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'Facilitated tucking by parents' in pain management of preterm infants—a randomized crossover trial

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Abstract

Background: There is a need for a safe and effective non-pharmacological pain management method for preterm infants. The parents could be given an active role in the pain management which may help the parents to cope with the stress related to painful situations of the infant.
Aims: To examine the effectiveness of a method called 'facilitated tucking by parents' (a parent holds the infant in a flexed position) in pain management during endotracheal/pharyngeal suctioning of preterm infants. In addition, the parental perception of the method was studied.
Study design: A randomized crossover trial.
Subjects: Twenty preterm infants with one of their parents participated in the study. Infants' gestational age ranged from 24 to 33 (median 28) weeks and postnatal age from 6 to 37 days (median 15 days).
Outcome measures: The primary outcome was the Neonatal Infant Pain Scale (NIPS) score. Heart rate and oxygen saturation were recorded. Parents completed a questionnaire about their perception of the procedure.
Results: The highest NIPS score was median 3 (range from 2 to 6) using 'facilitated tucking by parents' and median 5 (range from 2 to 7) without tucking during suctioning ($p<0.001$). The infants calmed down more quickly after 'facilitated tucking by parents' (5 s vs. 17 s, $p=0.024$). Nineteen out of twenty parents preferred facilitated tucking during suctioning compared to control care.
Conclusions: Facilitated tucking by parents is an effective and safe pain management method during suctioning of preterm infants. This study shows that parents can be given an active role in the pain care of their preterm infants.

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1. Introduction

Pain management in the NICU is currently a controversial topic. According to Simons et al. [1], each preterm infant is subject to a mean of 14 painful procedures per day in the first 2 weeks of their lives. They also found that in clinicians' opinion, most of the procedures in NICU—including suctioning of airways—are painful but only one third of the preterm infants received appropriate analgesic therapy.

There is an increasing interest in the effectiveness of different pain management methods especially concerning non-pharmacological methods ([2], review). There are also some uncertainties related to adverse effects of opiate analgesia and oral sucrose. Both of these analgesics reduce pain through opioid pathway mediation. Multiple doses of morphine can cause significant adverse effects [3] and possible risks related to oral sucrose are still under investigation [4,5]. Therefore, it would be helpful to have a safe non-pharmacological pain management method as an alternative to pharmacological pain medication.

Earlier research has focused on pain caused by heel-lancing which is a common and readily available pain-producing situation in NICU. It is understandably widely used in pain research as it can be largely standardized. However, suctioning is a common pain-producing situation as well [1], and has remained neglected in pain management research. Only few studied can be found on pain management during suctioning procedures [6,7].

If given the right support like touch, an infant can develop behaviors helping him/her to cope better with the stress of extra uterine life. Skin-to-skin contact [8] and holding [9] are interventions which have a potential to alleviate infant's pain. In addition, the sleep of preterm infants improved, the physiological parameters were more stable and the infants were less agitated when a containment holding was applied [10]. However, the responses of infants are individual and, therefore, the infants should be monitored [11].

It has been suggested that repetitive pain may be harmful to preterm infants [12,13] and it also causes psychological stress to the parents of these children [14]. Parents have reported that their infants experienced more moderate to severe pain during NICU treatment than they expected [15]. Parents have hoped that they would have had a greater involvement in the pain care of their infant [14,15].

Considering this information, hospital staff should offer more possibilities for parents to actively participate in their preterm infant's pain management. One potential method to use is facilitated tucking [6,16] which utilizes touch and position. Earlier crossover studies showed that facilitated tucking alleviated pain after a heel stick [16] and during endotracheal suctioning [6] in preterm infants. The pain assessment was based on heart rate, crying, sleep and sleep-state changes and on multidimensional pain assessment tool Preterm Infant Pain Profile (PIPP) [17], respectively. In both of these studies, the pain management was done by a nurse but the method can easily be adapted to parents' use. With this method, it might be possible to alleviate preterm infant's pain and at the same time, to reduce parents' stress. In tucking, a nurse or a parent holds the infant in the side-lying, flexed fetal-type position (Fig. 1). This posture gives the infant an opportunity to control his/her own body which may increase the infant's ability to control pain. Adding simultaneous skin contact to postural support may result in synergistic effect in pain control.

