simple to use and are not associated with any adverse effects.

There are some limitations associated with our study that should be considered when interpreting our results. For example, our sample size was relatively small. This prevented us from creating independent groups for NNS and nesting and thus prevented us from comparing the relative effects of these two techniques when used alone rather than in combination.

Conclusion

On the basis of the results above, NNS combined with nesting was shown to reduce PIPP pain scores during eye examinations for ROP, and appeared to provide premature

infants with a feeling of warmth and safety. This combined method is simple, safe, and is worth promoting for routine use during ROP screening in premature infants.

Declaration of Interest

The authors declared no potential conflicts of interest.

Acknowledgments

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