The purpose of this study was to examine if 'facilitated tucking by parents' is an effective pain management method for preterm infants during endotracheal/pharyngeal suctioning and to study parental perception of this method. We hypothesized that 1) facilitated tucking by parents is an effective pain management method compared to control care and 2) the parents prefer active participation in pain management to passive observation.

2. Methods

2.1. Subjects

During a 10-month period in 2003—2004, 20 preterm infants and 1 of the parents of each of these infants participated in

Figure 1 In 'facilitated tucking by parents', parent holds the infant in the side-lying, flexed fetal-type position.

this study in the NICU at the Turku University Hospital. Informed written consent was obtained from both parents of each infant. The criteria for inclusion were ≤37 completed weeks of gestational age at birth, no major congenital anomalies, a need for regular endotracheal/pharyngeal suctioning and no analgesics for 4 h before the procedure. Parents of five preterm infants refused participation. Reasons were the stress caused by the sick preterm infant ($n=4$) and a fear that the study could cause more pain for their child ($n=1$). The sample size was calculated using the primary outcome of pain response measured by Neonatal Infant Pain Scale (NIPS) [18]. Using data from prior studies [19,20], a reduction of 2 points in the NIPS scores during painful procedure was considered clinically significant. The sample size was calculated for Wilcoxon rank sum test with 80% power, the significance at level 0.05 and S.D. 2.5. A sample size of 20 preterm infants was required. The study protocol was approved by the Joint Commission on Ethics of Hospital District of Southwest Finland and Turku University Hospital.

2.2. Variables used for data analyses

The primary outcome was the NIPS scores. The NIPS quantifies the level of pain on a scale from zero to seven based on five behavioral characteristics: facial expressions, crying, movements of arms and legs, and the state of arousal. In addition, breathing pattern is used as a physiological parameter. The instrument has a good construct validity, inter-rater reliability (0.92 to 0.97) and internal consistency (Cronbach's alpha 0.87) [18]. The concurrent validity with the PAIN Scale has also been established (correlation 0.93) [20]. NIPS is very easy and quick to use. The data for NIPS were collected by video recording.

Heart rate and oxygen saturation data were recorded in 1 min intervals using Hewlett Packard 60 S and Philips IntelliVue Neonatal B.05.67 monitors. The heart rate was computed by averaging the 12 most recent beats-per-minute values and oxygen saturation was recorded at the end of each minute. The parents of the infants completed a questionnaire inquiring their experiences in participating in the infant's pain management. They were asked whether they preferred active participation or passive observation during endotracheal/pharyngeal suctioning procedure. They were also asked to write the explanation for their response in their own words.

Background data concerning the infant were collected from the patient records. Information included gender, birth weight, gestational age (GA) at birth, postnatal age, respiratory support, possible intraventricular hemorrhages (IVH) and number of earlier endotracheal/pharyngeal suctionings. The parents were given a separate questionnaire inquiring their gender, age, number of older children, possible previous experiences about NICU, how often they visited NICU and how many times they have taken part in the child's care before the study.

2.3. Procedure

By using a crossover design, each preterm infant and parent was to undergo endotracheal/pharyngeal suctioning for clinical purposes using either the 'facilitated tucking by parents' or control care within a 2-day interval. The order of conditions was randomized by an outside assistant. In the 'facilitated tucking by parents', the parent had been taught the procedure in advance. The 'facilitated tucking by parents' was used during the whole endotracheal suctioning and after that until the infant had calmed down. In control care, the nurse was allowed to talk to and pat the infant. There were no other procedures for at least an hour before recording. The incubator was covered with a blanket and the infant's position was supported by nesting [21,22]. During the procedure, each infant laid on their right side. If used, the Continuous Positive Airway Pressure (CPAP) nasal device was removed just before the procedure. Baseline video recording was started 2 min before the actual suctioning procedure. After 2 min, a nurse put saline to both nostrils and suctioned the throat and the mouth of the infant and the endotracheal tube of the intubated patients. The video recording continued at least for a minute or until the infant had calmed down. In addition, the parents were asked during the videotaping if the infant's arms or legs were tense or struggling to support the visual analyses of the tapes. The parents were given the questionnaire after both conditions.

2.4. Data analysis

First, the videotapes were analyzed by using NIPS in 1 min sections. This way, it was possible to assess the infant's pain at baseline, and both during and after the suctioning. The highest NIPS score during the suctioning was used to represent the maximum pain during the procedure. Two independent scorers rated NIPS scores from videotapes during both procedures. The peer observer was masked to the order of the conditions. The moments when the parent took the tucking position and released it, were measured with NIPS in order to detect a potential change in the scores caused by the procedure. The duration of the suctioning and the time for the infant to calm down i.e. the time interval between the end of the suctioning and reaching the NIPS score of 1 or below were recorded. Parents' explanations why they preferred active or passive participation were categorized.

For statistical analysis a 2×2 crossover design was used to test difference between procedures. In a case of absence of carry-over effect, these analyses can be performed using a two-sample t-test or Wilcoxon rank sum-test. A chi-square test and a two-sample t-test were used to detect possible group differences [23]. Multiple testing was taken in account using Bonferroni method. The correlations between the variables were studied using Spearman correlation coefficient (r_s). Inter-rater reliability between the researcher and a peer observer was examined with Kappa coefficient. The results are shown as median (range, lower quartile Q1—upper quartile Q3) or as means (S.D.). The SAS system for Windows version 9.1.3 statistical software was used in the analyses. p-values below 0.05 were regarded as statistically significant.

3. Results

3.1. Infant characteristics

Altogether 20 preterm infant took part in the study. No group differences were found in the demographic charac-

teristics between the randomized groups (order of the procedures) tested by chi-square and two sample *t*-tests. Sixty percent of them were girls and 40% boys. Their gestational age ranged from 24 to 33 weeks (median 28 weeks) and birth weight between 690 g and 1920 g (median 950 g). Postnatal age ranged from 6 to 37 days (median 15 days). Most of the infants (15/20, 75%) did not have any IVH, three had IVH grade I, one had IVH grade III and one had IVH grade IV. Minimum number of earlier suctionings was 24 and maximum 265 (median 65). Almost every infant (85%) needed CPAP device for respiratory support, 10% were on ventilator during the study and one infant had just been extubated.

3.2. Pain during 'facilitated tucking by parents' and control care

The interval between 'facilitated tucking by parents' and control care procedures ranged from 5 h 50 min to 81 h (median 24 h 30 min). No carry-over effect was found in NIPS scores, heart rate, oxygen saturation or time to calm down between the randomized groups (order of procedures) (crossover design). NIPS scores, heart rate and oxygen saturation values were analyzed 1 min before, during and 1 min after the suctioning procedure. The infants' clinical condition was similar in both procedures with one exception of an infant who got septicaemia after the experimental care and did not express pain during the control care. The median of baseline NIPS score was 0 in both intervention groups.

A randomized crossover trial was carried out with 20 preterm infants. The highest NIPS score was median 3 (range from 2 to 6, Q1—Q3 2—3) using 'facilitated tucking by parents' and median 5 (range from 2 to 7, Q1—Q3 4—6) without tucking. The difference between experimental and control care was statistically significant ($p<0.001$, Wilcoxon rank sum test, crossover design) (Fig. 2). Inter-rater reliability between the researcher and a peer observer was good (Kappa coefficient 0.927). A decrease by two points in NIPS scores was estimated to be a clinically significant pain reduction. All the infants got at least two NIPS points during endotracheal/pharyngeal suctioning during both procedures. These points came from a change of breathing pattern and facial expressions. The pain reduction in the experimental group was comprised of decreased fussing and crying and decreased movements of the extremities. One minute after the suctioning procedure, the statistically significant difference in NIPS scores had disappeared ($p=0.084$, Wilcoxon rank sum test, crossover design). The median of NIPS scores was 0 1 min after both conditions. Even after Bonferroni adjustment, the treatment effect was statistically significant.

No statistically significant differences in heart rate or oxygen saturation were found between 'facilitated tucking by parents' and control care (paired *t*-test, crossover design). Oxygen saturation and heart rate were not used in the following analyses because they did not provide a reliable estimate of the infants' pain in this study.

3.3. The relation between background variables and preterm infants' pain

The background variables such as gender, GA, postnatal age, birth weight, IVH, respiratory support and number of earlier suctionings were controlled by the crossover study design. The duration of the suctioning could have been different between the procedures. The mean duration of suctioning was 85 s (S.D. 40 s) during 'facilitated tucking by parents' and 102 s (S.D. 63 s) during control care. This difference was not statistically significant ($p=0.197$, crossover design). After excluding one outlier (337 s), the *p*-value was even less significant ($p=0.381$). When the duration of suctioning was taken as a covariate, it partly explained the NIPS scores

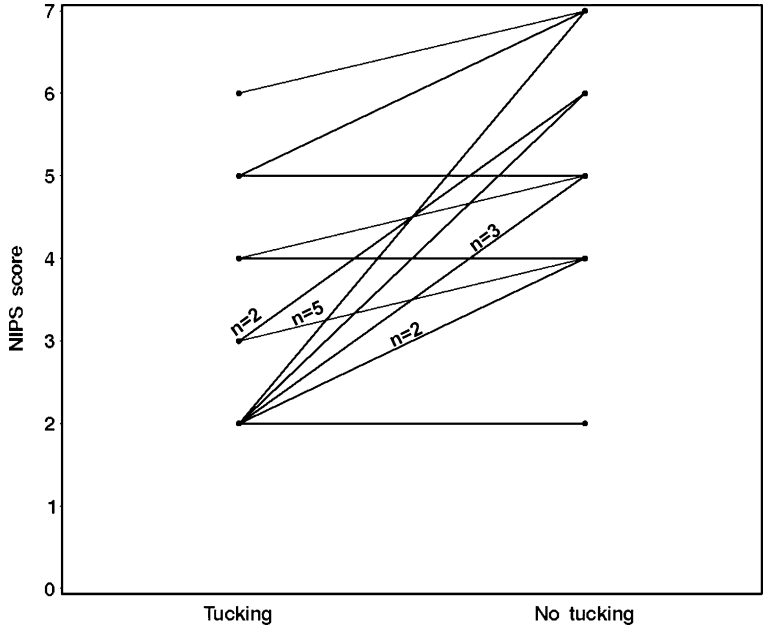

Figure 2 The highest NIPS score was median 3 (range from 2 to 6, Q1—Q3 2—3) using 'facilitated tucking by parents' and median 5 (range from 2 to 7, Q1—Q3 4—6) without tucking during suctioning procedure ($p<0.001$). If not one, the number of patients corresponding one line is indicated in the graph.

($p=0.023$, a paired t-test, crossover design). However, the 'facilitated tucking by parents' still had a statistically significant effect on NIPS scores after including the duration of suctioning as a covariate ($p<0.001$).

The parents' background variables (gender, age, number of older children, possible previous experiences about NICU, how often they visited NICU and how many times they had taken part in the child's care before the study) were also examined in relation to NIPS score reduction to examine potential parent/offspring pairs in which the study method could have been more effective. No statistically significant relations were found between parental background variables and NIPS score reductions (r_s).

3.4. Other effects of 'facilitated tucking by parents'

To detect possible effects caused by parents' touch, NIPS scores were assessed when the parent took the tucking position or released it. The NIPS scores were 0 in 18 and 1 in 2 out of 20 cases, when parent took the position. The situation was almost the same, when parents released the position as the NIPS scores were 0 in 19 and 1 in 1 out of 20 cases. Therefore, we conclude that 'facilitated tucking by parents' did not cause pain to the infants. The infants calmed down more quickly after 'facilitated tucking by parents' compared to the control care. It took a mean of 5 s for an infant to calm down after 'facilitated tucking by parents' and a mean of 17 s after control care ($p=0.024$, paired t-test ln transformation, crossover design) (Fig. 3).

3.5. Parents' opinions about active participation in pain management

The randomized groups were similar in the distribution of the parents' background variables (two sample t-test, chi-square test). Three fathers and 17 mothers participated in the study. The median age of the parent was 28 years (range from 18 to 38 years). The parents had 0 to 3 older children and one family previously had a child in a NICU. Sixty-five percent of the parents visited their child several times a day, 30% once a day, and the remaining 5% less often than once a day. Every parent had some experience in the care of their preterm infant before the study.

Ninety-five percent of parents (19/20) preferred participation in their own infant's pain management during the pharyngeal/endotracheal suctioning compared to passive observation. In the written responses some of the parents ($n=5$) expressed that they felt themselves uncomfortable in these situations. Despite feeling uncomfortable they wanted to participate and help their child during the painful procedure. The parents felt that they had an important role in the care of their child ($n=13$), since they could comfort their child. They felt that their child was calmer ($n=7$), less in pain ($n=6$), more secure ($n=10$) and calmed down more quickly ($n=4$) when the 'facilitated tucking by parents' procedure was used. This procedure did not only decrease the infant's pain, but according to some parents ($n=4$), helped them cope better with their own stress as well.

4. Discussion

In this study, we showed that 'facilitated tucking by parents' alleviates behavioral pain of preterm infants (NIPS scale) during endotracheal/pharyngeal suctioning. This innovation is a feasible, non-pharmacological pain management method which can be utilized during small, painful procedures in preterm infants to avoid adverse effects caused by pharmacological agents. Our results also suggested that the preterm infants were less painful still 1 min after the procedure if

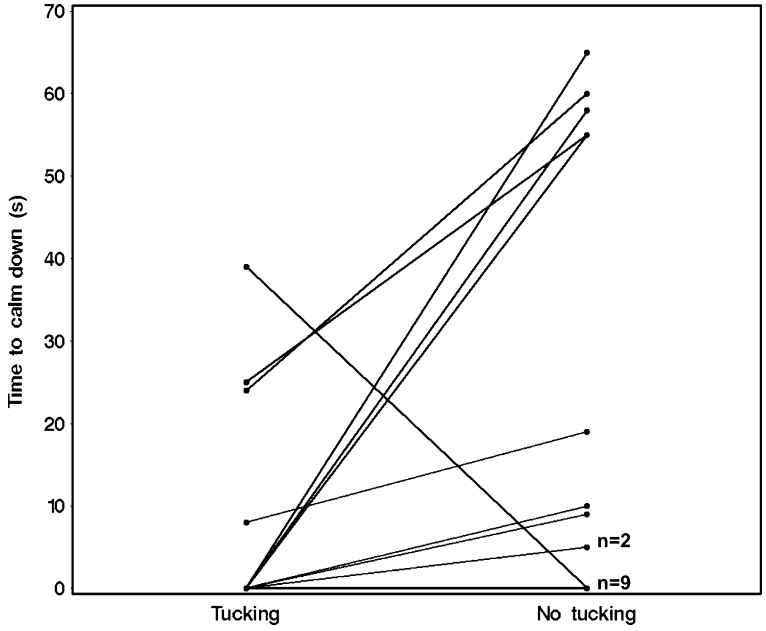

Figure 3 The infants calmed down more quickly after suctioning procedure accompanied with 'facilitated tucking by parents' (a mean of 5 s) compared to control care group (a mean of 17 s) ($p=0.024$, ln transformed, 2×2 crossover design). If not one, the number of patients corresponding one line is indicated in the graph.

'facilitated tucking by parents' was applied compared to the control care. The difference in NIPS scores 1 min post suctioning was close to statistically significant between the procedures (p-value 0.084).

The endotracheal/pharyngeal suctioning was selected to represent a painful procedure because it is one of the most common painful stimuli for preterm infants [1]. It has also been neglected in pain research which has mainly focused on pain at heel-lancing. The 'facilitated tucking by parents' procedure is technically appropriate during suctioning whereas oral methods like a pacifier or oral sucrose are not practical during oral suctioning. The suctioning procedure was standardized as much as possible although performed by different nurses. The duration of the suctioning varied due to different amounts of secretions in infants. This variation in the length of suctioning time was taken into account in the analysis as a covariate as it was shown that it had an effect on pain. The duration of suctioning should be considered as an intervening variable also in the future research.

We chose to use NIPS as an estimate of the level of pain. This scale is based on behavioral characteristics and breathing pattern. It is widely used since it is quick and easy and it has been shown to have a good construct validity, reliability and internal consistency [18]. In our study, NIPS was a better indicator of pain than the oxygen saturation and the heart rate. Only one infant (5%) with septicaemia did not show a pain response (NIPS above 3) during the control care. Using the Premature Infant Pain Scale (PIPP), 20% of preterm infants did not express pain during painful procedures [24]. The fact that oxygen saturation and heart rate did not react to pain was not surprising as physiological parameters do not react specifically to pain [25,26]. The correlation between behavioral and physiological measures across studies and situations is about $r = 0.3$ [27]. In addition, in this study the sampling of oxygen saturation and heart rate might have been too infrequent as other studies concerning facilitated tucking have shown responses also in these parameters [6,16].

There might be a concern that 'facilitated tucking by parents', itself, could effect on the NIPS parameters such as the movements of arms and legs by restraining movements. However, these parameters could be visualised very accurately from the videotapes in all but one case. The tenseness/struggling of the extremities was asked from the parent of the one infant in which case we could not fully rely on the visual scoring. In addition, endotracheal/pharyngeal suctioning always affected the infant's breathing and, therefore, every infant got one NIPS point from the change in breathing pattern. Despite these limitations, the NIPS seemed to be a good enough method in assessing pain in this kind of clinical setting.

We showed that the effectiveness of 'facilitated tucking by parents' method corresponded a difference of two points in NIPS. This has been considered as a clinically significant difference [19]. 'Facilitated tucking by parents' may be even more effective than continuous morphine-infusion (10 μg/kg/h) in pain induced by suctioning procedure. The preterm infants receiving morphine-infusion got 4.8 points at NIPS scale during endotracheal suctioning which was not different from the placebo group [7] and equalled to our control care group.

Based on earlier research, there are reasons to assume that 'facilitated tucking by parents' could be developmentally beneficial for a preterm infant helping the infant to cope better with stress. This was supported by our finding that infants calmed down more quickly after tucking when compared to control care. It was also shown by Als et al. [28] that developmental care including tucking reduced stress behavior. Furthermore, other methods such as gentle human touch [10,11] and Kangaroo care [29,30] utilizing human touch have been shown to improve the quality of sleep in preterm infants. Kangaroo care has also decreased preterm infants' pain, related to heel-lancing [31].

Parents of newborn infants have reported their preferences for greater involvement in their infant's pain care [15] and that active participation in pain management could help them to cope with stress [14]. Our results suggest that participation in pain management of a preterm infant is well received by the parents and they can—and want—to have an active role in this area of nursing. Therefore, 'facilitated tucking by parents' gives us a new possibility to support parents in the stressful NICU environment to develop their parenting skills. Parenting skills are compromised in the face of life-threatening situations. This has been shown to have effects on parenting and child behavior even 3 years later [32]. Based on this study it was not possible to find such characteristics of parents that affect their capabilities as performers of tucking. It would be important to define such potential parental characteristics that optimize their performance as our observation was that the pain was not alleviated enough in all infants.

It was shown that daily maternal visits in the NICU correlated to better long-term behavioral development of the child [33]. Encouraging the visits of the family is part of standard care in the NICU, but we should also focus on the quality of the parental visits. Interventions such as parental information and guidance for active participation have improved later child development [34]. Active participation in the pain management could increase the positive feedback for the parents. This could support the parents, the infant and their sensitive interaction. The effects of active participation on parent—infant interaction should be studied further in more detail as parent—infant interaction has been shown to have long-lasting effects on child development [34].

In conclusion, the best pain management approach includes avoiding pain by critical judgement of the need of any painful procedure, clustering the procedures and performing the procedures smoothly. In addition, each procedure should be accompanied by a safe and effective pain relief method chosen from the available options of pharmacological or non-pharmacological methods. We have demonstrated that behavioral pain in preterm infants is alleviated by 'facilitated tucking by parents' method during endotracheal/pharyngeal suctioning. 'Facilitated tucking by parents' was preferred by the parents compared to passive observation of the procedure. 'Facilitated tucking by parents' is a safe, non-pharmacological pain management method and should be considered to avoid/reduce adverse effects of pharmacological treatments. However, the long term effects of the method are still speculative after this study warranting further research to verify the potential effect.

In future, active parental participation in pain management should be studied further from a perspective of parent—infant relationship. Its use is potentially improving the quality of the parent—infant interaction and optimizing the quality of the time parents spend with their infants in the NICU.

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